



Ready for flipped foreign language teaching? Understanding K-12 teachers' flipped language teaching readiness and its relationship with perceived anxiety and self-efficacy

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Abstract

While the crucial role of teacher readiness in technology-assisted teaching and learning has been well documented, studies on K-12 language teachers' teaching readiness in the flipped classroom remain relatively few. Informed by the technological pedagogical content knowledge (TPACK) and technology acceptance (TAM) theories, the current research examined K-12 language teachers' flipped teaching readiness and its relationships with perceived anxiety of flipped teaching and teacher self-efficacy. Data were drawn from 489 K-12 pre-service and in-service Chinese language teachers. The findings showed that teacher participants reported a generally high level of flipped language teaching readiness, with gender differences only existing among pre-service language teachers' flipped teaching readiness. Teacher self-efficacy was found to be significantly related to both pre-service and in-service language teachers' flipped language teaching readiness, while perceived anxiety of flipped teaching was not associated with flipped language teaching readiness. The findings of this research shed light on how K-12 language teachers' flipped teaching readiness can be enhanced in language education.

Keywords Flipped teaching readiness · Perceived anxiety · Teacher self-efficacy · Structural equation modeling

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Introduction

In recent years, technology-integrated language teaching has become increasingly popular, such as mobile-assisted language teaching (Nie et al., 2020), online teaching (Huang et al., 2021; Luo & Zou, 2024a), language classrooms with extended reality (Luo et al., 2024), AI-based teaching (Luo & Zou, 2025a), and flipped language classrooms (Luo & Zou, 2024b). Flipped teaching is a learner-centered pedagogical approach that reverses the traditional roles of teachers and students in the classroom (Bergmann & Sams, 2012; McLaughlin et al., 2014). In the flipped classroom, the typical structure of delivering new content during class time is flipped, allowing students to engage with learning materials, such as online videos, recorded lectures, or pre-class assignments before attending class. This approach encourages students to take more responsibility for their learning outside of the classroom, preparing themselves to engage actively during face-to-face sessions (Bergmann & Sams, 2012; Hung, 2018; Luo & Zou, 2025b; Zou et al., 2022).

During face-to-face classes, which are utilized for collaborative and interactive language learning activities, students can actively participate in discussions, group work, problem-solving tasks or multiple activities to deepen their understanding of the material (Chuang et al., 2018). Language teachers can then assess students' understanding, address misconceptions, and provide targeted, real-time feedback to enhance learning (Joo et al., 2018). To create a technology-friendly language teaching environment using the flipped mode, it is essential to assess whether language teachers are equipped with the necessary technological skills and pedagogical knowledge to manage both the online and in-class components in the flipped context. Therefore, evaluating language teachers' readiness to embrace flipped teaching can help understand how they effectively integrate this mode into their teaching practices.

Additionally, understanding the factors that may influence both pre-service and in-service language teachers' readiness for flipped teaching is crucial for designing teacher training programs and workshops. The technology acceptance model (TAM) is an important theory that has been widely used in research on individuals' behavior regarding information and technology integration (Davis, 1989). As suggested by the technological pedagogical content knowledge (TPACK) proposed by Mishra and Koehler (2006), it is significant for teachers to develop a comprehensive knowledge of teaching content, knowledge, and technology, which is required in the new era of teaching environments in the twenty-first century (Joo et al., 2018; Zou et al., 2022).

Although existing studies have explored teachers' anxiety and self-efficacy in online teaching or flipped teaching, relatively little empirical research has paid attention to the relationships between language teachers' readiness, perceived anxiety, and teacher self-efficacy. It is revealed that language teachers experienced technology anxiety in online teaching (Huang et al., 2021). Compared to online teaching, flipped teaching would be more difficult as flipped language teaching requires teachers to prepare students to acquire learning content online in the preview section through multimedia while requiring teachers to design various activities or discussions to check learners' learning conditions to provide them with appropriate and immediate guidance in the face-to-face classroom (Hung, 2018; Luo & Zou, 2025b; Zou et al., 2022). Those English teachers with higher levels of self-efficacy were found to

be more willing to adopt the flipped teaching approach, even when they faced challenges in the flipped classroom (Jiang et al., 2021). As highlighted in the existing literature, language teachers sometimes experience perceived anxiety and self-efficacy in flipped teaching (Jiang et al., 2021), which might affect their implementation of flipped language teaching. This calls for more research on understanding language teachers' preparation and its relationships with teachers' psychological factors (Hsu & Lin, 2022; Joo et al., 2018). Grounded on the previous studies, existing empirical support, and the TPACK framework and TAM theory, this current research aimed to understand both K-12 pre-service and in-service language teachers' flipped teaching readiness and investigate the structural relationships between perceived anxiety of flipped teaching, teacher self-efficacy, and flipped language teaching readiness. The results and implications of this research might contribute to helping design training programs to better prepare both K-12 pre-service and in-service language teachers for flipped teaching.

Literature review

Flipped language teaching

Flipped teaching has gained significant attention in recent years, sparking engaging debates among educators and researchers (Chou et al., 2020). This innovative approach fundamentally transforms the nature of classroom activities (Bergmann & Sams, 2012) by requiring language educators to integrate multimedia into in-person teaching activities (Chuang et al., 2018) while simultaneously providing instructional materials for students to preview online (Bergmann & Sams, 2012). Through this mode, learners are expected to acquire foundational knowledge before class, allowing classroom time to be dedicated to higher-order thinking tasks, collaborative activities, and interactive discussions (Luo & Zou, 2024b).

Language teachers, particularly those teaching in K-12 settings, play a pivotal role in implementing the flipped classroom mode (Jiang et al., 2021). Acting as both organizers and facilitators, they are responsible for planning engaging content, designing effective multimedia materials, and creating interactive in-class activities (Jiang et al., 2021). Moreover, they need to develop pedagogical strategies to support students' independent learning and monitor their language learning progress (Huang et al., 2021). This multifaceted role requires teachers not only equip themselves with sufficient pedagogical knowledge but also technological competence to manage both online and offline teaching sections effectively (Hung, 2018). Therefore, understanding K-12 language teachers' readiness for flipped teaching, including their technological and pedagogical content knowledge as well as their perceived acceptance of technology seems crucial. Since the transition from traditional language teaching to flipped teaching entails fundamental changes in instructional practices, it may significantly influence teachers' emotions and psychological well-being (Luo & Zou, 2025b). Research also indicated that the challenges associated with flipped teaching led to increased anxiety and reduced self-efficacy compared to traditional methods (Jiang et al., 2021).

Technological pedagogical content knowledge (TPACK)

The theory of TPACK has been defined as teachers' management of professional knowledge for designing and implementing technology-enhanced instruction (Yeh et al., 2021). Shulman (1986) proposed the Pedagogical Content Knowledge (PCK) that conceptualized two separate entities: content knowledge and pedagogy knowledge (Oakley, 2020). Based on PCK, the TPACK framework was put forward by Mishra and Koehler (2006), which constructed the interplay and overlaps among technology, content, and pedagogy.

To be more specific, the TPACK framework contains seven dimensions: technological knowledge (TK), content knowledge (CK), pedagogical knowledge (PK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK), and technological pedagogical content knowledge TPACK (Mishra & Koehler, 2006). TPK, TCK, and TPACK show the essential pedagogical aspects of the TPACK theory, while TK only demonstrates knowledge in the technological area (Schmidt et al., 2009). Furthermore, in this research, TPK refers to language teachers' perceptions of utilizing particular teaching strategies integrated with technologies in the language classroom. TCK underscores language teachers' perceived use of multiple technologies in flipped teaching. TPACK is concerned with language teachers' understanding of the interaction among technology, pedagogy, and content in flipped teaching.

Previous research indicated that teachers' technological pedagogical content knowledge is positively associated with teacher self-efficacy, perceived ease of use, perceived usefulness of technology, and intention to use technology (Joo et al., 2018). Those who owned higher degrees of TPACK tended to find it easier to utilize technology and would perceive educational technology as a helpful teaching tool (Yang et al., 2021). According to Mishra and Koehler (2006) and Angeli and Valanides (2009), technology is only helpful when teachers combine its advantages with the subject content and relevant teaching pedagogies. In flipped language classrooms where language students engage with learning materials previous to class or apply knowledge in class, language teachers' abilities to integrate technology, pedagogy, and language teaching content become essential for successful flipped classrooms (Jiang et al., 2021). Hence, the involvement of the investigation of language teachers' technological pedagogical and content knowledge in flipped language teaching seems necessary.

Technology acceptance model in education

The technology acceptance model has been applied in numerous studies as the theoretical framework to investigate teachers' intentions regarding the use of technology (Huang et al., 2021; Scherer et al., 2019). As argued by Teo (2012), the constructs in the technology acceptance model were significant in explaining teachers' intention to technology use.

The technology acceptance model encompasses psychological factors that affect individuals' technology acceptance. Based on Davis (1989), perceived usefulness refers to individuals' beliefs that utilizing a particular technology can enhance their

effectiveness in performing certain tasks, while perceived ease of use is defined as the perception of the effort required to use specific technologies. Research has demonstrated that perceived usefulness and perceived ease of use significantly predicted technology adoption (Liu et al., 2019). The relationships between perceived usefulness (PU), perceived ease of use (PEU), attitude (A), and behavioral intention (BI) to use technology have been specified in the technology acceptance model. In this model, behavioral intention to use technology is considered a critical factor in determining actual technology or system usage (Teo, 2012). As proposed by Davis (1989), behavioral intention is influenced by attitudes toward usage, perceived usefulness, and perceived ease of use. Moreover, both perceived usefulness and perceived ease of use jointly affected attitude, while perceived ease of use also had a direct impact on perceived usefulness (Teo, 2012).

Numerous studies have provided evidence for the relationships among perceived usefulness, perceived ease of use, attitude toward computers, and behavioral intention in the technology acceptance model (e.g., Huang et al., 2021; Scherer et al., 2019). In the research domain of language education, previous research has also pointed out that both perceived usefulness and perceived ease of use influenced learning that integrated with technologies, such as mobile learning, online teaching attitude, and behavioral intention (Hsu & Lin, 2022; Huang et al., 2021). Based on Liu et al. (2019), further research is encouraged to explore the relationships between the factors of the technology acceptance model in diverse educational settings and learning modes. Moreover, if language teachers perceived the technology as effective and easy to use, they were more likely to implement it effectively in online teaching (Huang et al., 2021). As the learning mode in flipped teaching also integrates technologies, it seems worthwhile to explore the role of technology acceptance in this educational context. The application of the technology acceptance model could provide valuable insights into how teachers perceive and integrate technology into flipped language practices, thereby enhancing our understanding of teacher readiness.

Perceived anxiety

Previous literature on flipped English teaching has pointed out that teachers have come across several challenges, including inadequate pedagogies and technologies (Kim et al., 2014) and materials preparation (Lee & Martin, 2020). The accumulation of these difficulties may lead to teachers' uncertainty and anxiety about flipped language teaching (Jiang et al., 2021), especially under the condition brought by post-COVID-19 where technical support might be insufficient.

According to Jon-Chao et al. (2012), technology anxiety is defined as a negative emotion that people experience fear during the use of technology. Huang et al. (2021) indicated that teachers might exaggerate technology anxiety in online teaching. Compared with face-to-face teaching or online teaching, flipped teaching is made more difficult. Flipped teaching requires teachers to prepare students to learn knowledge online in the preview section through multimedia, while in the physical classroom, teachers need to organize different types of activities or discussions to keep track of students' learning conditions to monitor their learning (Luo & Zou, 2025b; Zou et al., 2022). To perform flipped language teaching successfully, teachers should own

online technological competencies (Jiang et al., 2021) and teaching strategies (Luo & Zou, 2024b). These requirements seemed not easy because technology training offered for pre-service or in-service teachers may not be sufficient. Existing research showed that teachers would feel anxious or embarrassed when making mistakes. For example, performing the wrong operation that causes a system breakdown (Bervell & Umar, 2020) would waste class time, influence lesson delivery, and increase teachers' anxiety (Huang et al., 2021).

Perceived anxiety (PA) in this research refers to individuals' fear of using online technologies in the flipped language teaching, which is similar to Jon-Chao et al.'s (2012) and Huang et al.'s (2021) technology anxiety. The distinction between the definition of perceived anxiety in this research and technology anxiety used in Jon-Chao et al.'s (2012) and Huang et al.'s (2021) studies is whether the teaching is conducted in the flipped teaching context.

Many demographic characteristics, including gender, age, and experience with using technology, could cause teachers' anxiety (Papanastasiou & Angeli, 2008). As reported by Jiang et al. (2019), teachers' anxiety about technology utilization might be because they took technologies as a threat, which may influence their intention to implement the flipped model into English teaching (Jiang et al., 2021). In addition, some language teachers asserted that they were not comfortable with managing technologies and were likely to be anxious and nervous about the inaccessibility of online materials (Lee & Martin, 2020). Such challenges could lead to negative sentiments regarding the flipped teaching approach, diminishing language teachers' intention and readiness to adopt the flipped model, especially when they are required to spend additional time redesigning lessons and addressing accessibility and technical issues (Lee & Martin, 2020). Moreover, technical difficulties encountered during flipped teaching have been shown to increase teachers' anxiety (Lee & Martin, 2020). Given these challenges concerning teachers' perceived anxiety about the utilization of educational technologies in flipped teaching, as well as the critical role of technology integration in the flipped context, it is essential to understand how perceived anxiety shapes teachers' readiness for flipped teaching. Gaining such insights would inform professional development and support to enhance flipped language teaching practices.

Teacher self-efficacy

Self-efficacy has been identified as people's perceived ability to organize and implement behaviors to accomplish designated tasks (Bandura, 1977). Based on Gavora (2010), teacher self-efficacy refers to teachers' perceptions of their capabilities to design instructional plans and complete teaching objectives. Researchers have paid attention to the impact of self-efficacy on teacher behavior and found that teacher self-efficacy is one of the powerful indicators that affect teachers' behavior (Huang et al., 2021) since self-efficacy can facilitate the enactment of particular behaviors (Deci & Ryan, 2000). In flipped English teaching, Jiang et al.'s (2021) research revealed that those teachers with higher levels of self-efficacy were more inclined to implement the flipped teaching approach even when they faced challenges in the actual

flipped English teaching classroom. In this research, teacher self-efficacy refers to language teachers' perceived abilities to carry out flipped teaching.

Gender

Taking participants' gender into consideration in the descriptives analysis in this present study was inspired by the existing literature. Hung (2016) found that male teachers showed better learning-transfer self-efficacy than females regarding online learning readiness, while there were no significant differences by gender concerning the other three readiness aspects: communication self-efficacy, institutional support, and self-directed learning. Jiang et al. (2021) found that female English teachers outperformed males regarding the use intention of flipped teaching. However, whether gender plays a role in Chinese language teachers' flipped teaching readiness can still be learned.

Informed by the technology acceptance model, technological pedagogical content knowledge theory, and relevant literature, a model has been constructed to predict K-12 language teachers' readiness for flipped teaching as well as how it relates to perceived anxiety of flipped teaching and teacher self-efficacy (see Fig. 1). While prior literature on technology-assisted teaching (e.g., online teaching, mobile teaching) has demonstrated the essential role of perceived anxiety and teacher self-efficacy, no similar study has been conducted in the context of flipped language teaching. Previous studies have suggested future work to employ more variables to investigate teachers' flipped teaching readiness (Chou et al., 2020) and pay attention to language teachers' actual implementation of flipped teaching (Jiang et al., 2021). Therefore, this current research attempted to examine the relationship between perceived anxiety, teacher self-efficacy, and K-12 language teachers' readiness in flipped teaching. It aimed to contribute to understanding whether perceived anxiety and teacher self-efficacy supported in previous studies on mobile teaching or online teaching is also applicable to flipped teaching and provide pedagogical insights for improving K-12 pre-service and in-service language teachers' readiness for flipped teaching. This research hypothesized that:

This research sought to answer the following two research questions:

1. What is the level of K-12 language teachers' readiness for flipped teaching in mainland China?
2. Do K-12 language teachers' perceived anxiety of flipped teaching and teacher self-efficacy have significant relations with their readiness for flipped teaching?
3. Is there any difference in gender in terms of flipped teaching readiness among pre-service and in-service language teachers?

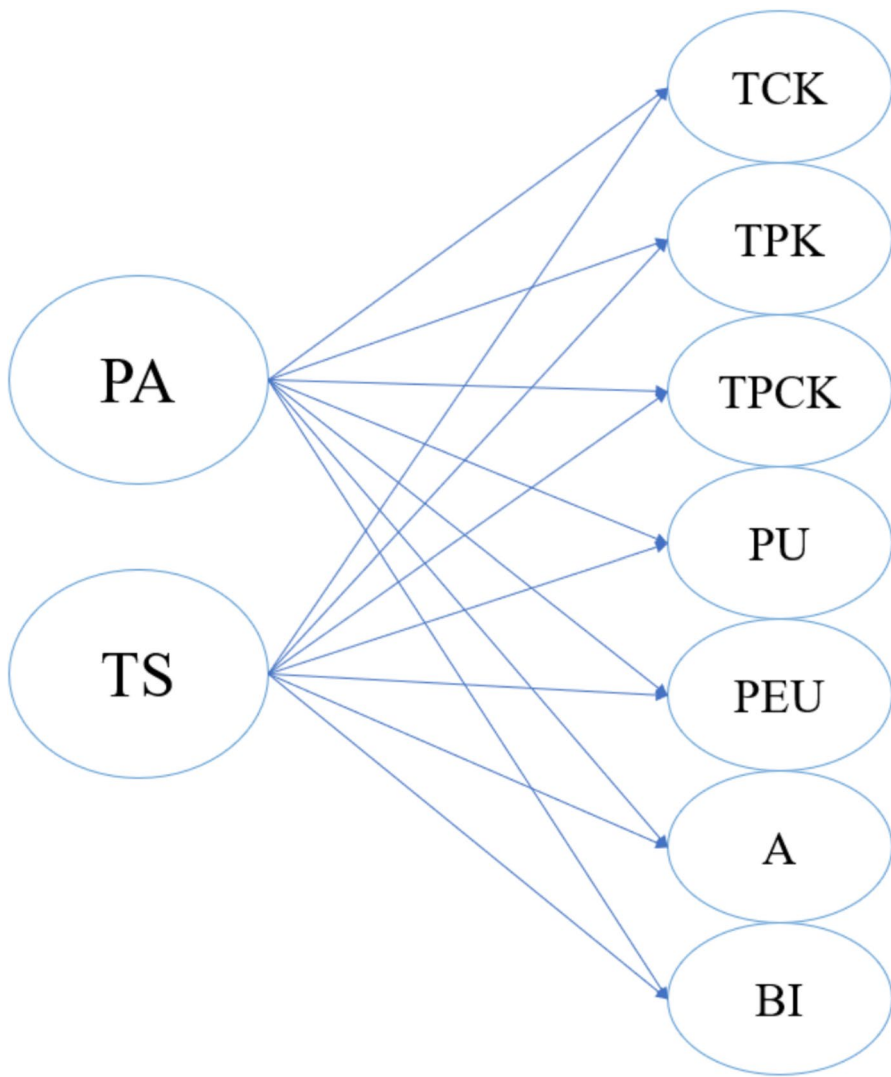


Fig. 1 The structural model for relationships among flipped teaching readiness, perceived anxiety of flipped teaching, and teacher self-efficacy. *PA* perceived anxiety; *TS* teacher self-efficacy; *TCK* technological content knowledge; *TPK* technological pedagogical knowledge; *TPCK* technological pedagogical content knowledge; *PU* perceived usefulness; *PEU* perceived ease of use; *A* attitude; *BI* behavioral intention

Methods

Participants

There were 489 valid participants who were K-12 foreign language pre-service and in-service teachers from Guangdong Province, Fujian Province, Zhejiang Province, and Shanghai through the online scales in mainland China in the fall of 2022. Par-

ticipants were selected using a random sampling technique to ensure representation from diverse tiers of schools, including primary, middle, and high schools, as well as from both pre-service and in-service language teachers. By employing this random sampling approach and recruiting language teachers from multiple regions and school types, the study aimed to enhance the generalizability of the findings and ensure a comprehensive understanding of K-12 foreign language teachers' readiness, perceived anxiety, and self-efficacy toward flipped teaching.

The respondents finished three questionnaires concerning their foreign language flipped teaching readiness, perceived anxiety of flipped teaching, and teacher self-efficacy. Of the teacher participants, there were 106 (21.7%) in-service elementary and secondary foreign language teachers and 383 (78.3%) pre-service language teachers from K-12 teacher education training programs. Among the 106 in-service teachers, 31 (29.2%) were primary school teachers, 31 (29.2%) were middle school teachers, and 44 (41.5%) were senior high school teachers with ages from 22 to 35 years. The teacher participants spoke Chinese as their first language, and they taught diverse foreign languages disciplines, such as English, Spanish, Japanese, French, and Russian. Males ($n=87$, 17.8%) were fewer than female participants ($n=402$, 82.2%). The in-service language teachers had approximately 6 years' teaching experience at average.

Measures

K-12 teacher readiness for flipped language teaching questionnaire (TRFLTQ)

To evaluate K-12 language teachers' flipped language teaching readiness, the K-12 Teacher Readiness for Flipped Language Teaching Questionnaire (TRFLTQ) with 20 items developed by Luo and Zou (2024b) based on the theory of technological pedagogical content knowledge and technology acceptance model has been directly used in this research. This scale has satisfactory psychometric properties confirmed through exploratory factor analysis and confirmatory factor analysis, with Cronbach's α of items ranging from 0.859 to 0.882.

Perceived anxiety for flipped language teaching questionnaire

To assess K-12 language teachers' perceived anxiety of flipped teaching, the four-item Perceived Anxiety for Flipped Language Teaching Questionnaire was adapted from Papanastasiou and Angeli's (2008) and Huang et al.'s (2021) perceived anxiety scales, which were used to evaluate teachers' perceived anxiety about technology use and online teaching, respectively. According to Huang et al. (2021), Cronbach's Alpha of the perceived anxiety scale was 0.833, with the composite reliability at 0.79, and the average variance extraction at 0.937. The adapted four items to evaluate teachers' perceived anxiety of flipped language teaching in this research were: *I feel apprehensive about flipped foreign language teaching. I hesitate to teach in the flipped foreign language classroom for fear of making mistakes that I cannot correct. Flipped foreign language teaching is intimidating to me. I experience fear when I think about flipped foreign language teaching.*

Teacher self-efficacy questionnaire

The four-item Teacher Self-efficacy Questionnaire by Venkatesh et al. (2003) and Lai et al. (2018) was directly used to measure K-12 language teachers' self-efficacy for flipped teaching. The four items designed by Venkatesh et al. (2003) and Lai et al. (2018) were: *I could complete the flipped teaching task if there was no one around to tell me what to do as I go. I could complete the flipped teaching task if I could call someone for help if I got stuck. I could complete the flipped teaching task if I had a lot of time to execute flipped teaching. I have sufficient ability to prepare teaching materials for the flipped teaching tasks in advance (such as recording videos and collecting educational resources on the Internet).*

According to Venkatesh et al. (2003) and Lai et al. (2018), the Teacher Self-efficacy Questionnaire contained four items with Cronbach's alpha from 0.880 to 0.941, confirmed average variance extracted at 0.847, and composite reliability at 0.957.

All the questionnaires in this current study were rated on a five-point Likert scale ("1 = completely disagree" to "5 = completely agree"). The items of the questionnaire have been written in English and translated into Chinese by the authors whose first language was Chinese and were experts in English education in order to make the questionnaire be easily comprehended by all K-12 language teachers. Both the English and Chinese versions of the questionnaire has been checked by the invited experts majoring in English and Chinese education to ensure the accuracy.

Data collection and analysis

The data was collected among voluntary pre-service and in-service language teachers using the Wenjuanxing Platform in semester of fall in 2022. Before the data collection, the teacher participants were informed of the research purpose, and consent forms from the participants were obtained. The participants were allowed to withdraw the research anytime they would like to. Then, participants were asked to complete the questionnaires that include personal information (age, gender, area, and school type) and items to assess their flipped language teaching readiness, perceived anxiety, and teacher self-efficacy.

The data from questionnaires were screened prior to data analysis, including the missing responses, normality, and homogeneity for bivariate and multivariate analyses. Missing data were examined through manual inspection, and a listwise measure was used via SPSS to remove these cases completely from data analysis.

To answer research question one, descriptive statistics, including means, standard deviations of participants' demographic characteristics, and their readiness for flipped teaching were calculated. Multivariate analyses of variance (MANOVA) were conducted to examine differences in gender in terms of flipped teaching readiness factors.

To examine the relationships between perceived anxiety of flipped teaching, teacher self-efficacy, and flipped language teaching readiness, Pearson correlation analysis and structural equation modeling were performed. As a common technique in quantitative research, structural equation modeling has been used via AMOS 26 to examine complex relations by using various types of data, including categorical,

dimensional, censored, and count variables (Wolf et al., 2013). Several model fit indices were applied to evaluate the adequacy of the model (Kline, 2015): chi-square statistic (χ^2), comparative fit index (CFI; > 0.90), the Incremental Fit Index (IFI; > 0.90), and standardized root-mean-square residual (SRMR; < 0.08).

Results

Descriptive statistics of flipped teaching readiness

The descriptive statistics among pre-service and in-service language teachers were demonstrated in Tables 1, 2, and 3. According to the classification of levels of self-reported scale data (Oxford, 1990), a mean value in the range of 1.0–2.4 was categorized as a low level, 2.5–3.4 as a medium level, and 3.5–5.0 as a high level. In general, the teacher participants maintained a high level of technological content knowledge ($M=4.451$), technological pedagogical knowledge ($M=4.021$), technological pedagogical content knowledge ($M=4.117$), perceived usefulness ($M=4.352$), and perceived ease of use ($M=3.843$), attitude ($M=3.996$), and behavioral intention ($M=3.911$).

MANOVA was conducted to compare the mean values of the flipped teaching readiness variables between gender among pre-service and in-service language teachers, respectively. There was a significant main effect of flipped teaching readiness factors

Table 1 Means among key variables of pre-service language teachers

	Pre-service Language Teachers								
	Mean								
	all participants	Whole sample	English	Chinese	Spanish	Japanese	French	Russian	others
TCK	4.451	4.416	4.246	4.286	4.073	4.203	4.5	4.25	4.25
TPK	4.021	3.999	3.981	4.048	3.982	4.063	4.083	4.167	4.292
TPCK	4.117	4.102	4.075	4.048	4.076	4.198	4.417	4.333	4.583
PU	4.352	4.313	4.313	4.286	4.253	4.324	4.917	4.5	4.5
PEU	3.843	3.79	3.756	4.048	3.658	4.027	4.417	4.333	4.333
A	3.996	3.961	3.975	3.929	3.787	4.054	4.438	4.375	4.406
BI	3.911	3.933	3.93	4.214	3.827	4	3.875	4.5	4.375
PA	3.056	3.099	3.176	3.143	2.607	3.324	3.438	2.875	4.094
TS	3.838	3.837	3.842	3.821	3.733	3.865	3.813	4.25	4.438

Table 2 Means among key variables of in-service language teachers

	Mean			
	Whole sample	English	Chinese	Japanese
TCK	4.575	4.659	4.167	4.292
TPK	4.101	4.094	4.296	4
TPCK	4.17	4.192	4.074	4.083
PU	4.494	4.506	4.556	4.361
PEU	4.035	3.992	4.074	4.306
A	4.123	4.097	4.083	4.333
BI	3.83	3.747	4.111	4.208
PA	2.903	2.882	2.861	3.083
TS	3.844	3.815	3.833	4.063

among pre-service language teachers (Wilks's $\lambda=0.888$, $p<0.005$, $F[20, 362]=2.29$, partial $\eta^2=0.112$). However, the difference in the flipped teaching readiness variables among in-service language teachers was not significant (Wilks's $\lambda=0.723$, $p>0.05$, $F[20, 85]=1.631$, partial $\eta^2=0.277$).

Relationship patterns between flipped teaching readiness, perceived anxiety, and teacher self-efficacy

The Pearson correlation results (see Table 4) showed that except for the insignificant relationship between perceived anxiety of flipped teaching, technological content knowledge, and perceived usefulness, variables were significantly and positively correlated with each other ($0.135 \leq r \leq 0.71$), with the strongest correlation between perceived usefulness and technological pedagogical content knowledge ($r=0.71$, $p<0.01$).

To further examine the relationship patterns between flipped teaching readiness, perceived anxiety, and teacher self-efficacy, the structural equation modeling using AMOS 26 was implemented. In terms of the structural model regarding the data of pre-service language teachers, the goodness of fit indices of the model indicated acceptable fit: $\chi^2=834.669$, $df=131$, $CFI=0.910$, $IFI=0.913$, $SRMR=0.061$. On the other hand, adequate model fit was found for the structural model of the part of data

Table 3 Descriptives statistics of gender among key variables of language teachers

	Pre-service Language Teachers				In-service Language Teachers			
	Male		Female		Male		Female	
	Standard		Standard		Standard		Standard	
	Mean	Deviations	Mean	Deviations	Mean	Deviations	Mean	Deviations
TCK	4.429	0.703	4.414	0.636	4.176	1.045	4.652	0.524
TPK	4.176	0.818	3.96	0.76	3.843	1.208	4.15	0.742
TPCK	4.276	0.69	4.063	0.711	4	1.112	4.202	0.736
PU	4.452	0.614	4.282	0.653	4.02	1.077	4.584	0.562
PEU	4.171	0.776	3.705	0.793	3.961	1.19	4.049	0.903
A	4.218	0.712	3.903	0.762	3.985	1.077	4.149	0.725
BI	4.114	0.869	3.893	0.826	3.676	1.089	3.86	0.882
PA	3.646	1.139	2.976	0.97	2.765	1.174	2.93	1.107
TS	4.089	0.715	3.78	0.658	3.838	1.027	3.846	0.717

Table 4 Correlation among key variables

	TCK	TPK	TPCK	PU	PEU	A	BI	PA	TS
TCK	1								
TPK	0.559**	1							
TPCK	0.574**	0.692**	1						
PU	0.598**	0.566**	0.710**	1					
PEU	0.372**	0.452**	0.522**	0.502**	1				
A	0.451**	0.552**	0.573**	0.552**	0.545**	1			
BI	0.389**	0.535**	0.509**	0.472**	0.428**	0.697**	1		
PA	0.054	0.175**	0.144**	0.082	0.194**	0.143**	0.135**	1	
TS	0.417**	0.567**	0.566**	0.513**	0.576**	0.552**	0.628**	0.259**	1

* $p < 0.05$ ** $p < 0.01$

concerning in-service teachers $\chi^2 = 373.935$, $\chi^2/df = 2.855$, CFI = 0.908, IFI = 0.916, SRMR = 0.075).

Among the fourteen hypotheses shown in Table 5, eight were supported (H4, H8, H9, H10, H11, H12, H13, and H14), while six were not supported (H1, H2, H3, H5, H6, and H7). Among the original variables in model 1, perceived anxiety was significantly associated with perceived usefulness (H4). Perceived anxiety had no significant effect on technological content knowledge (H1), technological pedagogical knowledge (H2), technological pedagogical content knowledge (H3), perceived

Table 5 Results of the structural model of data of pre-service language teachers

				Estimate	S.E.	C.R.	P-value
H1	TCK	<---	PA	-0.003	0.003	-1.068	0.286
H2	TPK	<---	PA	-0.005	0.005	-1.065	0.287
H3	TPCK	<---	PA	-0.027	0.014	-1.933	0.053
H4	PU	<---	PA	-0.028	0.014	-2.036	0.042
H5	PEU	<---	PA	0.090	0.035	2.556	0.11
H6	A	<---	PA	-0.004	0.004	-1.010	0.312
H7	BI	<---	PA	-0.006	0.006	-1.058	0.290
H8	TCK	<---	TS	1.254	0.191	6.547	***
H9	TPK	<---	TS	1.886	0.267	7.075	***
H10	TPCK	<---	TS	1.963	0.279	7.036	***
H11	PU	<---	TS	1.675	0.243	6.892	***
H12	PEU	<---	TS	1.688	0.253	6.663	***
H13	A	<---	TS	1.715	0.236	7.272	***
H14	BI	<---	TS	2.432	0.372	6.538	***

P-value=*** means p-value<0.001

ease of use (H5), attitude (H6), and behavioral intention (H7). Teacher self-efficacy had a significant influence on technological content knowledge (H8), technological pedagogical knowledge (H9), technological pedagogical content knowledge (H10), perceived usefulness (H11), perceived ease of use (H12), attitude (H13), and behavioral intention (H14).

Regarding the results of in-service teachers as demonstrated in Table 6, among the fourteen hypotheses shown, seven were supported (H8, H9, H10, H11, H12, H13, and H14), while seven were not supported (H1, H2, H3, H4, H5, H6, and H7). Among the original variables shown in model 2, perceived anxiety had no significant influence on technological content knowledge (H1), technological pedagogical knowledge (H2), technological pedagogical content knowledge (H3), perceived

Table 6 Results of the structural model of data of in-service language teachers

				Estimate	S.E.	C.R.
H1	TCK	<---	PA	-0.005	0.007	-0.772
H2	TPK	<---	PA	-0.010	0.012	-0.869
H3	TPCK	<---	PA	-0.007	0.010	0.730
H4	PU	<---	PA	-0.009	0.013	-0.746
H5	PEU	<---	PA	-0.131	0.074	-1.762
H6	A	<---	PA	-0.008	0.010	-0.852
H7	BI	<---	PA	-0.008	0.009	-0.850
H8	TCK	<---	TS	1.784	0.496	3.597
H9	TPK	<---	TS	2.327	0.612	3.804
H10	TPCK	<---	TS	2.181	0.581	3.751
H11	PU	<---	TS	1.880	0.5111	3.681
H12	PEU	<---	TS	2.084	0.557	3.744
H13	A	<---	TS	2.085	0.559	3.729
H14	BI	<---	TS	2.178	0.575	3.791

P-value = *** means p-value < 0.001

usefulness (H4), perceived ease of use (H5), attitude (H6), and behavioral intention (H7). Teacher self-efficacy was significantly related to technological content knowledge (H8), technological pedagogical knowledge (H9), technological pedagogical content knowledge (H10), perceived usefulness (H11), perceived ease of use (H12), attitude (H13), and behavioral intention (H14).

Discussion

Dimensions of language teachers' readiness for flipped teaching

In general, both K-12 pre-service and in-service language teachers reported relatively high levels of flipped language teaching readiness. It is revealed that the language teachers showed sufficient technological content knowledge concerning flipped language teaching. This finding is in line with Cheng (2017) that showed the crucial role of technological knowledge in language teaching. On the other hand, the finding that language teachers reported adequate technological pedagogical knowledge related to flipped teaching is aligned with prior research revealing the influence of language teachers' technological pedagogical knowledge on teaching (Cheng, 2017). In addition, both K-12 pre-service and in-service language teachers seemed to integrate educational technologies, teaching pedagogies, and knowledge content in flipped language teaching, which corroborates with Howard et al. (2021) reporting teachers' high degrees of technological pedagogical content knowledge in online teaching.

Concerning perceived usefulness, the teacher participants perceived technology as beneficial for teaching. This finding accords with the finding of Hung et al. (2021) that the perceived usefulness of educational technologies impacted teachers' perceptions of teaching. Regarding perceived ease of use, the general pre-service and in-service language teachers thought it was not hard to utilize technology in teaching, confirming a previous study among secondary school English teachers in online teaching (Li, 2021). Furthermore, the teacher participants regarded flipped teaching could enhance K-12 learners' language learning. This finding is consistent with Hung et al. (2021) underscoring the significance of attitudes in teaching. As for language teachers' high levels of intention to implement flipped language teaching, this supports Jiang et al.'s (2021) finding that English teachers' intentions to use flipped teaching are essential.

Overall, the findings reflected that both K-12 pre-service and in-service language teachers were ready for language teaching in the flipped classroom regarding their mastery of knowledge in integrating technology, flipped language teaching strategies and pedagogies, and language content as well as technology acceptance. This finding is gratifying and advocates the significance of the integration between technology, pedagogy, and content knowledge, and acceptance of technology in affecting both pre-service and in-service language teachers' readiness for flipped teaching.

Gender differences in flipped language teaching readiness

The discussion of gender differences in flipped language teaching readiness among pre-service and in-service language teachers is presented below. The results of the current research demonstrated that pre-service male language teachers exhibited statistically significantly better flipped language teaching readiness than their female peers. This finding is contradictory to Jiang et al. (2021) that reported female English teachers showed better levels of use intention in flipped teaching than male English teachers, which is consistent with previous studies that male teachers were more likely to apply technologies to teaching practices in technology acceptance (Hung, 2016). The contradictory finding with Jiang et al. (2021) may be because the partici-

pants in Jiang et al.'s (2021) study were in-service university English teachers, while the participants in this research were pre-service teachers from different language domains. The difference in the subject domains and the diverse teaching experience between pre-service and in-service teachers may result in different results. Further studies could examine this speculation.

On the other hand, no significant gender difference was found in in-service language teachers' flipped language teaching readiness. This finding is in line with consistent with Chu (2010) that males and females had similar degrees in readiness dimensions. Both male and female in-service language teachers may likely be more inclined to have similar levels of readiness for flipped teaching, concerning their integration of knowledge in technology, pedagogy, and content and their technology acceptance. The traditional stereotype of gender that depicts females showing worse technology acceptance (Wiseman et al., 2018) should be revisited when facing flipped language teaching. Further work is encouraged to explore and confirm this finding.

The relationship between perceived anxiety, teacher self-efficacy, and flipped teaching readiness

This current research found that perceived anxiety of flipped teaching did not significantly impact K-12 in-service language teachers' flipped teaching readiness, and was only statistically related to pre-service language teachers' perceived usefulness in flipped teaching readiness. This finding partly confirmed Huang et al. (2021) that perceived anxiety did not significantly influence English teachers' online teaching. The relationships between perceived anxiety of flipped teaching and teaching readiness in the flipped language classroom reveal that K-12 pre-service and in-service Chinese language teachers' perceived anxiety did not demonstrate a heavy barrier for them to conduct the flipped classroom in their future practice. It may be owing to the relatively low perceived anxiety mean values [pre-service teachers: mean=3.056 (Table 1); in-service teachers: mean=2.903 (Table 2)] and the high levels of technological, pedagogical content knowledge and technology acceptance among pre-service and in-service language teachers in China. This could be further explained as teacher training on professional development may have provided language teachers with sufficient technological, pedagogical, and content knowledge to overcome potential anxiety barriers that they might have come across (Huang et al., 2021). In addition, the technological support offered by relevant centers in colleges may help decrease language teachers' anxiety concerning technology use (Huang et al., 2021).

It is not surprising that the present research revealed the important role of teacher self-efficacy in influencing both K-12 pre-service and in-service language teachers' flipped teaching readiness. This finding is aligned with Chou et al. (2020) pointing out the positive role of teachers' self-efficacy in flipped teaching among junior high school teachers and is consistent with Jiang et al. (2021) reporting that teacher self-efficacy served as a moderator in affecting teachers' flipped English teaching intention. The finding of this research extends the literature by offering empirical evidence on the role of teacher self-efficacy in both pre-service and in-service language teachers' flipped teaching readiness in different language subjects. The finding

also indicates that both pre-service and in-service language teachers would be more likely to equip themselves with relevant technology, pedagogy, and content knowledge required in language teaching and accept flipped teaching with higher levels of teacher self-efficacy in flipped language teaching. Based on Hung (2016) and Lai et al. (2018), adequate encouragement and teaching resources provided to teachers could contribute to an enjoyable teaching atmosphere and consequently exerts an impact on teachers' perceived attitudes and self-efficacy. Teacher educators and future researchers could consider paying more attention to teachers' self-efficacy not only in flipped language teaching but also in other teaching modes that need to be integrated with educational technologies in the new era.

Implications

This present study has several implications for future studies on flipped language teaching readiness. First, research on teachers' flipped teaching readiness across different languages is relatively lack. In response, this research concentrated on K-12 pre-service and in-service language teachers, which makes a contribution to the body of flipped language teaching literature by understanding K-12 pre-service and in-service language teachers' readiness levels in different language classrooms.

Moreover, the impact of perceived anxiety and teacher self-efficacy on language teachers' flipped teaching readiness was empirically illustrated by K-12 pre-service and in-service language teachers. Since flipped language teaching gains increasing importance, these associations could contribute to a better understanding of the factors that affect language teachers' flipped teaching readiness, which might, in turn, improve language teachers' preparation for flipped teaching.

Since teacher self-efficacy had a direct effect on language teachers' flipped teaching readiness, it is recommended that more language teaching resources, for example, MOOC platforms and videos, and technical support could be provided to language teachers to enhance their teacher self-efficacy (Lai et al., 2018). In addition, providing language teachers with relevant training workshops to integrate language teaching materials with technologies and teaching strategies (Jiang et al., 2021) and more freedom to explore the use of educational technologies to increase their technology acceptance may be effective in greatly facilitating their teacher self-efficacy and flipped teaching readiness.

Although perceived anxiety of flipped teaching seemed not to significantly affect both K-12 pre-service and in-service language teachers' flipped teaching readiness in this current research, we suggest future research replicate this research in other contexts or use longitudinal studies or collect qualitative data to further explore the role of perceived anxiety in flipped language teaching.

Conclusion and limitations

Successful flipped language teaching requires language teachers' knowledge of technology, pedagogy, and content as well as their attitudes toward technology acceptance. To better understand the association between perceived anxiety, teacher self-efficacy, and flipped teaching readiness, this present research investigated not only the characteristics of K-12 pre-service and in-service language teachers' flipped teaching readiness, but also examined the complicated interplay between perceived anxiety, teacher self-efficacy, and flipped language teaching readiness. Compared to the existing literature (e.g., Chou et al., 2020), this research extended the understanding of teachers' flipped teaching readiness from different language domains and covered both pre-service and in-service language teachers, which yielded a more wholistic picture of language teachers' readiness for flipped teaching with results were more inclusive to the reality. The results showed that K-12 language teachers have an overall high level of flipped teaching readiness in the language classroom, and gender only made a difference to pre-service language teachers' flipped teaching readiness.

Although this research has been carefully designed, this research is not without limitations. First, we collected the data only through the online self-reporting questionnaire. The results from the online questionnaire may not guarantee participants' response rate (Lefever et al., 2007) and may not reflect respondents' true understanding. We suggest future research apply diverse data collection methods, including qualitative methods, such as class observation and semi-structured interviews, to have a complete and deeper understanding of language teachers' flipped teaching readiness and minimize the potential bias of self-reporting questionnaires. Second, we only involved language teachers in mainland China. Future research is encouraged to recruit language teachers from diverse educational and cultural backgrounds to achieve greater generalizability concerning teachers' flipped teaching readiness in the language classroom.

Appendix: K-12 teacher readiness for flipped language teaching questionnaire (TRFLTQ)

Dimensions/Items

(1) Technological Content Knowledge (TCK)

- Q1 I am able to use multimedia (e.g., videos, PPT, etc.) to show language topics.
- Q2 I am able to use online technologies (such as WeChat, online learning platform, email) to communicate and discuss with k-12 students about language learning.

(2) Technological Pedagogical Knowledge (TPK)

- Q3 I am able to design diverse online learning activities for k-12 students' previews.
- Q4 I am able to organize activities in the physical classroom to check k-12 students' understanding of the learning materials.
- Q5 I am able to use different teaching strategies to create a flexible and interactive learning environment in the flipped foreign language classroom.

(3) Technological Pedagogical Content Knowledge (TPCK)

- Q6 I am able to use diverse online tools to assess k-12 students' language learning outcomes.
- Q7 I am able to use multimedia to improve k-12 students' language skills.
- Q8 I am able to use online technologies to support k-12 students' cooperation and interaction in the flipped language classroom.

(4) Perceived usefulness (PU)

- Q9 Using technology can help me complete my teaching task.
- Q10 Using technology can enrich my teaching materials.
- Q11 Using technology can help me interact with students.

(5) Perceived ease of use (PEU)

- Q12 I find it easy to get technology to do what I want to do.
- Q13 I find technologies easy to learn.
- Q14 I find it easy to be skillful at using technologies.

(6) Attitude (A)

- Q15 I think the flipped classroom can improve k-12 students' ability in foreign language reading.
- Q16 I think the flipped classroom can improve k-12 students' ability in foreign language listening.
- Q17 I think the flipped classroom can improve k-12 students' ability in foreign language speaking.
- Q18 I think the flipped classroom can improve k-12 students' ability in foreign language writing.

(7) Behavioral Intention (BI)

- Q19 I plan to use flipped foreign language teaching in the future.
- Q20 I plan to recommend flipped foreign language teaching to others.
-

Data availability The data will be available upon reasonable request from the corresponding author.

Declarations

Conflict of interest No potential conflict of interest was reported by the authors.

Ethical approval I confirm that all the research meets ethical guidelines and adheres to the legal requirements of the study country.

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