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A Preliminary Study on Graduate Student Instructors' Exploration, Perception, and Use of ChatGPT

Yingling Bao, Indiana University, Bloomington, USA*
Belle Li, Purdue University, USA
https://orcid.org/0009-0000-5750-4793

ABSTRACT

Research on teachers' technological pedagogical content knowledge (TPACK) has been burgeoning recently. Yet, little is known about how teachers integrate AI tools such as ChatGPT in language teaching. This preliminary qualitative study investigates the exploration and incorporation of ChatGPT in language teaching by graduate student instructors (GSIs). By analyzing data from questionnaires, focus group interviews, screenshots of interactions with ChatGPT, and participants' lesson plans, this study shows how instructors develop their knowledge about ChatGPT and mobilize content and pedagogy knowledge to enact technology integration. Findings reveal that GSIs adopted various strategies when exploring the affordances of ChatGPT. Furthermore, while GSIs form positive perceptions of ChatGPT affordances, negative perceptions pertain to its limited capacity to process the Chinese language. Lastly, GSIs drew on various aspects of TPACK to design lessons, among which content knowledge and its interplay with technology seem to be prominent.

KEYWORDS

ChatGPT, Exploration, Foreign Language, Novice Instructors, Perception, TPACK

INTRODUCTION

The evolution of generative artificial intelligence (GenAI) technologies (e.g., ChatGPT, BingChat, Dalle-E, and MidJourney), with a particular focus on ChatGPT, has sparked heated discussion concerning their impact on education. Since its release in November 2022 by OpenAI, ChatGPT has attracted millions of users, and in interactions with them, it has generated natural conversations (Grant & Metz, 2022; OpenAI, 2022). Technology-enhanced language learning has demonstrated an ability to positively affect learners' performance and engagement (Golonka et al., 2014), and unsurprisingly, within a few short months of ChatGPT's debut, a plethora of research had already begun to investigate ChatGPT's potentials, pitfalls, and challenges by examining the perspectives of various stakeholders, including students (e.g., Chan & Hu, 2023), English as a foreign language (EFL) instructors (e.g., Mohamed, 2023), and social media influencers such as YouTubers (e.g., Li et al., 2023b). Studies have explored a diversity of topics, such as the integration of ChatGPT into EFL writing education

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(e.g., Han et al., 2023), the generation of chatbot dialogues for EFL purposes (e.g., Young & Shishido, 2023), and the application of ChatGPT for multilingual purposes (e.g., Li et al., 2023a).

ChatGPT has been widely described as a "game changer" (Gao et al., 2023), and its debut has given rise to various opportunities and challenges in the realm of language education (as well as in various other domains), spanning pedagogical, ethical, and technological dimensions. Both Kohnke et al. (2023) and Li et al. (2023b) explored how ChatGPT can be employed for language teaching and learning and highlighted the heightened need to prioritize the development of teachers' digital competence in light of this digital advancement. More specifically, teachers need to enhance their technological proficiency, pedagogical compatibility, and social awareness to effectively harness ChatGPT—these are skills they presently lack to a certain extent (Kohnke et al., 2023). Li et al. (2023b) proposed that technical proficiency, clear prompt formulation, contextual awareness, critical thinking, instructional design expertise, ethical usage, and a commitment to lifelong learning are key competencies educators must possess.

Teaching is a highly complex activity that draws upon diverse forms of knowledge, and teacher knowledge and learning experiences play a crucial role in their capacity to incorporate technologies into teaching (e.g., Hughes, 2005; Lam, 2000; Thoms, 2011). As informed by the Technological Pedagogical Content Knowledge (TPACK) model (Mishra et al., 2011), teacher knowledge consists of technological, pedagogical, and content knowledge, which can be developed through both informal learning (e.g., self-initiated, peer collaboration, or book-based) and formal learning (e.g., pre- or in-service training). Although GenAI holds considerable promise in the areas of language teaching and learning, its novelty leaves much unknown about teachers' GenAI-related learning process. Some studies have focused on teacher perceptions of GenAI as a novel tool (e.g., Mohamed, 2023) and the relationship between ChatGPT and teachers (e.g., Jeon & Lee, 2023), but few efforts have been directed at understanding these processes and how they influence teachers' decisions regarding whether and how to utilize GenAI. To fill this research gap, this study adopted a qualitative, context-specific approach to investigate how teacher knowledge and self-learning experience affect novice teachers' (i.e., graduate student instructors; GSIs) perceptions of and intention to use GenAI, specifically ChatGPT, in the courses they may teach in the future.

LITERATURE REVIEW

Technology in Language Teaching and Learning

In line with how technologies have become an indispensable component of everyday life, the same is true for the language field, which has released new standards for teachers and students. For example, Teaching English to Speakers of Other Languages (TESOL) created the Technology Standards for Language Teachers (Healey et al., 2008). These standards outline four key objectives, namely that 1) language teachers acquire and maintain foundational knowledge and skills in technology for professional purposes, 2) language teachers integrate pedagogical knowledge and skills with technology to enhance language teaching and learning, 3) language teachers apply technology in recordkeeping, feedback, and assessment, and 4) language teachers use technology to improve communication, collaboration, and efficiency. Technology standards and frameworks can provide much-needed guidance for language teachers at the macro level. On the student side, the American Council on the Teaching of Foreign Languages (ACTFL, 2011) developed the 21st Century Skills Map, which prioritizes technology literacy. Students are expected, first, to use digital technology, communication tools, and/or networks appropriately to access, manage, integrate, evaluate, and create information in order to function in a knowledge economy and, second, to use technology as a tool to research, organize, evaluate, and communicate information; further, they are expected to understand the ethical and legal issues surrounding the access and use of information. As is evident from the foregoing, integrating technology into language teaching and learning has become essential.

AI in Language Education

Research on employing AI technology in education has surged. Chiu et al. (2023) conducted a literature review concerning the applications of AI in education from 2012 to 2021, which revealed 13 roles for AI technology in the four major educational domains of learning, teaching, assessment, and administration. These roles include assigning tasks according to individual competence, providing human–machine conversation, analyzing student work for feedback, providing adaptive teaching strategies, and providing automatic marking.

In the language education field, intelligent computer-assisted language learning research has investigated the use of AI tools for language skills areas, such as the four skills (speaking, listening, reading, and writing), grammar, and vocabulary (Huang et al., 2023; Woo & Choi, 2021). Huang et al. (2023) analyzed 516 papers published during 2000–2019 and highlighted 10 key topics concerning AI in language education; these included automated writing evaluation and ITS for reading/writing. They summarized the advantages of using AI in language learning, specifically noting the capacity of AI for (1) providing personalized learning experiences, (2) enabling learners to adjust their learning after receiving automated feedback, and (3) fostering enriching learning opportunities.

ChatGPT Features

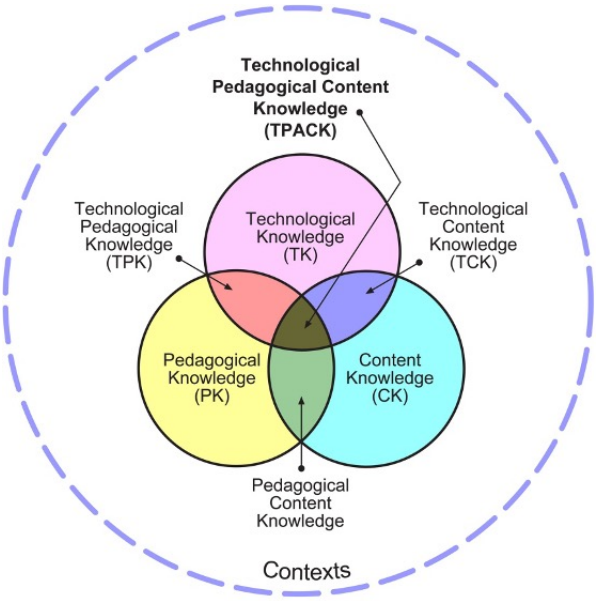
Mishra et al. (2023) stated that GenAI refers to "artificial intelligence (AI) applications which are designed to use a variety of machine learning algorithms to create new content" (p. 2). ChatGPT, however, is a state-of-the-art natural language processing model with applications in diverse fields, including language teaching (Li et al., 2023b; Kohnke et al., 2023). Many people mistake ChatGPT for an advanced version of Google search, but these two technologies are fundamentally different in their mechanisms. Built upon a transformer architecture and possessing an underlying self-attention mechanism, ChatGPT considers the context of each word in a sentence when generating text (Kasneci et al., 2023). Further, ChatGPT is a pretrained model, which means it has been trained on a massive corpus of text from the Internet. During pretraining, the model learned to predict the next word in a sentence, which developed its ability to capture grammar, syntax, and world knowledge. After pretraining, the model can be fine-tuned on specific tasks such as language translation, grammar correction, vocabulary expansion, and text summarization, to name just a few. Integrating ChatGPT into education demands a deep knowledge of the technology as well as a nuanced application of pedagogical and content knowledge. In the following section, we introduce the TPACK framework and explain its relevance to our study.

TPACK

The TPACK framework (also known as the Technological Pedagogical Content Knowledge framework) is a model that describes the knowledge and skills needed by teachers to effectively integrate technology into their teaching practices (Niess, 2005). The TPACK model, developed by Koehler and Mishra (2005), is rooted in the pioneering work of Shulman (1986), who initially explored teacher knowledge and classified it into subject matter knowledge, pedagogical knowledge (PK), and pedagogical content knowledge (PCK).

The three core constructs of the framework are 1) technological knowledge (TK), which refers to knowledge of technology tools, 2) PK, which refers to knowledge of teaching methods, and 3) content knowledge (CK), which refers to knowledge of subject matter. The derived constructs include the intersection of the core constructs, including 4) technological CK (TCK), which refers to knowledge concerning representing subject matter with technology, 5) technological PK (TPK), which refers to knowledge of using technology to implement different teaching methods, 6) PCK, which refers to knowledge of teaching methods in relation to subject matter content, and 7) technological PCK (TPCK), which refers to knowledge of using technology to implement teaching methods for different types of subject matter content (Mishra & Koehler, 2006; Mishra et al., 2011).

Figure 1. The TPACK framework and its knowledge components (Koehler & Mishra, 2009)



The TPACK framework suggests that technology-supported teaching is not simply a matter of adding technology to an existing teaching context but rather involves teachers' awareness and understanding of a dynamic, transactional relationship between three components of knowledge: technology, pedagogy, and content (Mishra & Koehler, 2006). As asserted by Mishra et al. (2023), "changes in technology push us to reconsider how we think about the content to be taught as well as the pedagogical approach that is most appropriate" (p. 5). Researchers have acknowledged that although the TPACK framework appears to be a simple but elegant construct, in both textual and graphical forms, it is complex and difficult to comprehend and apply in educational settings (Cox, 2008; Jimoyiannis, 2015; Lee & Tsai, 2009).

The TPACK framework is not specific to any technology. Rather, it focuses on the relationship between technology, pedagogy, and content. Studies have focused on the integration of tools such as YouTube (e.g., vocabulary enhancement) (Kabooha & Elyas, 2018), and Wikipedia (e.g., intercultural communication) (Wang et al., 2013) in language classes. Different tools have unique affordances, and this applies to using the TPACK framework to study how newer tools such as ChatGPT are used in language teaching and learning. Therefore, although technology keeps changing over time, the TPACK model remains an appropriate framework for exploring the issue of technology integration.

In terms of measuring TPACK, Koehler et al. (2012) identified several approaches that have been used in empirical studies. They categorized these approaches into five types: self-report measures, open-ended questionnaires, performance assessments, interviews, and observations. Self-report measures (e.g., large-scale surveys) are one of the most frequently used methods to measure participants' TPACK. Such surveys typically contain multiple subscales of TPACK and aim to investigate the extent to which each construct contributes to overall TPACK (see review by Tseng et al., 2022). Open-ended questionnaires and interviews usually ask pre- or in-service teachers about their opinions of technology in general or the strengths and weaknesses of certain tools (e.g., Ozgun-Koca, 2009; So & Kim, 2009). Approaches such as performance assessments and observations directly examine participants' teaching performance and/or how their level of TPACK has changed over time. Instead of looking at "espoused TPACK" (i.e., teachers' claimed knowledge and skills in using

technology), these approaches enable researchers to investigate "in-use TPACK" (teachers' actual use of technology in practice) (So & Kim, 2009). Each approach has its advantages and disadvantages. Quantitative methods tend to achieve higher reliability and validity, whereas qualitative methods can provide a rich contextual understanding and identify emerging trends.

Development of TPACK

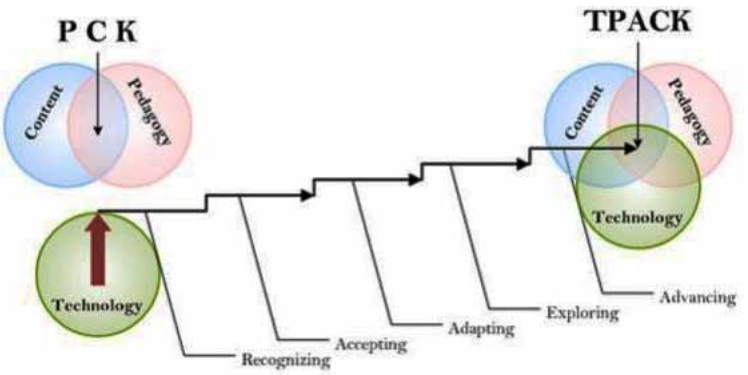
Niess et al. (2009) proposed five sequential stages of TPACK: recognizing (knowledge), accepting (persuasion), adapting (decision), exploring (implementation), and advancing (confirmation) (Figure 2).

Teachers proceed through the stages of recognizing (knowing but not using the knowledge), accepting (developing attitudes), adapting (deciding to incorporate), exploring (actively using), and advancing (evaluating and refining). The proposed development trajectory was based on teachers in mathematics education, but we believe that this progression is not subject-specific and can be applied to language education. This development model suggests that to gain insights into teachers' TPACK development, exploring their knowledge, attitudes, and implementation is crucial. Further, as teachers cultivate their knowledge pertaining to technology, the relationship between the three constructs also changes. In the beginning stage, technology is separate from PCK. However as teachers' TK expands and intertwines with their PK and CK, comprehensive TPACK emerges. TPACK empowers teachers to effectively guide students in their subject-learning endeavors by employing appropriate technological tools.

The application of the TPACK framework in designing technology-enhanced learning environments has yielded positive results (Tseng et al., 2022). This aligns with Chai et al.'s (2013) study, which highlighted how the TPACK framework can be applied as a scaffold for designing such environments. Incorporating emerging technologies such as ChatGPT can streamline the integration of technology, pedagogy, and content, thereby saving teachers valuable time and effort.

By reviewing the existing literature, we identified the following research gaps. One notable gap within the TPACK literature pertains to the incorporation of ChatGPT, a novel and distinct technology, into language teaching contexts. TPACK has been instrumental in understanding how teachers integrate technology, but ChatGPT possesses unique features, which make it a particularly intriguing subject. Mishra et al. (2023) contended that much of the discussion around GenAI tools has been built on a "fundamental misunderstanding of these technologies" (p. 3). ChatGPT is still very new, and many instructors have little knowledge of it and even less experience using it. We thus proposed that it would be useful to first investigate what strategies instructors have adopted to explore ChatGPT, what type of knowledge instructors have (or may be able to) developed, and whether (and how) they plan to integrate it into their teaching practice.

Figure 2. Process of teachers' development of TPACK (Niess et al., 2009)



Another underexplored area within the TPACK literature concerns the development of TPACK among novice teachers, particularly GSIs. TPACK development and its connection to teachers' beliefs have been investigated, but scant attention has been given to GSIs (e.g., Burnett, 1998; Thoms, 2011) despite their substantial teaching responsibilities at the postsecondary level. GSIs are usually assigned to teach lower- or intermediate-level language courses in programs that offer multiple sections. As future foreign language professionals, GSIs need to learn the knowledge and skills necessary to effectively incorporate new AI technologies, such as ChatGPT, into their pedagogy to effectively meet the linguistic and (inter)cultural demands of foreign language students.

Further, the tracking and assessment of TPACK development has relied heavily on quantitative methods such as questionnaires. However, a more nuanced understanding of how teachers develop TPACK is needed, particularly in the context of integrating ChatGPT.

To bridge the identified gaps, this study investigated the following research questions to illuminate the unexplored territories of novice teachers' (i.e., GSIs) technology integration in language education, specifically concerning ChatGPT.

1. What strategies do GSIs use to explore ChatGPT?
2. How do GSIs perceive the affordances and constraints of ChatGPT in language teaching?
3. How do GSIs plan to incorporate ChatGPT in language teaching?

The first two questions address the process of TK development among GSIs and their TK competencies. As Voogt et al. (2016) argued, TK encompasses the technical skills for using technology and also implies an understanding of the affordances of technology—in other words, how technology can be leveraged to attain certain objectives. The last question focuses on how teachers use their TK in concert with CK and PK.

METHODOLOGY

Context

This study was conducted at a large midwestern (USA) university, which is strong in language education and offers more than 60 languages. The annual enrollment in the Chinese language program is approximately 470 students in total. The program adopts a lecture–drill model across first- to third-year language courses. Lectures are given by full-time lecturers, whereas drills are overseen by GSIs. Lecturers and graduate students work together to develop teaching materials for the assigned level. To ensure that GSIs understand the curriculum setup and teaching approach, the program offers a one-week in-house orientation before the beginning of a new semester. Each level holds a two-hour level meeting to introduce the teaching materials for the next week (e.g., lesson plans and slides).

In addition to the language program for undergraduates, the department also offers an MA in Chinese pedagogy. This study was conducted in a graduate-level course on curriculum design and material development. The course adopted a proficiency-oriented teaching approach and material development for all four language skills, with a specific emphasis on teaching Chinese at the postsecondary level.

Participants

The study included all five GSIs enrolled in this course. Compared to graduate students with little background in language instruction training, these participants had prior teaching experience and had received some training in linguistics, language pedagogy, and material development. Given their specialized training and background, we believed that they were well positioned to provide insights into the nuanced and context-specific use of ChatGPT in language teaching and that their experiences

and perspectives would be highly relevant to our research focus, which centered on the integration of technology in language instruction.

The GSIs had diverse backgrounds and experiences in language teaching. They were primarily native speakers of either Chinese or English and demonstrated proficiency in both languages (Table 1). Only one participant (P2) had undergone formal training in technology for language teaching and used technology frequently, whereas the others had limited experience and used technology rarely. Most of them had a moderate level of familiarity with ChatGPT and expressed a moderate level of confidence in integrating it into their teaching, as shown in Table 2.

Research Design

This study aimed to gain insights into how GSIs explore and perceive ChatGPT as well as what knowledge they leverage to utilize ChatGPT in language teaching. We thus adopted a qualitative research method, which we deemed appropriate because little research has been done on this topic. As stated by Creswell (2014), qualitative research is particularly valuable when dealing with novel topics that have not been explored within a specific group of people. The type of our research is what Merriam (2009) termed "basic qualitative research" (p. 22). A central characteristic of qualitative research is constructionism. According to Denzin and Lincoln (2005), "qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them" (p. 3). As researchers, we were interested in understanding how GSIs construct their knowledge of ChatGPT in their experiences of exploring the technology.

Table 1. Participant profile

	Gender	Education Level	Area of Study		Native Language		Proficient Foreign Languages	
		Master's	Chinese Pedagogy	Chinese Literature	Mandarin Chinese	English	Mandarin Chinese	English
P1	F	X	X		X			X
P2	F	X		X		X	X	
P3	M	X		X		X	X	
P4	F	X	X		X			X
P5	F	X	X			X	X	

Table 2. Familiarity with ChatGPT and technology in language teaching

	Familiarity With ChatGPT	Confidence in Incorporating ChatGPT	Formal Training in Technology for Language Teaching	Frequency of Technology Use in Chinese Instruction
P1	4	4	*Yes*	*Frequently*
P2	3	2	*No*	*Almost always*
P3	1	2	*No*	*Almost always*
P4	3	2	*No*	*Rarely*
P5	2	2	*No*	*Almost always*

* Numbers represent the participants' ratings on a scale of 1 to 5, with higher values indicating greater familiarity or confidence.

Data Collection

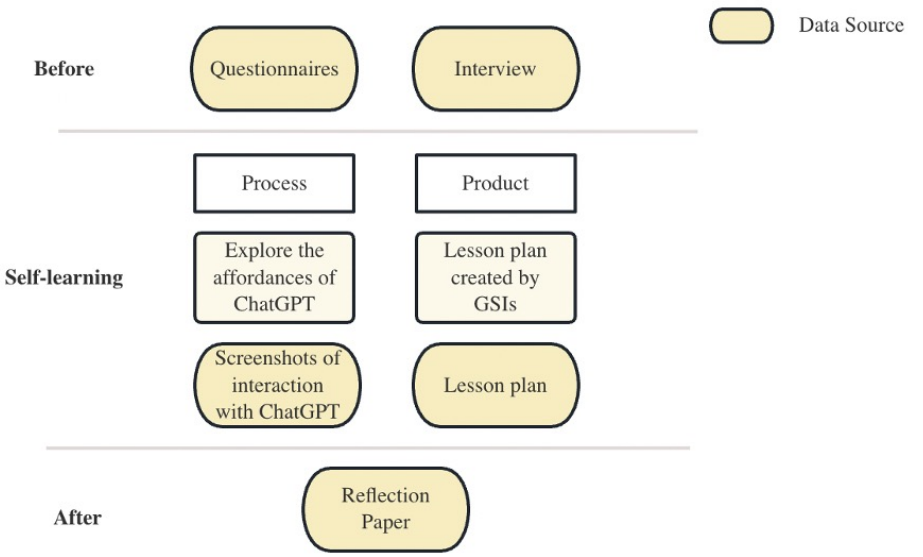
The data for this study were collected from various sources, including questionnaires, focus group interviews, screenshots of interactions with ChatGPT, lesson plans created by the participants, and participant reflection papers. The questionnaires (Appendix A) were designed to collect background information on the participants' habits of technology use and their familiarity with technology in general and ChatGPT in particular. To ascertain the tools participants commonly use and whether they are teaching related, we provided a comprehensive list of technologies for them to choose from. These tools can be broadly categorized into everyday technologies (e.g., computers, mobile devices, software), common educational technologies (e.g., Zoom, Canvas, PowerPoint), social media and entertainment platforms (e.g., Facebook, Netflix), and AI-based tools (e.g., Siri, Grammarly, ChatGPT).

A 30-minute focus group interview was conducted prior to the participants engaging in self-learning exploration. The interview questions were mainly open-ended and intended to explore their knowledge of and experience with ChatGPT as well as initial perception of it. This helped us to establish a baseline understanding of their ChatGPT knowledge before the exploration.

One of the course assignments (Appendix B) required students to explore the affordances of ChatGPT and design a lesson plan incorporating ChatGPT to accomplish learning goals selected by the GSIs. Screenshots of interactions with ChatGPT served as tangible evidence of the participants' exploration of ChatGPT's functionality and affordances. These interactions provided valuable insights into their experiences and interactions with ChatGPT. The lesson plans designed by the participants were thoroughly analyzed to determine how and in what contexts they incorporated ChatGPT in their language instruction. Their reflection papers (including screenshots) ranged from 5 to 27 pages in length, providing contextualized evidence of their perceptions of ChatGPT and their decision-making processes. They added an additional layer of data with which to triangulate the findings and demonstrate the potential implementation of ChatGPT in their teaching.

By exploring both the process (exploration) and product (lesson plans) of GSIs using ChatGPT, we intended to identify the needs and challenges encountered by GSIs and clarify the implications for potential areas of teacher knowledge development.

Figure 3. Process of data collection



Data Analysis

To familiarize themselves with the content, the two authors carefully reviewed the data collected, including responses from questionnaires, transcripts of interviews, screenshots of interactions with ChatGPT, and lesson plans. This initial phase was aimed at establishing an understanding of the dataset as a whole.

Drawing on Jimoyiannis (2015), we developed a coding schema (Table 3). We focused on areas directly related to technology, namely TK, TPK, TCK, and TPACK. Following this, the two researchers individually coded data. The content analysis of both process and product data allowed for the clarification of how participants explored ChatGPT, the challenges they faced, and potential areas for teacher knowledge development for integrating ChatGPT into language teaching. Upon completing independent coding, the researchers compared their coded data to assess intercoder reliability. Any discrepancies or disagreements were discussed and resolved to ensure consistency in the interpretation of the data.

FINDINGS

RQ1: What Strategies Do GSIs Use to Explore ChatGPT?

The group interview suggested that many participants lacked knowledge of how ChatGPT functions. They seemed to treat it basically as an advanced search engine rather than as a generative and social tool. Two participants had prior experience with ChatGPT. P4 used it for tasks such as generating sign-up sheets, drafting emails, and correcting grammar mistakes. P1 used it to generate topics for language partner interactions. As second-language learners, both used ChatGPT for language learning, but neither of them utilized it for teaching purposes.

Table 3. Coding schema

Codes	Knowledge Components	Examples
TK	Knowledge and skills relating to ChatGPT	"During the course of interacting with ChatGPT, I discovered that it could in fact understand longer, more complicated prompts" (P3, reflection)
TPK	Knowledge of the affordances of ChatGPT and knowledge of how ChatGPT can support specific pedagogical strategies or goals—in particular, teaching and learning, without consideration of subject matter	"Design a 50-minute lesson plan with clear stages of warm-up, target language teaching, practice, and wrap up. Approach: TBLT/TSLT, Technology-assisted language teaching" (P1, reflection, explaining prompt)
TCK	Knowledge of how to use ChatGPT to represent, transform, and create language learning content, without consideration of instructional issues	"I enjoyed using ChatGPT to help brainstorm because it helped me think of all my options by giving me general synopses of the fields/topics I asked about" (P5, reflection)
TPACK	An integrated body of knowledge concerning how to design and implement meaningful learning activities based on constructive and efficient use of ChatGPT to teach language by using specific pedagogical strategies/techniques to achieve the intended learning outcomes	"I asked ChatGPT to make the activities in the practice section clear by using information gap activities" (P1, reflection)

All the participants engaged in some initial exploration before focusing on certain functions of ChatGPT. They all quickly became aware of the diverse affordances offered by ChatGPT, including its ability to generate ideas for class activities, provide grammar explanations, and support various language-related tasks. The majority of the participants emphasized the crucial role of the prompt in facilitating the generation of useful responses from ChatGPT.

During the stage of further exploration, GSIs sought new possibilities, tested different prompts, and explored ChatGPT's capabilities in various language teaching contexts. Although the GSIs had limited knowledge of how to effectively train or prompt ChatGPT to obtain more accurate and satisfactory answers, they adopted various strategies to enhance their skills and knowledge in "training ChatGPT."

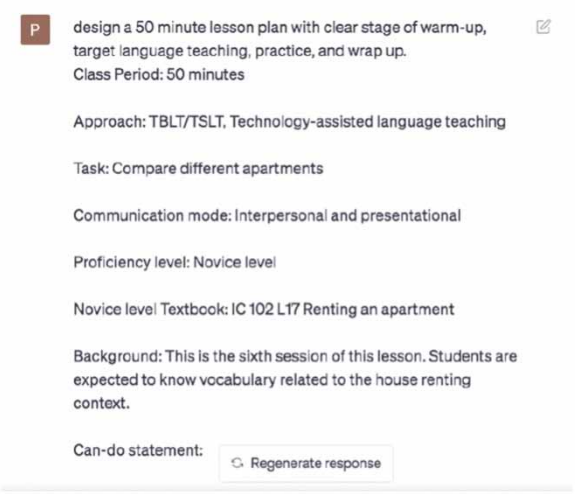
In their review of qualitative studies that had examined strategies for preparing preservice teachers to effectively integrate technology into their lessons, Tondeur et al. (2012) identified key themes such as using role models, reflecting on technology's role, learning by design, collaborating with peers, scaffolding experiences, and receiving feedback to prepare teachers for technology integration. Drawing on their analysis, we identified six specific strategies for exploring ChatGPT, which are outlined in Table 4.

Finding role models (A), reflecting on strategies for prompting (B), and giving feedback (E) were methods commonly adopted by participants. The GSIs' ability to craft explicit and specific prompts greatly affected the generated outcomes. For example, as shown in Figure 4, P1 provided detailed instructions and the necessary context in the prompt to elicit a desirable response. By contrast, P4 found

Table 4. Descriptions of six exploration strategies

No.	Strategies	Descriptions	Examples
A	Role models	Learning from experts, teaching cases, online articles, and YouTube videos how to guide ChatGPT's responses	"One of the videos I used to learn how to use ChatGPT was 'How To Use Chat GPT by Open AI For Beginners'" (P1, reflection)
B	Reflect on strategies for writing prompts	Adjusting the prompt based on the generated answer to improve subsequent responses	"During the course of interacting with ChatGPT, I discovered that it could in fact understand longer, more complicated prompts. Thus, I gave it more detailed prompts, which improved the quality of the materials it generated for me" (P3, reflection)
C	Break down tasks	Breaking complex grammar tasks into smaller, more manageable parts for better understanding and response generation	"Make a dialogue" "Make this dialogue simpler" "Integrate the following grammar points into the dialogue:..." (P3, screenshot)
D	Provide informative input	Giving examples or providing relevant information before requesting a grammar-related response from ChatGPT	"I gave the program the specific examples I wanted it to translate, such as 'The dog ate my homework,' and 'My homework was eaten by the dog'" (P2, reflection)
E	Give feedback	Pointing out mistakes or errors in the generated grammar response and asking ChatGPT to modify its response accordingly	"Again, the table is unclear, could your adjust the table again and the scale change it to 1-4 only" (P1, screenshot) "Have 朋友 A give a different excuse as to why his credit card is not working" (P3, screenshot)
F	Start over when ChatGPT reaches its memory capacity	Resetting or clearing ChatGPT's memory to ensure optimal performance in generating grammar-related responses	"After that, I told the program that we needed to start over" (P2, reflection)

Figure 4. Snapshot of prompt provided by participant



ChatGPT's response to be too generic when they prompted it to "design a lesson plan that incorporates ChatGPT to allow students to learn the basic Chinese expressions to handle a job interview."

Giving feedback is another important strategy that participants adopted in the process of training ChatGPT. Several participants noticed errors in ChatGPT's responses regarding Chinese grammar and writing styles. They pointed out the problems, which in some cases were subsequently corrected by ChatGPT. In one instance, as shown in Figure 5, P1 utilized her pedagogical expertise to provide feedback regarding grading rubrics and successfully generated a more desirable response.

Figure 5. Snapshot of feedback provided by participant

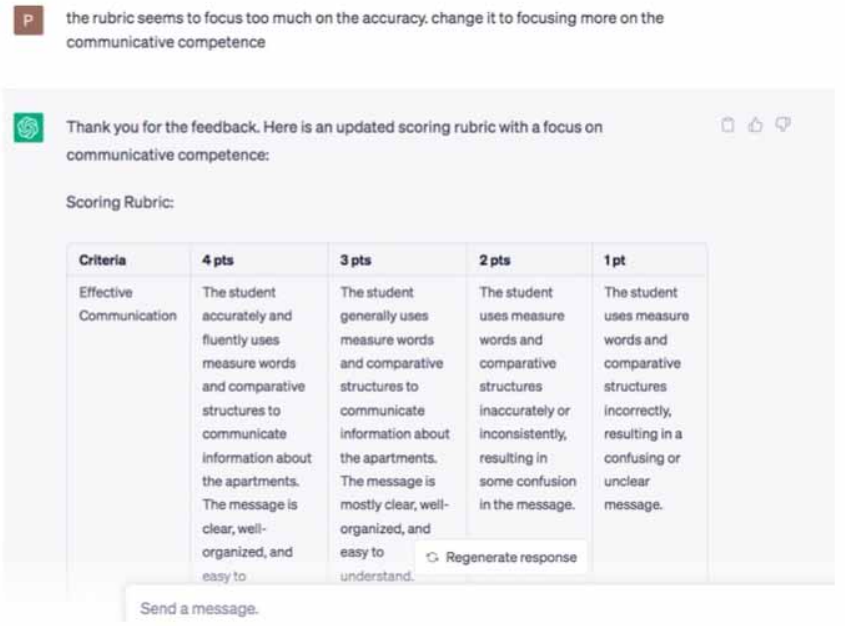


Table 5 is a summary of the exploration strategies used by individual participants.

These data indicate that knowledge of prompting is crucial for GSIs to understand the affordances of ChatGPT. Several participants tried to adjust the complexity of prompts by engaging in self-reflection, providing informative input, and giving feedback. They sought to determine how adjusting prompts influenced the quality of the generated responses. Others, however, opted for a single round of prompting and response for each task. For instance, in the case of participant P4, if an initial response was unsatisfactory, he proceeded to the next task and used a new prompt rather than revising the current one. In the case of participant P3, he chose to refine his prompts until he was satisfied with the response. The depth of one's exploration thus affects one's perceptions of ChatGPT and the integration thereof into teaching.

RQ2: How Do GSIs Perceive the Affordances and Constraints of ChatGPT in Language Teaching?

As GSIs continued their exploration, they developed a deeper knowledge of ChatGPT's viability as a tool in language teaching. The GSIs' perceptions regarding the affordances and constraints of ChatGPT in language teaching varied. Some recognized its affordances, such as the ability to generate ideas and texts and assist in certain teaching tasks, but other participants identified some limitations.

Perceived Affordances of ChatGPT

1. **Idea generation:** Participants praised ChatGPT's ability to generate ideas, specifically ideas on how to teach specific skills, and classroom activities for certain topics. In their opinion, ChatGPT can provide some general guidance and ideas, which can spark inspiration. For example, P1 opined that "One of the benefits of using ChatGPT is that it can help individuals who are not experts in a specific field to gain an overview of the knowledge" (P1, reflection). Similarly, P5 noted that "I enjoyed using ChatGPT to help brainstorm because it helped me think of all my options by giving me general synopses of the fields/topics I asked about" (P5, reflection).
2. **Text analysis and generation:** Participants found ChatGPT to be effective in extracting keywords and grammar patterns from a given text. They also noted its ability to generate sentences for target grammar (P2, P3, P4) or to provide grammatical explanations (P3). Several participants asked ChatGPT to generate dialogues or narratives according to specific prompts (P2, P5). For example, P3 first prompted ChatGPT to create a dialogue regarding paying for a meal and further prompted it to generate several modifications of the conversation either by adding complications to the scenario or adjusting the language difficulty level. He also instructed ChatGPT to develop several comprehension questions for the dialogue. This highlights the potential of using ChatGPT for text-based activities in language teaching.

Table 5. Exploration strategies used by the individual participant

	A Role Models	B Reflect on Strategies of Writing Prompts	C Break Down Tasks	D Provide Informative Input	E Give Feedback	F Start Over When Reaching Its Memory Capacity
P1	X	X			X	
P2		X	X	X	X	X
P3	X	X		X		
P4						
P5	X				X	

* Note: "X" indicates that the participant employed the particular technique.

In addition to creatively generating content and activities, several participants (P1, P3) were also pleasantly surprised by ChatGPT's ability to undertake mechanical tasks, such as creating tables. In her opinion, this function "allows me to focus more on the content I need to teach and less on paperwork" (P1, reflection). Another participant opined, "I believe ChatGPT shines most when it is asked to do rather mechanical tasks such as generating customized handouts, worksheets, grammar explanations, glossaries, and dialogues" (P3, reflection).

Perceived Constraints of ChatGPT

1. **Error correction:** Several participants used ChatGPT for grammar-related activities but quickly realized its limitations regarding grammatical accuracy. For example, one participant (P3, reflection) tested ChatGPT's error-correction ability by using some ungrammatical sentences, as shown below (Figure 6). In Chinese, adjectives can be modified by adverbs either preceding or following the verb. This sentence is ungrammatical because it contains adverbs in both positions. However, ChatGPT failed to identify the error (see Box 1).

Even after the participant pointed out the error, ChatGPT still stated that the sentence was grammatically correct (Figure 7).

When experimenting with some other grammar elements such as the descriptive complement marker 得 (DE), P3 noticed similar problems. Therefore, he expressed some skepticism toward the technology: "In my view, that ChatGPT did not catch these errors means it is not yet reliable enough to be used to correct students' work" (P3).

P2 asked ChatGPT to generate a passive voice practice worksheet regarding the grammar point BEI (被; Figure 8). The sentences generated by ChatGPT cannot be transformed into the passive voice in Chinese.

2. **Adjustment of language difficulty level:** Another limitation that participants identified was ChatGPT's poor ability to adjust the language difficulty level. When she requested ChatGPT to simplify the language in the generated texts a couple of times, P2 noticed that some words were

Box 1.

*他	很	聪明	极了。
TA	HEN	CONGMING	JILE
He	very	smart	extremely

Figure 6. Errors in ChatGPT-generated Response 1

Figure 7. Errors in ChatGPT-generated Response 2

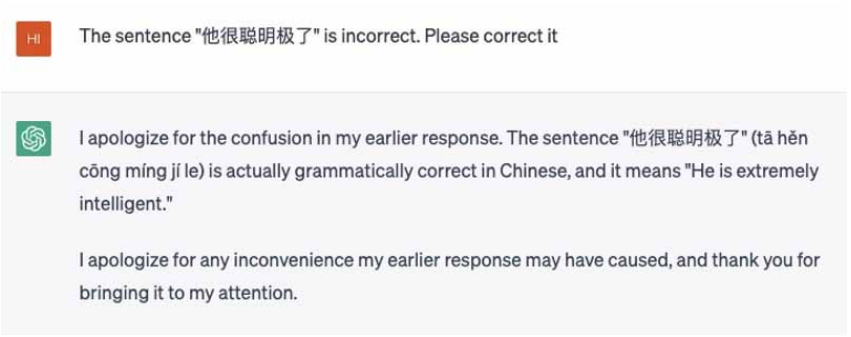
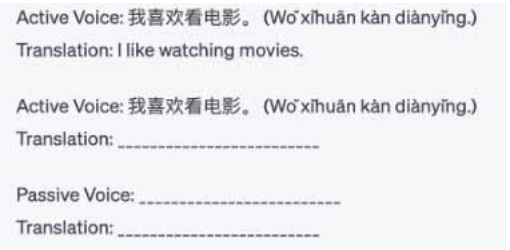


Figure 8. Errors in ChatGPT-generated Response 3



simplified while others were not. She stated in her reflection that "GPT does not have a clear grasp on what vocabulary is suitable for different levels of proficiency." P3 asked ChatGPT to categorize selected vocabulary according to the levels of the Hanyu Shuiping Kaoshi (HSK), a standardized Chinese language proficiency test. ChatGPT erroneously classified 承担 (to undertake) as a Level 2 word, when in reality, it is a Level 5 word. The experiences of both P2 and P3 suggest that ChatGPT still has a limited capacity with grammatical and lexical classification in Chinese.

Instructors' perceptions are also related to the degree of their engagement with ChatGPT. During the pre-interview, several participants expressed a conservative attitude toward ChatGPT. However, as the GSIs engaged more in exploring ChatGPT, they became more likely to develop a positive attitude toward it. Notably, one participant (P4) did not adopt any of the recommended strategies during the exploration stage. The lack of engagement likely contributed to and further consolidated his negative perception of using ChatGPT in language teaching, as he may not have experienced the benefits or opportunities for improvement that other participants encountered when using ChatGPT. In his reflection, P4 wrote that "ChatGPT gave a very generic suggestion to my question, which pushed me back to believing that it is only good for checking the grammatical and semantic content of a text" (P4, reflection). As a result, his integration of ChatGPT was limited (further detailed in the discussion of RQ3).

These findings reveal that participants recognized ChatGPT's ability to generate ideas and aid in the development of lesson plans and teaching materials. Yet, they also observed its limitations in grammatical accuracy and ability to adjust language difficulty. Some of ChatGPT's advantages are to provide automated feedback for students and to generate content that is appropriate for learners'

language proficiency. The perceived constraints may affect GSIs' willingness to integrate ChatGPT in their teaching.

Such limitations may not be exclusive to the Chinese language. Similar challenges have been observed in other languages, in particular non-Romanized languages (e.g., Li et al., 2023a; Kohnke et al., 2023). This suggests that these constraints may not be language-specific but may rather be inherent limitations of ChatGPT, regardless of the language, which suggests that instructors need to develop technological knowledge to understand these constraints when considering adopting ChatGPT for language teaching. This finding further underscores the importance of teachers' CK and PK when integrating technology.

RQ3: How Do GSIs Plan to Incorporate ChatGPT in Language Teaching?

This research question was focused on how GSIs' TK is integrated with the constructs of CK and PK. Specifically, we intended to investigate whether TK is separate from CK and PK, or if these constructs intersect with each other in the form of TCK, TPK, and TPACK.

The participants' perceptions of ChatGPT's capabilities and limitations influenced their proposed incorporation of the tool in their teaching, as evidenced in the lesson plans. Close analysis (Table 6) revealed participants had an interest in content-centered integration but limited pedagogical integration. The focus of GSIs' engagement with ChatGPT primarily involved generating instructional materials for teaching specific language content. For example, P2 used ChatGPT-generated sentences to support grammar instruction. P3 generated a sample dialogue of an awkward dining scenario to be used as a preview assignment. Notably, these teachers did not just adopt the generated content as given. Instead, they modified the content to better suit the learning needs. P5 chose not to use a ChatGPT-generated email because the content became too simple when she prompted ChatGPT to make the language simpler. Overall, the participants seem to have relatively rich TCK.

In terms of pedagogy and technology integration, ChatGPT was used in a manner that minimally changed teaching and learning, which suggests GSIs' limited TPK. Only P4 asked students to interact

Table 6. Summary of content, pedagogy, and technology in proposed lesson plans

	Content/Skill Focus	Pedagogy Employed	How GPT Is Used in Lesson	Student or Teacher Use
P1	Vocabulary (furniture, room layout) Grammar (measure words, comparative structure) Speaking-focused	Task-based language teaching (TBLT)	Generate a lesson plan (TPACK) Generate in-class activities (TPK) Generate grading rubrics (TCK)	Teacher use
P2	Grammar (passive marker BEI) Grammar focused	Grammar translation	Generate sentences for a conversion and translation activity (TCK) Generate a diary entry concerning luggage being lost with BEI (TCK)	Teacher use
P3	Grammar (prepositional phrase "impression of") Speaking focused	Task-based language teaching (TBLT)	Generate ideas for group activities to practice a sentence pattern ("impression of" …) (TPK) Generate an "impression of" survey handout (TK) Generate character profiles for the group activity (TCK) Generate a list of awkward situations for students to act out and resolve (TPK) Generate a sample dialogue for an awkward dining scenario to be used as a preview assignment (teacher made modifications by simplifying the language; TCK) Generate comprehension questions for the aforementioned dining conversation and text (TCK)	Teacher use
P4	Vocabulary ("be good at") Speaking-focused	Traditional sentence building	Generate sentences for the target vocabulary (TCK) Check students' use of the target vocabulary (TPK)	Student use
P5	Pragmatics (request a leave of absence) Writing-focused	Communicative approach	Generate ideas for teaching pragmatics (TCK) Generate writing sample (however, it was not used; TCK)	Teacher use

with ChatGPT during class (i.e., generating sentences with target vocabulary and checking the grammar of students' written responses). In other words, the participants recognized the value of ChatGPT in preparing instructional materials and planning lessons, but they did not perceive ChatGPT as a real-time tool for engaging students or enhancing interaction among students. As a result, the current adoption of ChatGPT was more teacher-centric than student-centric. Also noteworthy is that none of the instructors considered ChatGPT as a possible interlocutor with whom students might communicate with. In P4's case, students would work in pairs to compare the ChatGPT-generated responses and negotiate meanings. In other words, ChatGPT was perceived as not yet capable of replacing human interaction in language classrooms.

Regarding the intersection of CK, PK, and TK, only one case of emerging TPACK was noted. Drawing on the TPACK development model in Niess et al. (2009), we analyzed the development level of GSIs in relation to the theme of teaching. Most of the participants seemed to be at the accepting stage—they used ChatGPT in a facilitating or supplementary role in language teaching and learning. P2 stated in her reflection, "I do not believe that it can grasp the specific needs of your students. It is not aware of the level of your students and will never know the curriculum you are following." P1 was an exception, prompting ChatGPT to design a lesson plan on the topic of renting an apartment using the TBLT approach (Figure 4). With detailed information on the teaching context and learning goals, ChatGPT generated a lesson plan that included several stages (e.g., warm-up, target language teaching) and activity ideas for each stage (e.g., comparison activity, information gap). P1 initially adopted the lesson plan and then made further modifications. ChatGPT served a primary role in P1's teaching design, including in the areas of design (i.e., generating an overall lesson plan), implementation (i.e., refining activity ideas), and assessment (i.e., creating grading rubrics).

As Olphen (2008) stated, TPACK is "not an extension or appendix of content, pedagogy, and technology but rather a complex form of knowledge that blends all three components and the dynamic relationships that exist among them" (pp. 116–117). The current practices of the GSIs indicated an integration of technology mainly with content and occasionally with pedagogy. The minimal overlap of the three constructs means that GSIs still need to develop strategic thinking regarding how to appropriately utilize domain-specific knowledge and strategies to effectively guide student learning with technology (Niess, 2011).

DISCUSSION

Olphen (2008) contended that teachers' knowledge and their ability to integrate technology into their pedagogy are intricate and multidimensional phenomena (p. 117). Investigating GSIs' exploration, perception, and use of ChatGPT is essential to identify the knowledge gaps that may hinder teachers from fully leveraging their potential in language teaching and learning.

This preliminary study revealed that instructors draw on various aspects of knowledge to explore and integrate ChatGPT. Similar to previous studies (Chai et al., 2013; Manfra & Hammond, 2008), we determined that teachers' CK and PK influence their technology use. To be specific, TCK was explicated in GSIs' lesson planning. As indicated earlier, many instructors considered using ChatGPT to generate instructional content. The versatile capabilities of ChatGPT offer teachers numerous opportunities to utilize it for teaching various facets of language. For example, the readings provided by ChatGPT can serve as templates or sample texts for teaching specific genres. The conversations generated by ChatGPT can serve as exemplary models to help students grasp the concepts of turn-taking and the use of discourse markers in communication. Yet, teachers' content knowledge still plays a critical role when it comes to evaluating the quality and appropriateness of ChatGPT-generated materials.

Teachers may try to use ChatGPT for teaching, but they may not fully explore its technological capabilities. Their TK of ChatGPT seems to be focused on basic functionalities, such as generating text or providing information, rather than leveraging more advanced features for pedagogical purposes.

In line with previous research on preservice teachers (e.g., Lei, 2009; So et al., 2012), the present research demonstrated that GSIs are confronted with the challenge of how to incorporate more advanced technologies in teaching. The participants recognized ChatGPT's flexibility and generative nature, but not all of them understood that "the quality of the output often reflects the quality of the input provided" (Mishra et al., 2023, p. 6). In addition, participants who failed to engage in a conversation-like interaction with ChatGPT (e.g., they only engaged in a single round of prompting and response for each task) also expressed some dissatisfaction with the tool. Recognizing ChatGPT's social nature may help GSIs generate higher-quality responses.

The results indicated that GSIs may need to expand their pedagogical knowledge. Similar to the findings of previous studies on technology use in language learning (Tseng et al., 2022), the present study revealed that GSIs' current use of ChatGPT tends to be teacher-centered rather than student-centered. ChatGPT is perceived to be and is used more as a tool to facilitate instructional material development than to provide personalized learning experiences, empower learners to adapt their learning, or enrich learning opportunities (Huang et al., 2023). GSIs can further explore the use of ChatGPT for assessments. The participants in this study did not seem to strongly consider the possibility of students relying on ChatGPT to answer grammatical questions or generate written content, which may impact the accuracy of assessments. To address this issue, Xiao et al. (2023) recommended focusing on learners' creative skills in language learning to extend assessments beyond linguistic proficiency. Thus, enhancing novice teachers' PK may facilitate more creative and effective applications of ChatGPT.

The TPACK framework also suggests that technology-supported teaching is not simply a matter of adding technology to an existing teaching context; rather, it involves teachers' awareness and understanding of a dynamic, transactional relationship between three varieties of knowledge, namely TK, PK, and CK (Mishra & Koehler, 2006). The development of TPACK is not limited to the stage when instructors first explore a new technology but should occur throughout all the aspects of teaching practice. TPACK comes about through an iterative cycle that involves teachers building upon their previous knowledge and experiences to constantly refine and expand their understanding of technology—in the present case, ChatGPT's capabilities.

ChatGPT has the potential to be used as a tool for teaching and learning different language skills in various pedagogical contexts, whether in a meaning-focused approach (e.g., communicative language teaching, TBLT) or a form-focused approach (i.e., grammar translation). However, the current version of ChatGPT is limited in terms of generating accurate grammar and adjusting language levels in Chinese. Xiao et al. (2023) also determined that ChatGPT has not been well trained with large data in classical Chinese and may fabricate answers. Such findings suggest that although ChatGPT can serve as a valuable tool, it does not replace the need for teachers' professional judgment and expertise in developing effective teaching materials.

This study also indicated that GSIs' self-learning experiences play a crucial role in their incorporation of ChatGPT. Their exploration of the functionality of ChatGPT was a dynamic and multifaceted process. GSIs engaged in a continuous cycle of exploration and identified new capabilities, experimented with different approaches, adapted their strategies, and advanced their understanding.

LIMITATIONS AND IMPLICATIONS

This study has a few limitations. A primary one is the study's small sample size of only five participants, which may have limited the study's ability to represent the diverse experiences and perceptions of novice teachers or GSIs regarding ChatGPT. Future research could aim to address this limitation by including a larger and more diverse participant pool to yield a more comprehensive understanding of the topic. The sample size may have limited the generalizability of the results, but the participants were representative of GSIs in the Chinese teaching field at US colleges. Second, the study's limited exploration period might not have captured the full range of challenges and

benefits that may arise with extended use, and as AI technologies evolve, the findings may quickly become outdated. The preliminary nature of this research suggests the importance of continued, more extensive investigations into how teachers' knowledge and learning experiences influence AI technology utilization in education.

The research also yields important implications. It underscores the need for teacher training programs to effectively train educators to integrate AI technologies such as ChatGPT into their teaching practices. The study also highlights the necessity for educators, both pre- and in-service teachers, to commit to updating their knowledge and reflect on how integrating emerging technologies can affect what they teach and how they teach language.

CONCLUSION

This study makes a significant contribution to the field by revealing how novice language teachers explore, perceive, and utilize ChatGPT. First, GSIs employ various strategies to explore the affordances of ChatGPT, such as referring to role models and reflecting on their prompts. Their ability to generate appropriate prompts in the exploration stage emerged as a crucial component of teachers' TK. The GSIs generally held positive perceptions of ChatGPT's affordances, including its capacity to generate ideas, text, grammar exercises, and comprehension questions. However, they also noted some constraints of ChatGPT, some of which are inherent to its nature (e.g., generating fabricated answers) and some of which are specific to the Chinese language. Last, an analysis of the GSIs' lesson plans further revealed how their TK intersected with CK and PK. Our findings revealed content-centered integration, limited pedagogical integration, and minimal intersection among the three constructs.

ChatGPT's multifaceted characteristics offer both opportunities and challenges within the TPACK framework. The present findings highlight the importance of providing targeted training to empower language teachers to maximize the potential of using ChatGPT as a valuable instructional tool; in particular, teachers must be able to comprehend ChatGPT's decision-making process for informed task selection and to employ efficient methods of prompting. By developing their knowledge through continuous self-exploration and training support, teachers can better adapt to and embrace innovative tools such as ChatGPT for language teaching.

COMPETING INTERESTS

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APPENDIX A

Pre-Questionnaire

1. What is your current level of education?
2. What is your major and/or area of study?
3. What is your teaching experience in Chinese language instruction? Please provide the following details for each course you have taught:
    a. Proficiency level (e.g., beginner, intermediate, advanced)
    b. Type of course (e.g., lecture, drill, culture course, tutor)
    c. Number of years taught
4. What is your native language?
5. What foreign language(s) are you proficient in and comfortable teaching?
6. What is your overall familiarity with technology and your training background?
7. What types of technology do you use in your daily life or work?
    a. Computers (desktops, laptops, tablets)
    b. Mobile devices (smartphones, tablets)
    c. Software applications (Microsoft Office, Adobe Creative Suite)
    d. Internet browsers (Chrome, Firefox, Safari)
    e. Social media platforms (Facebook, Twitter, Instagram)
    f. Video conferencing platforms (Zoom, Microsoft Teams, Google Meet)
    g. Learning management systems (Canvas, Blackboard, Moodle)
    h. Online language learning platforms (Duolingo, Rosetta Stone)
    i. Digital whiteboards or presentation tools (Smartboard, PowerPoint)
    j. Cloud-based storage and collaboration tools (Google Drive, Dropbox)
    k. Project management software (Asana, Trello)
    l. Virtual reality or augmented reality tools
    m. Chatbots and virtual assistants (Siri, Alexa, Google Assistant)
    n. Natural language processing (NLP) and speech recognition software (Dragon, Google Speech-to-Text)
    o. Recommendation algorithms (Netflix, Amazon)
    p. Image and facial recognition software (Google Photos, Facebook)
    q. AI-powered writing assistant (Grammarly, Ginger)
    r. Generative models (ChatGPT-3/4, DALL-E, NewBing)
8. On a scale of 1 to 5, how familiar are you with ChatGPT or other AI language technologies? (1 = *not at all familiar*, 2 = *slightly familiar*, 3 = *moderately familiar*, 4 = *very familiar*, 5 = *extremely familiar*)
9. How often do you use technology in your Chinese language instruction? Please select the most appropriate response:
    a. Never
    b. Rarely
    c. Occasionally
    d. Frequently
    e. Almost always
10. List the three technologies you most frequently use: _____
11. Have you received any formal training in the use of technology for language teaching?
    a. Yes, extensive training (e.g., certificate, degree)
    b. Yes, some training (e.g., workshop)
    c. No, but I have informally learned on my own (e.g., online videos)
    d. No, and I have not learned on my own
12. On a scale of 1 to 5, how confident are you in your ability to effectively incorporate ChatGPT in your teaching? (1 = *not at all confident*, 2 = *slightly confident*, 3 = *moderately confident*, 4 = *very confident*, 5 = *extremely confident*)

APPENDIX B

MA Course Assignment on GPT

Technology Assignment (10%)

For this assignment, propose how you plan to incorporate ChatGPT in your language teaching. In your written report, include the following aspects, as well as screenshots of your chat record:

- Target audience: Who is the target audience for your lesson plan? Is it intended for beginners or more advanced learners of the language?
- Objectives: What are the specific learning objectives of your lesson plan? Are you trying to improve the students' speaking, listening, writing, or reading skills? Their cultural and pragmatic skills? Or are you targeting specific language forms or language functions?
- Activities: How will you incorporate ChatGPT into your teaching? For example:
  - Use ChatGPT to prepare for a lesson and design activities
  - Use ChatGPT to provide feedback to students and evaluate students' work
- Reflection:
  - Narrate your exploration process, and provide evidence in the form of a chat history.
  - If you have used ChatGPT before, please share some screenshots.
  - How did you explore the functions of ChatGPT?
  - What were the challenges and benefits of using this technology? Would you use it again in the future? Why and why not?
  - How has your ability to use ChatGPT changed after completing this assignment? In what areas do you hope to receive more training and support?
    (The above prompt and examples were created on the basis of ChatGPT-generated responses.)

Yingling Bao is a senior lecturer in the Department of East Asian Languages and Cultures. She earned her PhD degree in Literacy, Culture, and Language Education from Indiana University Bloomington. Trained in the field of language education, in particular teaching Chinese as a second language, she continues to adopt innovative pedagogical approaches in language teaching. Her research focuses on the social aspects of language learning and teaching, as well as integration of technology. Her recent work on online language teaching can be found in the Journal of Technology and Chinese Language Teaching.

Belle Li is a Dean's full scholarship doctoral student studying Learning Design & Technology at Purdue University. She obtained a master's degree in Instructional Systems Technology, Indiana University Bloomington. After graduation, she worked for the Chinese flagship program at Indiana University for three years, teaching and managing the tutoring program. Her research focuses on the development and integration of instructional methods and technologies including Web applications, virtual reality, augmented reality, and mixed reality for collaborative, contextual, experiential, and authentic learning experiences in blended and online learning environments. She designed and developed a mobile application, TIC APP, available for download on the App Store.