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REVIEW ARTICLE

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Systematics review on artificial intelligence chatbots and ChatGPT for language learning and research from self-determination theory (SDT): what are the roles of teachers?

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ABSTRACT

Recent advances in artificial intelligence (AI) give chatbots, e.g. ChatGPT, more human-like interaction and conversational capability. AI chatbots are becoming more popular for supporting language learning. Most current review research disregards the significance of teachers' roles in chatbot-assisted language learning. Self-determination theory (SDT) explains the roles by suggesting how teachers satisfy student needs and how chatbots thwart those needs. Therefore, this systemic review aims to: (i) suggest the roles that teachers play in student English learning with AI chatbot; (ii) discuss how those roles satisfy SDT needs of the students; and (iii) discuss the challenges in this learning. This review selected 23 articles published throughout the last ten years (2014–2023). The findings offer (i) four empirical and theoretical contributions: technological pedagogical content knowledge (TPACK) for chatbots, needs satisfaction from teachers, needs thwarting from chatbots, and SDT-based research designs for chatbots; (ii) two practical suggestions: understanding technological knowledge of chatbots and SDT needs support for chatbots; and (iii) six research directions: experimental studies, student language proficiency, more teacher roles, revisiting TPACK, future development of chatbots, and large language model teacher-like chatbots. Overall, the findings enhance our knowledge of TPACK and teacher digital and AI competences for chatbot-assisted language learning.

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Chatbot; language learning; self-determination theory; teacher AI and digital competence; TPACK; ChatGPT

1. Introduction

A chatbot is a virtual agent that uses natural language processing to interact with users and process their inputs (Chiu et al., 2023; Huang et al., 2022; Jeon et al., 2023a). Chatbots are first intended to respond to frequently requested queries, i.e. questions and answers. Recent advances in artificial intelligence (AI) technology, including natural language processing, automatic speech recognition, and large language models (Hsu et al., 2023), give chatbots – like ChatGPT – a more human-like interaction and more conversational capability (Chiu, 2023, 2024b; Hsu et al., 2023). AI-powered chatbots are becoming more and more common in the fields of language learning and research (Chiu et al., 2023; Jeon, 2024). These AI chatbots can simulate human interactions and hold spontaneous discussions in real time. They can react to previous exchanges between students as well as give immediate

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and personalized responses, streamlining the learning process. More related research is needed to understand how to use AI chatbots for teaching and learning languages (Chiu et al., 2023; Huang et al., 2022; Jeon, 2024; Jeon et al., 2023a).

Recent years have seen a significant increase in the review of research on chatbots in English language teaching, with an attempt to synthesize the results of past studies for practices and future research direction. In their review, Jeon et al. (2023a), for instance, used a framework that included goal-orientation, embodiment, multimodality, and derived affordance to classify different types of chatbots. Jeon et al. (2023b) reviewed 37 articles to propose a conceptual framework that consists of three components – goal-orientation, embodiment, and multimodality. Huang et al. (2022) reviewed 25 empirical studies to identify three technological affordances of chatbots: timeless, ease of use, and personalization. Zhang et al. (2023a) reviewed 18 articles to identify the factors affecting language learning with chatbots. The factors included instruction duration, chatbot interface, chatbot development. Therefore, the significance of teachers' roles was disregarded in this review of research. What are the roles of teachers in student English learning with chatbots? How do teachers support student learning with chatbots? These questions are aligned with the future research recommendations suggested by studies on how generative AI impacts learning (Chiu, 2023, 2024a; Kasneci et al., 2023).

Since most students who learn with chatbots are L2 learners, they are likely to need the teachers' support and guidance (Chiu et al., 2023; Jeon, 2024; Jeon & Lee, 2023). A few review studies investigated how teachers design instruction to use chatbots to assist or facilitate teaching and learning. For example, Weng and Chiu (2023) used First Principles of Instruction to analyze 83 articles to give teachers suggestions on how to design language learning environments with chatbots. Ji et al. (2023) review focused on suggesting how chatbots and teachers together fostered student language learning and investigated challenges existed in integrating chatbots into language learning. However, there are clear gaps in the understanding of the roles of teachers in chatbot-assisted English language learning and how the roles function in students' learning processes.

Self-determination theory (SDT) is a theory of motivation that examines the interaction between human needs, motivation, and overall well-being within social environments (Chiu, 2022). Teachers should know how to better support students by satisfying their basic needs. For example, teachers can facilitate students' learning with various strategies, enable students to learn at their own pace (Alamri et al., 2020) to satisfy their need for autonomy; prepare various difficulty levels of materials to expect desirable learning outcomes (Chiu, 2021, 2022) to satisfy students' need for competence; and discuss with students in a warm, friendly, and positive atmosphere to make students feel cared for and loved (Chiu et al., 2023) to satisfy their need for relatedness. Many studies have shown that support for the three basic psychological needs in digital environment leads to positive learning outcomes such as learning performance and engagement (Ryan & Deci, 2020; Chiu, 2021, 2022). Therefore, it is very important to understand how teachers use chatbots to motivate L2 student English learning with chatbots?

Understanding the roles of teachers in language learning with chatbots contributes to its TPACK (technological pedagogical content knowledge). TPACK, developed by Mishra and Koehler (2006), is a well-acknowledged theoretical framework guiding the integration of technology into learning and teaching. The framework differentiates three types of knowledge: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). CK concerns "what is being taught", PK concerns "how the teacher imparts that content", and TK concerns "how the technology is being implemented to communicate the content and support the pedagogy". This framework offers a productive approach to many of the dilemmas that teachers face in using technology to enhance students' learning experiences (Chiu et al., 2024; Rosenberg & Koehler, 2015).

The main goal of this review is to suggest ways in which teachers can effectively support language learning with chatbots (including ChatGPT) from the perspective of SDT. This review study aims to (i) suggest the roles that teachers play in the AI chatbots (including ChatGPT)-assisted

language learning process, (ii) discuss how those roles satisfy the SDT needs of the students, and (iii) discuss the challenges faced by teachers in this learning. Therefore, the three research questions are:

RQ1: What roles do teachers play in student English language learning with AI chatbots (including ChatGPT)?

RQ2: How do the teachers' roles satisfy the needs for autonomy, competence, and relatedness in the student learning?

RQ3: What are the challenges faced by teachers in the student learning?

The findings of this study could inspire researchers to consider how the roles of teachers contribute to TPACK, teacher AI competence, and teacher digital competence, and to design SDT-based studies on how teachers satisfy and thwart student needs in chatbot-assisted language learning. They also offer practical recommendations on how teachers use chatbots in language teaching and learning.

2. Method

This review adopted the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) (Page et al., 2021) approach and proceeded in three steps: article selection, article screening and inclusion, and finally data coding and analysis.

2.1. Article identification

The search query [("chatbot" OR "generative artificial intelligence" OR "generative AI" OR "intelligent" OR "ChatGPT" OR "GenAI" OR "large language model") AND ("language" OR "listening" OR "speaking" OR "reading" OR "writing" OR "grammar" OR "vocabulary")] in titles, abstracts, and keywords was used to select articles published from January 1, 2014 to December 30, 2023. This period is able to cover how chatbots and ChatGPT support language learning because the first wave of using AI technology in chatbot design dates back to 1996, and ChatGPT makes its public debut in 2021. The search focused on education, social science, psychology, arts and humanity in three databases, resulting in 4,580 initial articles for further screening: 706 in Web of Science (educational research), 1,583 in ProQuest, and 2,291 in Scopus, as shown in Figure 1. The articles were peer-reviewed and published in English with full text.

2.2. Article screening and inclusion

We screened and identified the articles for the main analysis. First, three hundred and fifty-eight duplicate articles were removed by the deduplication function of EndNote20, resulting in 4,222 articles for further screening. Two of the authors did the screening. When they had disagreements in article screening, another author acted as a moderator to assist in making the final decision. We went through the titles and abstracts of the articles to identify relevant empirical studies on teacher teaching and student learning outcomes in language learning assisted by AI chatbots, including ChatGPT. A further 4,123 articles were excluded based on the inclusive and exclusive criteria, see Table 1, resulting in 99 articles. We also removed 16 duplicate articles not detected by EndNote20 in the initial screening. Then we read the remaining 83 articles in full text to fit our inclusive and exclusive criteria and identified 23 articles for this review, see Table 2.

2.3. Coding and analysis

To address the three RQs, two authors coded the selected articles independently. They first coded 10 articles to extract information on the roles of teachers, students' needs satisfaction and challenges in this AI chatbot-assisted language learning, and then discussed and confirmed their coding approach and results. To identify the roles of teachers, a focus was placed on the method part of the reviewed

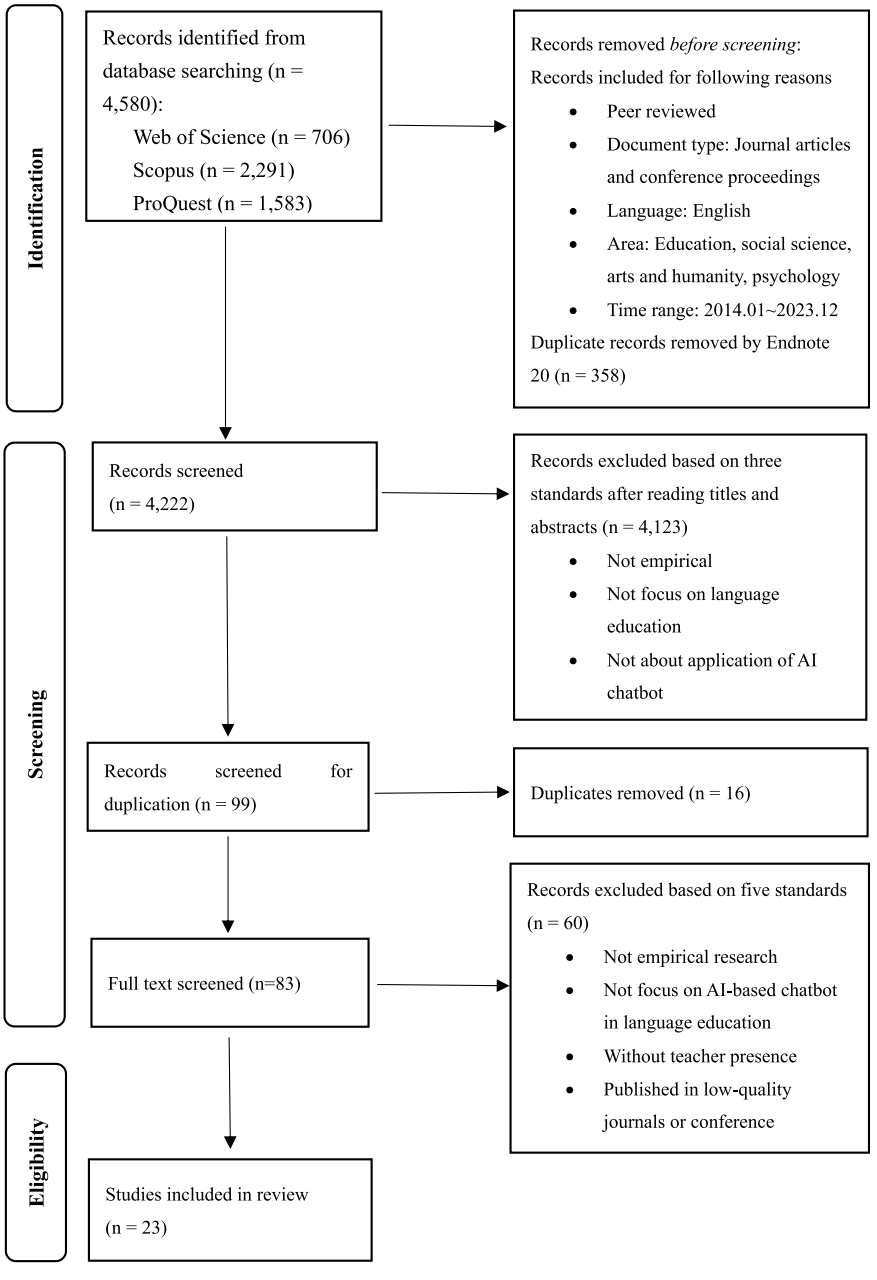

Figure 1. Flowchart of article selection.

Table 1. Inclusive and exclusive criteria.

Inclusive criteria	Exclusive criteria
Used AI chatbots, including ChatGPT, in teaching and learning English	Were reviews, meta-analyses, and commentaries, editorials
Published in English	Discussed teacher gesture and sign
Satisfied one of the needs	Used non-AI chatbots in research (e.g. simple rule-based chatbots)
Discussed teacher teaching	

Table 2. Twenty-three articles selected for the review.

ID	Author	Year	Region of corresponding author	Educational level of participants	AI-based chatbot implemented	Target language	Roles of teachers
1	Bailey et al.	2021	Korea	higher education	storybot	English	①
2	Bašić et al.	2023	Croatia	higher education	ChatGPT	English	⑤
3	Chen et al.	2023	Taiwan	higher education	Google Assistant	English	①
4	Chiu et al.	2023	Hong Kong	K-12 education	ChatBot	English	①④
5	Dizon	2017	Japan	Higher education	Alexa	English	①
6	Dizon	2020	Japan	higher education	Alexa	English	①
7	Ebadi & Amini	2024	Iran	higher education	Computer Simulation in Educational Communication	English	①
8	Hsu et al.	2023	Taiwan	higher education	Alexa	English	①③④⑤
9	Hwang et al.	2022	Taiwan	K-12 education	Smart UEnglish	English	⑤
10	Guo et al.	2024	Hongkong	higher education	Argumate	English	①
11	Jeon	2024	Korea	primary school	researcher-developed chatbot using Dialogflow	English	①
12	Lee et al.	2023	Korea	N/A	CopyAI	English	①③
13	Lin & Chang	2020	Canada	higher education	Chatbot DD	English	①⑤
14	Lin & Mubarok	2021	Taiwan	N/A	map-guided AI chatbot & conventional AI chatbot	English	①
15	Tai & Chen	2023	Taiwan	secondary school	Google Assistant	English	①
16	Tai & Chen	2024a	Taiwan	secondary school	Google Assistant	English	①④
17	Tai & Chen	2024b	Taiwan	secondary school	Google Assistant	English	④
18	Tseng	2018	Taiwan	secondary school	Cool English	English	①③④
19	Yan	2023	Mainland China	higher education	ChatGPT	English	①④
20	Yang et al.	2024	Taiwan	higher education	Google Assistant	English	①⑤
21	Ye et al.	2022	Mainland China	secondary school	Microsoft Xiaoying	English	⑤
22	Yuan	2023	UK	Primary school	mondly	English	②
23	Zhang et al.	2023b	Hong Kong	higher education	researcher-developed chatbot using ManyChat	English	①⑤

Roles of teachers: ① prior knowledge presenter; ② resource provider; ③ designer; ③ facilitator; ⑤ assessor

articles. An open coding format was used to address the students' SDT needs satisfaction and challenges with focusing on the results and discussion parts of the articles. As for the challenges in this learning, the open coding was summarized from two perspectives: the limitations of AI chatbots and their inappropriate application by students. The authors discussed and made decisions together when encountering something unclear.

3. Results

3.1. Roles of teachers play in English language learning with AI chatbots (RQ1)

Our analyses indicated that the roles of teachers were not clearly identified in the majority of the reviewed articles, which aligns with the findings of the study by Ji and colleagues (2023). Nevertheless, five teachers' roles were identified from the selected articles, and they are teachers as prior knowledge presenters, designers, facilitators, assessors, and resource providers, see Table 3. In some articles, teachers tend to take multiple roles in the AI chatbot-assisted language learning process.

- *Teachers as prior knowledge presenters:* Teachers tend to introduce prior technical (technological) and content knowledge to students to facilitate their language learning with chatbots. This role is to make sure the students can effectively learn language with the chatbots in the beginning. In the reviewed studies, the authors trained their students on how to use the chatbots before learning, like signing up for the platform (Tseng, 2018; Ebadi & Amini, 2024) and understanding its features and functions to familiarize students with interactions with the chatbots (Hsu et al., 2023; Jeon, 2024; Tai & Chen, 2023). In order to improve chatbot-student interactions, Dizon (2020) provided the students with an idea of the kinds of queries and requests that they could make of Google Assistant. These queries could be seen as technical skills or engineering prompts for

Table 3. Roles of teachers in ai chatbots language learning.

Prior knowledge presenters	Present technological knowledge
	Present content knowledge
Designers	Set teaching objectives
	Design appropriate learning activities
Facilitators	Explain teaching objectives and encourage interactions
	Guide learning activities and activate student interactions
	Monitor students' progress and participation
	Provide help by answering questions and solve technological and task performance problems
	Build positive student–chatbot interaction environments
	Steer students' affective condition
Assessors	Evaluate student academic performance
Resource providers	Revise materials generated by AI to fit students' needs
	Select appropriate teaching materials from different sources

interacting with chatbots. In addition, a combination of technical and content knowledge has also been presented in some research. Lee et al. (2023) and Zhang et al. (2023b) prepared the students by organizing activities that activated students' prior knowledge before reading and writing in the AI chatbot-assisted language learning. Overall, the results of these articles show that teachers tend to provide chatbots (technological) and language (content) knowledge before or at the beginning of language learning to make students better prepared for target learning activities. The teachers are viewed as prior knowledge presenters. However, teachers seem to present basic technical knowledge for students' interaction without deepening students' understanding of the AI chatbots, i.e. accuracy and biased output. The teachers in this role might talk to the students about what AI chatbots can and cannot afford.

- *Teachers as designers:* In the reviewed articles, the teachers set the objectives and designed learning activities within the AI chatbot-assisted learning context. In the study of Lee and colleagues (2023), in order to enhance students' foreign language enjoyment and interest in reading English books, the teachers designed a keyword selection activity. The teachers asked their students, working in groups, to provide keywords on genre, characters, place, and event to the AI chatbot for generating a story. The output generated served as a reference for students creating their own story. In Hsu and colleagues' (2023) study, the teachers scaffolded the student's learning by using briefings, handouts, and practices. In the study of Tseng (2018), to consolidate student understanding of the use of language, the teachers designed an image-based vocabulary activity in a chatbot that asked the student to judge if the vocabulary was correct or not. In order to enable students' mastery of specific grammar, the teachers designed an activity that allowed students to evaluate the sentence pattern through text chatting. The students also evaluated and rated the chatbot's output. Overall, in these roles, the teachers try to design appropriate and specific tasks or activities in this technology-assisted environment; however, they tend to underuse the great power of AI chatbots in the designing process.
- *Teachers as facilitators:* The teachers used several strategies to facilitate students' interactions with the AI chatbots. They encouraged the students to engage with the chatbots more actively and explained the objectives of each session to them (Hsu et al., 2023). They used games, songs, and chants to get the students involved in dialogue practice and to get them interacting with chatbots (Jeon, 2024). They strolled around to observe students' progress and engagement during the chatbot-student interactions (Hsu et al., 2023). They also helped students by answering their questions about their chatbot-assisted learning and clarifying the specifics of the materials when necessary (Chiu et al., 2023). Some teachers understood the issues of using chatbots and used physical space to foster student chatbot-assisted learning. They asked them to engage with chatbots in private spaces in order to reduce the noise problem that arises from other students when interacting with chatbots. This way, students were protected from being distracted by other smart speakers or their peers (Dizon, 2020). Overall, the teachers acted as facilitators to help the students effectively learn languages with chatbots. The articles also suggested that students with low language proficiency and weak technical skills need more attention from teachers.

- *Teachers as assessors:* In the reviewed articles, the teachers assessed students' language performance after their language learning with the chatbots. Some of them assessed students' grammar and pronunciation in oral performance after practicing speaking with the chatbots (Hsu et al., 2023; Tai, 2024; Ye et al., 2022). Some educators assessed their students' writing abilities by rating their essays, their arguments, and their outline (Lin & Chang, 2020; Zhang et al., 2023b) and students' vocabulary learning (Jeon et al., 2023a, 2023b; Hsu et al., 2023). No reviewed study investigated the reading or listening comprehension of students. In this role, chatbots are seen as self-regulated digital learning environments. Using chatbots, the teachers assessed students' learning and provided guidance for their future studies.
- *Teachers as resource providers*: In the reviewed articles, the teachers prepared various learning materials to fit students' needs in the AI chatbot-assisted language learning process. They revised reading passages generated by AI chatbots for students' reading activities (Lee et al., 2023). Although chatbots embedded with AI technology are powerful in generating different resources, teachers must filter the resources provided by technology as they may be inaccurate, inappropriate, or unsatisfactory (Tai & Chen, 2023).

3.2. Needs satisfaction of students in the learning with AI chatbots (RQ2)

The needs satisfaction of students for autonomy, competence, and relatedness are summarized in Table 4. Our analysis showed that teachers' roles may satisfy the three SDT needs. It revealed that the most frequently addressed need in the reviewed studies was competence. To support the needs for competence, the teachers informed the students of clear learning objectives (Hsu et al., 2023; Yan, 2023) and made the students have sufficient technical and content prior knowledge (Bailey et al., 2021; Ebadi & Amini, 2024). The students met the teachers' expectations of chatbot-assisted learning and were able to create new knowledge by combining what they had previously learned (prior knowledge) with what the chatbots had taught them. The teachers are also able to create various appropriate resources and tasks to cater to the students' learning differences (Lee et al., 2023).

The reviewed studies also suggested how the roles of teachers satisfied students' need for relatedness in two ways. The teachers created a positive and inclusive digital learning environment and encouraged peer collaboration. They were not only provided with a satisfactory environment to interact with their chatbots but also valued their peer interactions, which helped to foster a friendly interpersonal relationship. For example, Tai and Chen (2024a) encouraged the students to work in pairs or groups when interacting with Google Assistant to provide opportunities for collaboration and social interaction. Yan (2023) asked the students to exchange with and learn from their peers for tips and techniques discovered in their interactions with the chatbots. The students found a clear preference for peer collaboration in the chatbot-assisted learning environment (Tai & Chen, 2024b). These suggest that the teachers could diversify the chatbot activities to address students' concerns about peer collaboration (Hsu et al., 2023). In addition, the teachers build a strong teacher-student relationship in their instructional process. For example, when the students interacted with chatbots, teachers walked around to check students' progress (Hsu et al., 2023), answered their questions (Lin & Chang, 2020), explained materials (Chiu et al., 2023), and provided individual help to technical issues as well as assigned tasks (Jeon, 2024) to support their learning activities, which created a warm and supportive teacher-student relationship and helped students build up a positive affective condition. However, the reviewed studies paid little attention to how teachers instructed students to do tasks relevant to an authentic environment with the chatbots.

According to some reviewed articles, the teachers used the chatbots to help students feel more autonomous while learning a language. Yuan (2023), for instance, gave the students a choice of discussion topics rather than making them work on subjects about which they were completely

Table 4. How the teachers' roles support the needs of students.

Role of teachers		Autonomy	Competence	Relatedness
Prior knowledge presenters	Present technological knowledge	Ebadi & Amini, 2024; Lin & Chang, 2020 (2 articles)	Bailey et al., 2021; Chiu et al., 2023; Chen et al., 2023; Dizon 2017, 2020; Ebadi & Amini, 2024; Guo et al., 2024; Hsu et al., 2023; Jeon, 2024; Jeon & Lee, 2023; Lin & Chang, 2020; Tai & Chen, 2024a; Tai & Chen, 2023; Tseng, 2018; Yan, 2023; Yang et al., 2024; Zhang et al., 2023b (17 articles)	
	Present content knowledge	Lin & Mubarok 2021 (1 article)	Hsu et al., 2023; Jeon, 2024; Zhang et al., 2023b (3 articles)	
Designers	Set teaching objectives		Hsu et al., 2023 (1 article)	
	Design appropriate learning activities	Yuan, 2023 (1 article)	Jeon & Lee, 2023; Tai & Chen, 2024a; Tseng, 2018; Yan, 2023 (5 articles)	
Facilitators	Explain teaching objectives and encourage interactions		Hsu et al., 2023; Yan, 2023 (2 articles)	
	Guide learning activities and activate student interactions		Jeon & Lee, 2023; Lin & Chang, 2020; Tai & Chen, 2024a; Tseng, 2018; (4 articles)	Jeon & Lee, 2023 (1 article)
	Monitor students' progress and participation	Hsu et al., 2023; Yan, 2023; Yang et al., 2024 (3 articles)		Zhang et al., 2023b; Yan, 2023
	Provide help by answering questions and solve technological and task performance problems	Yang et al., 2024 (1 article)	Chiu et al., 2023; Jeon, 2024; Lin & Chang, 2020; Tai & Chen, 2024a; Yang et al., 2024 (5 articles)	Chiu et al., 2023; Hsu et al., 2023; Lin & Chang, 2020 (3 articles)
	Build positive student–chatbot interaction environments		Dizon, 2020 (1 article)	
Assessors	Evaluate student academic performance		Bailey et al., 2021; Bašić et al., 2023; Hsu et al., 2023; Hwang et al., 2022; Lin & Chang, 2020; Yang et al., 2024; Ye et al., 2022; Zhang et al., 2023b (8 articles)	
Resource providers	Revise materials generated by AI to suit students		Jeon & Lee, 2023 (1 article)	
	Select appropriate teaching materials from different sources		Hsu et al., 2023; Tseng, 2018 (2 articles)	

stumped. With the chatbots, Zhang et al. (2023b) emphasized that the students ought to feel a sense of ownerships over their own learning.

3.3. Challenges in the learning with AI chatbots (RQ3)

The reviewed articles have noted substantial existing challenges in implementing chatbots in language learning, and the challenges were mainly in two categories: the limitation of chatbot technology and student inappropriate application, which thwarted students' basic psychological needs for autonomy, competence, and relatedness, see Table 5.

3.3.1. Limitations of chatbots technology

More studies reported limitations of the AI chatbot technology, including technical issues, unindividualized resources, a vacuum interaction environment, and less reliability. The following discusses the four major limitations:

Table 5. Challenges faced by the teachers in the English language learning with chatbots.

Challenges		Autonomy	Competence	Relatedness
Limitations of chatbots technology	Technical issues	Hsu et al., 2023 (1 article)	Chen et al., 2023; Hsu, 2021; Jeon, 2024; Lin & Chang, 2020; Tai & Chen, 2024b; Yang et al., 2024 (6 articles)	
	Unindividualized resources		Chiu et al., 2023; Chen et al., 2023; Hsu et al., 2023; Tai & Chen, 2024b; Yang et al., 2024 (5 articles)	
	Vacuum interaction environment			Bašić et al., 2023; Hsu et al., 2023; Jeon, 2024 (3 articles)
	Less reliability		Bailey et al., 2021; Tseng, 2018 (2 articles)	
Student inappropriate applications	Unethical application			Bašić et al., 2023; Yan, 2023 (2 articles)
	Unskilled application	Jeon, 2024; Yang et al., 2024 (2 articles)		
	Unrestricted application		Yan, 2023 (1 article)	

When interacting with AI-based chatbots, the students tended to encounter different technical issues, like slow responses and input recognition mistakes. For example, Lin and Chang (2020) reported that college students complained about the slow responses from their AI chatbots. Some of the reviewed articles revealed that the chatbots gave irrelevant responses (Guo et al., 2024) and limited feedback (Lin & Chang, 2020). The students were confused (competence) and lost control of their learning process (autonomy). In addition, the recognition mistakes caused are more likely to thwart students' need for competence. The students felt their requests or responses were not understood, thus failing to have a sense of achievement and mastery. For example, the chatbots are unable to recognize the oral English of primary school students (Jeon, 2024) and college students (Tai, 2024). They were struggling with their pronunciation. Some other studies mentioned that chatbots failed to understand students' expressions or commands (Chiu et al., 2023; Yang et al., 2024) and did not respond to their requests or questions (Hsu et al., 2023) or provide appropriate responses (Tai, 2024). Specifically, Dizon (2017) mentioned that Alexa could only understand 50% of students' commands, and Guo et al. (2024) found that Argumate failed to provide strong supporting evidence required by students in their argumentative writing. Moreover, students expected more explicit or corrective feedback (Chiu et al., 2023; Guo et al., 2024) and complained the chatbot could not assist students like a human teacher (Jeon 2024). These student–chatbot interaction experiences tended to make students frustrated and discourage their engagement, making chatbots less effective in their language learning process.

In addition, the resources in the chatbot were another concern, and some studies showed that the learning materials and contents provided were not satisfactory or ideal for personalized learning. For example, some chatbots were developed by native language speakers, so the speed of speech and level of vocabulary turned out to be challenging for ESL students from secondary school (Tai & Chen, 2023), and that was also the case for students from primary school who could not understand some expressions in the chatbot's speech (Yang et al., 2022), which hindered the development of students' academic capabilities and was a great challenge for competence satisfaction.

Although many studies mentioned that the stress-free and non-judgmental learning environment created by the AI chatbots helped to reduce students' anxiety and fear in their learning, some studies also pointed out that students feel like they are in a vacuum or less expressive environment when interacting with these chatbots, where they failed to build relationships and felt isolated as the chatbots were developed on AI (Annamalai et al., 2023a), which harmed students' social interaction and

isolated students from the authentic environment, resulting in a lack of relatedness satisfaction. Students desired more attractive student-student interactions or supportive student-teacher interactions other than interacting with chatbots, which offered mechanical responses (Chiu et al., 2023).

Meanwhile, AI chatbots can be less reliable. Bailey et al. (2021) mentioned storybot frequently generate inappropriate responses, resulting in students avoiding asking many open-ended questions; Tseng (2018) found chatbot's answers were "weird" and grammatically wrong; thus, the students could never rely on or trust everything provided by them. The information shared could be irrelevant or even wrong due to a limited database (e.g. storybot) or the chatbots' incapability to do source verification (e.g. ChatGPT), making it less reliable, which greatly challenged students' academic performance, thus thwarting their needs for competence.

3.3.2. Student inappropriate applications

The other risk in this study lied in the inappropriate applications of AI-based chatbots by students, specifically unethical application, unskilled application, and unrestricted application. The following discuss the three applications:

In terms of the unethical application, according to certain studies (Bašić et al., 2023; Yan, 2023), the AI chatbots caused issues with plagiarism and academic dishonesty. The students could pass off work done by the chatbots as their own. They made a poor impression on the teachers in this instance, and they had a higher chance of failing the task, which might have a bad effect on the relationships between the teachers and students. Additionally, by taking unfair advantage of others and undermining the integrity of exams, assignments, and tasks, this behavior tended to damage their relationships with classmates or peers.

About the unskilled application, some reviewed articles revealed that the students ran into a variety of technological problems when using the chatbots, requiring extra or specific instruction on how to prompt and manage their learning (Yang et al., 2024). In contrast to their peers, the students with weaker digital or AI competency were more likely to feel thwarted while interacting with chatbots (Jeon 2024), thus delaying their learning process and frustrating their sense of ownership.

With regard to the unrestricted application, the students tended to become overly dependent on chatbots, which hindered the development of critical thinking and creativity. Students' need satisfaction for competence is thwarted when they over rely on chatbot outputs for solutions instead of seeking, investigating, improving, and developing their own skills and knowledge.

4. Discussions

The purpose of this systematic review study is to offer recommendations for how researchers and teachers might use chatbots, such as ChatGPT, to facilitate language learning from an SDT perspective. The findings offer (i) four empirical and theoretical contributions: TPACK for chatbots, needs satisfaction from teachers, needs thwart from chatbots, and SDT-based research designs for chatbots; (ii) two practical suggestions: understanding TK of chatbots and learning SDT needs support for chatbots; and (iii) six research directions: experimental studies, student language proficiency, more teacher roles, revisiting TPACK, future development of chatbots, and large language model chatbots.

4.1. Empirical and theoretical contributions

4.1.1. TPACK for chatbots

The five teacher roles were identified through the analysis of reviewed articles: prior knowledge presenters, designers, facilitators, assessors, and resource providers. Teachers can pick up tips on how to use chatbots to help students learn languages more effectively from the roles. By suggesting how the chatbots are used to communicate the content and support the pedagogy, this could contribute to TPACK (Mishra & Koehler, 2006; Rosenberg & Koehler, 2015). Teachers controlled the content of the majority of non-chatbot technology, including learning management systems and instant

response systems. Teachers knew in advance what kind of material their students would be given. The teachers bear the responsibility of spearheading the delivery of the content. In a learning environment without chatbots, teachers' roles are mostly predetermined or assumed. Conversely, AI chatbots communicate and interact with students via text as well as voice. That is to say, it is the responsibility of the students to initiate conversation and take the initiative. Different students in a class could have varying learning needs and progress. The roles that the teachers play are unpredicted and unforeseen. The study's findings suggest five roles that teachers might employ to help their students learn English.

4.1.2. Needs satisfaction from teachers

The findings imply that in a learning environment with AI chatbot assistance, the five teacher roles may satisfy students' needs for autonomy, competence, and relatedness. These are in line with a study by Chiu et al. (2023) that suggests that by satisfying the three SDT-based needs, teachers can increase student motivation when learning with chatbots. Less capable students might not be able to communicate with chatbots because they lack the vocabulary necessary to form coherent sentences, have trouble pronouncing certain phrases, or do not know enough to prompt. Teachers' teaching should involve providing students with immediate needs support in chatbot-assisted language learning. Furthermore, AI-powered chatbots are strong; rather than taking the job of teachers, they would enhance teachers' teaching skills and strategies (Jeon & Lee, 2023). The findings provide more evidence for this, indicating how the five teacher roles satisfy the needs of students and increase their motivation to learn with chatbots.

4.1.3. Needs thwart from chatbots

This study identified two main themes that may thwart student needs when learning with chatbots: limitations of chatbot technology (i.e. technical issues, unindividualized resource, vacuum interaction environment, less reliability), and student inappropriate applications (i.e. unethical, unskilled, and unrestricted application). The findings are aligned with the study of Kasneci et al. (2023), suggesting chatbots or ChatGPT may benefit or hinder student learning. Kasneci et al. (2023) suggest the challenges of using the chatbot in learning include bias and fairness (i.e. less reliability and unskilled application in this study), learners may rely too heavily on the model (i.e. unrestricted application), data privacy and security (i.e. unethical), difficulty to distinguish between real knowledge and convincingly written but unverified model output (i.e. less reliability), lack of adaptability (i.e. unindividualized resource, vacuum interaction environment), and lack of understanding and expertise (i.e. technical issues). These findings helped us better understand how chatbots thwart student needs, which are in line with the study of Falloon (2020). Falloon (2020) expanded on the TPACK framework to create a broadly based framework for teacher digital competence. This framework acknowledges the growing complexity of the knowledge and skills that young students require to operate in a safe, responsible, and ethically and morally complex manner in diverse, inclusive, and digitally mediated environments. The expanded framework now includes two additional types of competencies: personal-ethic and personal-professional. The two newly added competencies and TPACK are addressing the needs thwarted by chatbots. In other words, the teachers should have good teacher digital and AI competence to support student chatbot-assisted learning (Chiu et al., 2024).

4.1.4. SDT-based research designs for chatbots

The findings can also be used as a categorization tool to help researchers design and plan SDT-based intervention studies that look at how teacher roles impact student SDT needs being satisfied and thwarted. To gain a deeper understanding of how teachers support students' needs when learning languages using chatbots, the researchers can apply the findings from RQ2 and RQ3 as treatments. Moreover, students can go from amotivation to extrinsic motivation to intrinsic motivation by satisfying their three basic needs: autonomy, competence, and relatedness in digital learning and

chatbot environments (Chiu, 2021; 2022, 2024a; Chiu et al., 2023). Teachers can motivate both less – and strong-ability students to learn with chatbots by satisfying their three needs. The students can benefit from the SDT-based chatbot learning environments. This implies that teachers use SDT-based teaching to address the issues of the digital divide raised by chatbots.

4.2. Practical suggestions

4.2.1. Understanding TK of chatbots

Language teachers lack understanding and expertise in chatbots (Kasneci et al., 2023). In order to have more effective language learning with chatbots, they should take the initiative to understand the affordances of different chatbots (Yuan, 2023). Inappropriate choices of chatbots would cause chaos in some students' learning. Relevant professional development should be provided to the teachers to get better TK, so they can find the right chatbots for the right content and pedagogy. They should take the effort to learn about the affordances of various chatbots in order to use them for more efficient language teaching (Yuan, 2023). Chatbots with the wrong selections could ruin some student learning experiences. To enhance their TK and empower them to choose the right chatbots for the right content and pedagogy, the teachers should get relevant professional development. The teachers should further improve personal-ethic and personal-professional competencies in Falloon's (2020) framework for teacher digital and AI competence.

4.2.2. Learning SDT needs support for chatbots

When using chatbots to teach English, teachers need to understand how important their roles are in satisfying the SDT needs of their students (Chiu et al., 2023; Liang et al., 2023). They should develop their ability to design a variety of assignments that satisfy student needs (Chiu et al., 2023; Hsu et al., 2023). For example, for the students who are less prepared to interact with chatbots, the teachers can encourage peer collaboration to satisfy their needs for competence and relatedness. For those who are well-skilled and eager to learn with chatbots, they can be assigned to do some creative tasks at their own pace to satisfy their needs for autonomy and competence. The teachers are suggested to learn SDT needs support strategies before using chatbots in learning and teaching.

4.3. Future research direction

- *Experimental studies*. The five roles that teachers should play, as recommended by this review study, were not tested experimentally in this study, nor were their effects on language acquisition. Furthermore, the findings of this study revealed that more research was done on writing and speaking. Consequently, we propose that intervention or experimental studies should be used in future research to investigate their effects on various aspects of language learning, particularly reading and listening.
- *Student language proficiency*. Our analysis revealed that teacher roles in the chatbot-assisted language learning process may be impacted by the student's prior knowledge (Chiu et al., 2023; Jeon 2024; Yang et al., 2024). To accommodate students' varying learning differences, teachers may adopt several roles. Research design in the future should take into account the student's prior knowledge, such as literacy and language skills.
- *More teacher roles*. The five teacher roles in chatbot-assisted language learning were proposed by this study. As this area is still new, future research should investigate more teacher roles when we have a better understanding of how generative AI affects student learning.
- *Revisiting TPACK*. The use of generative AI complicates our learning environments (Falloon, 2020). By creating environments that are safe, comfortable, moral, and ethical, teachers may safeguard their kids (Chiu, 2023, 2024; Kasneci et al., 2023). In the future, research on TPACK should be done again in order to develop an updated framework related to teacher digital competence.

- *Future development of chatbots*. With the recent development of large language model (e.g. ChatGPT and Bing), chatbots are expected to be more human-like, interactive, informative, and accurate. The chatbots' feedback may outperform that of teachers. The roles of teachers and how they satisfy the need may need to be revisited. Future studies could focus on how the large language model affects teacher teaching.
- *Large language model teacher-like chatbots:* Large language model chatbots are not ready for education, particularly for younger students. The chatbots can generate outputs, but the outputs may not foster language learning. Future studies may develop teacher-like chatbots, i.e. chatbots that act like teachers.

5. Conclusion and limitations

This study presents a systematic review of the ways in which teachers use AI chatbots to assist language learning. We examined 22 chosen publications from three significant databases – WOS, Scopus, and ProQuest – that were published between 2014 and 2023. The findings contribute to the field by illuminating how chatbots thwart student SDT needs and how teacher roles satisfy SDT needs. They will aid in the advancement of teacher digital and AI competence. Nonetheless, three study limitations were mentioned in this article. First, only articles from three main databases were selected for this analysis, indicating that articles from other databases or grey literature that may have been relevant were not taken into account. Furthermore, different searches may provide different results, which implies some relevant articles might not be included. Third, the study limited the target readership to English speakers by only including items written in English, which eliminated pertinent content written in other languages.

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References

Alamri, H., Lowell, V., Watson, W., & Watson, S. L. (2020). Using personalized learning as an instructional approach to motivate learners in online higher education: Learner self-determination and intrinsic motivation. *Journal of Research on Technology in Education*, *52*(3), 322–352. https://doi.org/10.1080/15391523.2020.1728449

Annamalai, N., Eltahir, M. E., Zyoud, S. H., Soundrarajan, D., Zakarneh, B., & Al Salhi, N. R. (2023a). Exploring English language learning via chabot: A case study from a self determination theory perspective. *Computers and Education: Artificial Intelligence*, *5*, 100148. https://doi.org/10.1016/j.caeai.2023.100148

Bailey, D., Southam, A., & Costley, J. (2021). Digital storytelling with chatbots: Mapping L2 participation and perception patterns. *Interactive Technology and Smart Education*, *18*(1), 85–103. https://doi.org/10.1108/ITSE-08-2020-0170

Bašić, Ž, Banovac, A., Kružić, I., & Jerković, I. (2023). ChatGPT-3.5 as writing assistance in students' essays. *Humanities and Social Sciences Communications*, *10*, 750. https://doi.org/10.1057/s41599-023-02269-7

Chen, H. H.-J., Yang, C. T.-Y., & Lai, K. K.-W. (2023). Investigating college EFL learners' perceptions toward the use of google assistant for foreign language learning. *Interactive Learning Environments*, *31*(3), 1335–1350. https://doi.org/10.1080/10494820.2020.1833043

Chiu, T. K. F. (2021). Digital support for student engagement in blended learning based on self-determination theory. *Computers in Human Behavior*, *124*, 106909. https://doi.org/10.1016/j.chb.2021.106909

Chiu, T. K. F. (2022). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education*, *54*(1), S14–S30. https://doi.org/10.1080/15391523.2021.1891998

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

Chiu, T. K. F. (2024a). A classification tool to foster self-regulated learning with generative artificial intelligence by applying self-determination theory: A case of ChatGPT. *Educational Technology Research and Development*, https://doi.org/10.1007/s11423-024-10366-w

Chiu, T. K. F. (2024b). Future research recommendations for transforming higher education with generative AI. *Computers and Education: Artificial Intelligence*, *6*, 100197. https://doi.org/10.1016/j.caeai.2023.100197

Chiu, T. K. F., Falloon, G., Song, Y. J., Wong, V. W. L., Zhao, L., & Ismailov, M. A. (2024). A self-determination theory approach to teacher digital competence development. *Computers & Education*, *214*, 105017. https://doi.org/10.1016/j.compedu.2024.105017

Chiu, T. K. F., Moorhouse, B. L., Chai, C. S., & Ismailov, M. (2023). Teacher support and student motivation to learn with artificial intelligence (AI) chatbot. *Interactive Learning Environments*, https://doi.org/10.1080/10494820.2023.2172044

Dizon, G. (2017). Using intelligent personal assistants for second language learning: A case study of alexa. *TESOL Journal*, *8*(4), 811–830. https://doi.org/10.1002/tesj.353

Dizon, G. (2020). Evaluating intelligent personal assistants for L2 listening and speaking development. *Language Learning & Technology*, *24*(1), 16–26. https://doi.org/10.1080/10125/44705

Ebadi, S., & Amini, A. (2024). Examining the roles of social presence and human-likeness on Iranian EFL learners' motivation using artificial intelligence technology: A case of CSIEC chatbot. *Interactive Learning Environments*, https://doi.org/10.1080/10494820.2022.2096638

Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development*, *68*(5), 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Guo, K., Li, Y., Li, Y., & Chu, S. K. W. (2024). Understanding EFL students' chatbot-assisted argumentative writing: An activity theory perspective. *Education and Information Technologies*, *29*, 1–20. https://doi.org/10.1007/s10639-023-12230-5

Hsu, H. L., Chen, H. H. J., & Todd, A. G. (2023). Investigating the impact of the Amazon alexa on the development of L2 listening and speaking skills. *Interactive Learning Environments*, *31*(9), 5732–5745. https://doi.org/10.1080/10494820.2021.2016864

Huang, W. J., Hew, K. F., & Fryer, L. K. (2022). Chatbots for language learning—Are they really useful? A systematic review of chatbot-supported language learning. *Journal of Computer Assisted Learning*, *38*(1), 237–257. https://doi.org/10.1111/jcal.12610

Hwang, W. Y., Guo, B. C., Hoang, A., Chang, C. C., & Wu, N. T. (2022). Facilitating authentic contextual EFL speaking and conversation with smart mechanisms and investigating its influence on learning achievements. *Computer Assisted Language Learning*, https://doi.org/10.1080/09588221.2022.2095406

Jeon, J. (2024). Exploring AI chatbot affordances in the EFL classroom: Young learners' experiences and perspectives. *Computer Assisted Language Learning*, *37*(1-2), 1–26. https://doi.org/10.1080/09588221.2021.2021241

Jeon, J., & Lee, S. (2023). Large language models in education: A focus on the complementary relationship between human teachers and ChatGPT. *Education and Information Technologies*, *28*(12), 15873–15892. https://doi.org/10.1007/s10639-023-11834-1

Jeon, J., Lee, S., & Choe, H. (2023a). Beyond ChatGPT: A conceptual framework and systematic review of speech-recognition chatbots for language learning. *Computers & Education*, *206*, 104898. https://doi.org/10.1016/j.compedu.2023.104898

Jeon, J., Lee, S., & Choi, S. (2023b). A systematic review of research on speech-recognition chatbots for language learning: Implications for future directions in the era of large language models. *Interactive Learning Environments*. https://doi.org/10.1080/10494820.2023.2204343

Ji, H., Han, I., & Ko, Y. (2023). A systematic review of conversational AI in language education: Focusing on the collaboration with human teachers. *Journal of Research on Technology in Education*, *55*(1), 48–63. https://doi.org/10.1080/15391523.2022.2142873

Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., … Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, *103*, 102274. https://doi.org/10.1016/j.lindif.2023.102274

Lee, J. H., Shin, D., & Noh, W. (2023). Artificial intelligence-based content generator technology for young English-as-a-foreign-language learners' Reading enjoyment. *RELC Journal*, *54*(2), 508–516. https://doi.org/10.1177/00336882231165060

Liang, J.-C., Hwang, G.-J., Chen, M.-R. A., & Darmawansah, D. (2023). Roles and research foci of artificial intelligence in language education: An integrated bibliographic analysis and systematic review approach. *Interactive Learning Environments*, *31*, 4270–4296. https://doi.org/10.1080/10494820.2021.1958348

Lin, C. J., & Mubarok, H. (2021). Learning analytics for investigating the mind map-guided AI chatbot approach in an EFL flipped speaking classroom. *Educational Technology & Society*, *24*(4), 16–35. https://www.jstor.org/stable/48629242

Lin, M. P.-C., & Chang, D. (2020). Enhancing post-secondary writers' writing skills with a chatbot: A MixedMethod classroom study. *Educational Technology & Society*, *23*(1), 78–92.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record: The Voice of Scholarship in Education*, *108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hrobjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *International Journal of Surgery*, *88*, 105906. https://doi.org/10.1016/j.ijsu.2021.105906

Rosenberg, J. M., & Koehler, M. J. (2015). Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education*, *47*(3), 186–210. https://doi.org/10.1080/15391523.2015.1052663

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Tai, T. Y. (2024). Effects of intelligent personal assistants on EFL learners' oral proficiency outside the classroom. *Computer Assisted Language Learning*, *37*(5-6), 1281–1310. https://doi.org/10.1080/09588221.2022.2075013

Tai, T. Y., & Chen, H. H. J. (2023). The impact of google assistant on adolescent EFL learners' willingness to communicate. *Interactive Learning Environments*, *31*(3), 1485–1502. https://doi.org/10.1080/10494820.2020.1841801

Tai, T. Y., & Chen, H. H. J. (2024a). The impact of intelligent personal assistants on adolescent EFL learners' listening comprehension. *Computer Assisted Language Learning*, *37*(3), 433–460. https://doi.org/10.1080/09588221.2022.2040536

Tai, T. Y., & Chen, H. H. J. (2024b). The impact of intelligent personal assistants on adolescent EFL learners' speaking proficiency. *Computer Assisted Language Learning*, *37*(5-6), 1224–1251. https://doi.org/10.1080/09588221.2022.2070219

Tseng, J. J. (2018). Exploring TPACK-SLA interface: Insights from the computer-enhanced classroom. *Computer Assisted Language Learning*, *31*(4), 390–412. https://doi.org/10.1080/09588221.2017.1412324

Weng, X. J., & Chiu, T. K. F. (2023). Instructional design and learning outcomes of intelligent computer assisted language learning: Systematic review in the field. *Computers and Education: Artificial Intelligence*, *4*, 100117. https://doi.org/10.1016/j.caeai.2022.100117

Yan, D. (2023). Impact of ChatGPT on learners in a L2 writing practicum: An exploratory investigation. *Education and Information Technologies*, *28*(11), 13943–13967. https://doi.org/10.1007/s10639-023-11742-4

Yang, H., Kim, H., Lee, J. H., & Shin, D. (2022). Implementation of an AI chatbot as an English conversation partner in EFL speaking classes. *Recall*, *34*(3), 327–343. https://doi.org/10.1017/S0958344022000039

Yang, C. T. Y., Lai, S. L., & Chen, H. H. J. (2024). The impact of intelligent personal assistants on learners' autonomous learning of second language listening and speaking. *Interactive Learning Environments*, *32*(5), 2175–2195. https://doi.org/10.1080/10494820.2022.2141266

Ye, Y. W., Deng, J. X., Liang, Q. Y., & Liu, X. B. (2022). Using a smartphone-based chatbot in EFL learners' oral tasks. *International Journal of Mobile and Blended Learning*, *14*(1), 17. https://doi.org/10.4018/IJMBL.299405

Yuan, Y. (2023). An empirical study of the efficacy of AI chatbots for English as a foreign language learning in primary education. *Interactive Learning Environments*, https://doi.org/10.1080/10494820.2023.2282112

Zhang, S., Shan, C., Lee, J. S. Y., Che, S., & Kim, J. H. (2023b). Effect of chatbot-assisted language learning: A meta-analysis. *Education and Information Technologies*, *28*(11), 15223–15243. https://doi.org/10.1007/s10639-023-11805-6

Zhang, R., Zou, D., & Cheng, G. (2023a). Chatbot-based training on logical fallacy in EFL argumentative writing. *Innovation in Language Learning and Teaching*, *17*(5), 932–945. https://doi.org/10.1080/17501229.2023.2197417