

Evaluating Digital Competence in Graduate-Level Chinese International Education Programs: A Dual Perspective on Teacher Needs and Training Models

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Abstract

This paper employs a mixed research methodology, integrating a questionnaire survey and sample interviews, to assess the current state of digital competence and identify the factors influencing it among international Chinese pre-service teachers. Building upon the authoritative model framework, this study developed a questionnaire on the digital competence of international Chinese pre-service teachers and collected data from 100 master candidates of international Chinese language education from leading domestic universities in China. Upon analysis of the data, it was determined that the digital competence of international Chinese pre-service teachers is currently satisfactory overall, although there is a notable discrepancy in development. In particular, competences related to digital teaching, research, and pedagogical innovation are less developed. The training experience of international Chinese pre-service teachers has a significant correlation with their digital competence. However, the experience of international Chinese teaching does not have a significant effect on their digital competence, nor does it have a significant effect on their digital teaching competence or digital pedagogical innovation competence. This study identifies the reasons for this and proposes to refine the training system for digital competence, develop and optimize shared digital resource repositories, and enhance the capacity for innovation in pedagogical practice.

Keywords: digital competence, influencing factors, international Chinese teaching, pre-service teachers

1. Introduction

The ongoing technological advancement is driving significant changes in established social production systems, thus advancing the evolution of education. Accelerated global development has transformed the education system, necessitating a fresh perspective in the new era. UNESCO's publication "Reimagining Our Futures Together: A New Social Contract for Education," released in November 2021, emphasizes the critical importance of digital transformation in education. Similarly, the United Nations Summit on Education Transformation in September 2022 declares that "the digitalization of education has emerged as a transformative force, guiding global education reform." This reaffirms the central role of digitalization in education.

"Teachers' Digital Literacy and Competence Improvement" received special attention at the World Conference on Digital Education, convened in Shanghai, China in January 2024. This highlights the pivotal role educators play in driving the digital transformation of education. Integral to this transformation is the enhancement of the teaching force's digital literacy, which contributes significantly to the advancement of a high-quality education system (Xiang & Chen, 2023). Digital technology facilitates the integration of core literacy education, reshapes teaching methodologies and dynamics, introduces innovative approaches to evaluating teaching efficacy, and empowers educators in their professional and instructional development (Wu et al., 2023)

Amidst the ongoing digital revolution, it is imperative for the field of international Chinese language education to seize this opportunity and adapt to scientific advancements. With the rapid progress in multimedia teaching technology and the emergence of sophisticated language models like ChatGPT, employing intelligent technology to propel the digital transformation and ensure quality development in international Chinese language education has become an unavoidable trend (Li et al., 2023). It is now an indisputable fact that artificial intelligence language models such as ChatGPT have reshaped the teaching paradigm of international Chinese language education, redefining the roles of instructors and transforming student learning processes (Liu et al., 2023). In contemporary times, significant transformations have occurred in the pedagogy of second language instruction (Zheng, 2016).

Consequently, upcoming language instructors should strive to act as “intermediaries” who bridge the gap between the known and unknown through diverse inquiries, or as “catalysts” who connect the realms within and beyond the classroom (Zhao et al., 2023). Due to the digital transformation trend, international Chinese language instructors are compelled to integrate digital technology into their personal development, enhance their digital knowledge and skills, and consistently refine their digital proficiency to effectively implement it in their teaching practices.

The “International Chinese Language Teachers’ Professional Competence Standards” (T/ISCLT 001-2022) were published in August 2022 by the World Society of Chinese Language Teaching. Notably, “Educational Technology” is a newly introduced Level 2 indicator and one of seven specific requirements outlined in the Standards. Among these requirements is “Developing an understanding of the profound integration of information technology into the process of teaching Chinese.” This unequivocally demonstrates that digital proficiency has evolved into an essential component of the competency framework for Chinese language instructors.

Given the circumstances, The paper examines the current state of digital competence among international Chinese pre-service teachers and identifies the factors that influence it. Its twofold objective is to gain a deeper understanding of the actual situation from the perspective of teachers and to provide empirical evidence that can inform the majority of researchers in developing effective solutions. Secondly, the current training model is to be reflected upon, existing problems within the teacher education system are to be analyzed, and practical suggestions are to be put forward in order to help improve the digital competence of international Chinese language education teachers and to facilitate the digital transformation of education.

2. Overview of Research

2.1 Definition of the Concept of Digital Capacity

“Digital competence” is an extension of the term “digital literacy” (Wang, 2022). Initially introduced by Alkalai in 1994 (Eshet, 2004) and further elaborated upon by Gilster (1997) in *Digital Literacy*, “digital literacy” was defined as “the capacity to acquire, evaluate, and integrate information via computers” (Wang, 2022). Digital competence, as defined in the 2018 EU Council Recommendation on Key Competences for Lifelong Learning, refers to “the assured, discerning, and accountable utilization of digital technologies in the contexts of education, employment, and societal engagement.”

Currently, the terminology surrounding “digital competence” lacks standardization across different countries, regions, and documents. Consequently, the terms “digital skills,” “digital capability,” and “digital literacy” are used inconsistently. For the sake of consistency and practicality, this study adopts the conceptual definitions provided by Wu et al. (2023) and Wu et al. (2021), without delving into precise differentiation among these terms. Instead, they are collectively considered within the scope of this study.

2.2 Definition of the Term “Teacher Digital Competence” and Pertinent Scholarly Investigations

Due to the centrality of “teachers” in the Three Teachings (Cui, 2010) and a pedagogical perspective on “digital competence,” the notion of “teachers’ digital competence” has garnered considerable interest; however, its precise definition has been the subject of varying interpretations. The notion of “teachers’ digital competence” has garnered considerable interest; however, its definition has been the subject of differing opinions. While Krumsvik (2011) and Luo et al. (2023) have attempted to define it, their investigations have primarily concentrated on the pedagogical aspect of teachers’ proficiency with digital applications, neglecting a broader perspective on the teacher’s role. They do not possess a broader perspective on the function of educators. Given the circumstances, the author is more inclined to concur with the definition of digital competence put forth by Lai et al. (2023) for educators. The authors point out that “teachers’ digital competence covers not only the awareness, knowledge, attitudes, and abilities related to the creation and use of digital information resources needed by teachers in the process of teaching and learning but also the elements that teachers should possess in the process of achieving their own professional development.” This definition offers a more all-encompassing depiction of the proficiencies that educators must possess in the era of digital technology.

Europe has accomplished noteworthy outcomes in its early stages of developing a framework to assess the digital competence of educators. The Digital Competence Framework for Teachers in Europe (Dig Comp Edu) (Note 1), introduced by the European Union in 2017, offers a comprehensive elucidation of the criteria that define digital competence in the context of education. After a span of five years, the European Union revised the framework and introduced version 2.2, which expanded upon the initial six competence domains by incorporating 22 additional specific competencies. In the meantime, the Chinese Ministry of Education, which officially published the Digital Literacy for Teachers standard on November 30, 2022, has also placed significant emphasis on the development

of teachers' digital competence. The standard is comprised of thirteen secondary dimensions and thirty-three tertiary dimensions and further subdivides the aforementioned into digital awareness, digital technology knowledge and skills, digital application, digital social responsibility, and professional development. This framework offers robust direction for the holistic enhancement of educators' digital literacy. Furthermore, there has been a notable increase in domestic research on digital competency frameworks for teachers in recent years. This growth has been accompanied by a proliferation of studies that examine this topic from various professional and educational standpoints. While certain academics direct their attention towards enhancing the overall digital proficiency of educators (Wu et al., 2021), others concentrate on the utilization of digital technology during instructional sessions (Ge et al., 2017). Scholars have also devoted considerable attention to the digital competence of foreign language instructors in instructional design (Lai et al., 2023) and the digital competence of college instructors (Yang et al., 2019).

Scholars have come to agree that teacher digital competence education plays a crucial role in advancing the digital transformation of the national education system. A considerable number of academics have devoted their efforts to investigating the determinants of digital competence at various phases of the professional development of teachers. In their study, Guerrero et al. (2020) discovered that there were variations in digital competence among pre-service teachers of different ages. Specifically, they differed in their ability to navigate the Internet and search for resources. Furthermore, the researchers observed that older pre-service teachers had a greater understanding of the various types of search engines and educational resources. Çebi et al. (2020) undertook a research investigation to examine the impact of gender and diverse professional contexts on the digital competence of 518 pre-service teachers in Turkey. In contrast, Reisoğlu and Çebi (2020) examined a case study involving 24 pre-service teachers. The study utilized the Dig Comp and Dig Comp Edu frameworks and confirmed that training is effective in enhancing the digital competence of pre-service teachers. These results are consistent with the findings reported by Laskaris et al. (2017). In a study conducted by Yang (2022) involving primary and secondary school educators in Anhui Province, China, it was observed that pre-service teachers possessed lower levels of digital competence than in-service teachers on average. In addition, the study discovered significant correlations between the level of digital competence of in-service teachers and a variety of external factors, including age, years of teaching experience, and educational background. In a study conducted by Yi (2022), the digital literacy of 335 full-time teachers employed in in-service higher education institutions was examined. The results indicated that gender, academic qualifications, and institutional affiliation did not significantly influence the digital literacy of the teachers. However, a significant correlation was observed between the age of the teachers, the nature of the institution to which they belonged, and the level of the institution. These results indicate that the variability of different fields and research subjects must be considered when examining the factors that influence teachers' digital literacy, as the same factor may not always be significantly correlated in different contexts. Therefore, it is crucial that this study fills an academic gap by examining group differences in the development of digital literacy among international Chinese pre-service teachers.

2.3 A Study Related to the Digital Competence of International Chinese Language Teachers

A distinct trend in the development of instructors' digital competence in the domain of international Chinese language instruction is evident in the research. Academic attention transitioned from modern educational technology initially (Liu et al., 2021) to digital competence and literacy progressively thereafter. Liu Yuping's team at Minzu University of China has conducted a large number of studies in the field of digital competence of international Chinese teachers, in which Yuan Ping et al. (2020) combed through the domestic and international studies on digital literacy of international Chinese teachers, and found that there are many research topics that have not yet been covered, and many other areas of research that urgently need to be expanded and deepened; Liu et al. (2021), based on the European framework of digital competence of teachers and the evaluation standard of digital literacy for domestic college and university teachers designed a questionnaire to examine the current digital competence status of 205 in-service international Chinese language teachers in three dimensions: knowledge, skills, and attitudes; however, reference to the digital competence frameworks of teachers in other countries and fields has never been able to reflect the characteristics of international Chinese language education, and it is obvious that an examination of only the above three dimensions is too thin, so Li et al. (2022) used the Delphi method to conduct three rounds of anonymised consultation with 13 international Chinese language experts in the field of Chinese language. A digital competence model for the field of international Chinese language teachers was developed through three rounds of anonymous consultation and consists of 27 secondary indicators in addition to the six primary ones. In contrast to the aforementioned investigations, Wang (2023) constructed a comprehensive and intricate framework for teaching competence.

Amidst this, numerous academicians have contributed to the field of international Chinese language teachers'

proximate digital competence. In their investigation of the digital competence of international Chinese language teachers engaged in distance learning, Wang et al. (2022) found that teachers currently possess a low level of digital competence and that an efficient pathway to developing digital competence is required. Both Wang et al. (2022) and Hui (2023) are concerned with the trajectory of enhancing the digital competence of educators. The latter approach tends to commence at a macro level, placing emphasis on the criticality of developing a teaching case base and refining the cultivation system. In contrast, the former approach commences at a micro level, highlighting the significance of considering the feedback effect of course evaluation on instruction and its potential to foster learning. The former underscores the significance of the feedback effect that course evaluation has on instruction and the pragmatic function that “promoting learning by using” plays in the classroom.

2.4 Research Summary, Gap and Questions

A comprehensive examination of the existing literature reveals that prior research has primarily concentrated on digital teaching competence, neglecting to a significant extent the significance of digital knowledge, digital awareness, and digital innovation in shaping teachers’ digital competence. As a consequence, the research has been somewhat limited in scope. Concurrently, the determinants of the present condition of teacher competence are of varying applicability to various research domains, and the cohort of pre-service teachers from China who are international in nature have yet to be adequately studied. In general, research on the digital competence of teachers in the context of international Chinese language education remains scant and has primarily concentrated on in-service teacher surveys. An in-depth examination of the present state, requirements, and determinants of pre-service teachers’ digital competence will contribute to the enhancement of the teacher education model and training framework, the rejuvenation of the foundations of the branches, the deliberation of the sources that flow with the waves, and thus advance the educational transformation.

Drawing from the aforementioned, this study employs a mixed-method research design to develop the International Chinese Teachers’ Information Competency Scale. This scale assesses the present state of digital proficiency among pre-service Chinese international Chinese teachers and the determinants that impact it. Subsequently, sample interviews are conducted, and the findings of the quantitative analyses are utilized to identify issues, analyze their origins, and propose recommendations.

The present investigation prompts the subsequent inquiries:

- (1) In the era of digital intelligence, how is the information competence of international Chinese language teachers currently? In the era of digital intelligence, what are the distinguishing features of each digital competence dimension among international Chinese pre-service teachers?
- (2) Does the region of study, teaching practicum experiences, and digital competence training experiences of international Chinese language teachers influence their digital competence? Which issues are being reflected? Why are these the case?

3. Methods

3.1 Subjects of Study

To ensure the study’s representativeness, we selected master’s degree students in international Chinese education from universities of “double first-class” in China. The survey was conducted using the Questionnaire Star platform, with a total of 102 questionnaires distributed, out of which 100 were considered valid. Following prior research on the regional classification of Chinese higher education institutions, the survey included a sample of one hundred individuals, comprising 20 males and 80 females, with 50 participants from the western region and 50 from the eastern region. The majority of participants had backgrounds in international Chinese education, followed by Chinese language and literature, as well as various foreign language majors such as English, French, and Spanish. A minority of participants were from fields such as software engineering, business administration, logistics management, and related disciplines.

3.2 Tools for Research

3.2.1 Questionnaire

In order to develop a questionnaire regarding the digital competence of international Chinese teachers, this research is grounded in the Digital Competence Model for International Chinese Language Teachers developed by Li et al. (2022). Once the preliminary version of the questionnaire was finalized, it was distributed to two specialists specializing in international Chinese language education. Their feedback was incorporated into the preliminary questionnaire, which was subsequently combined with their modifications. The outcomes of the small-scale pre-test were utilized to inform the revision of the formal questionnaire.

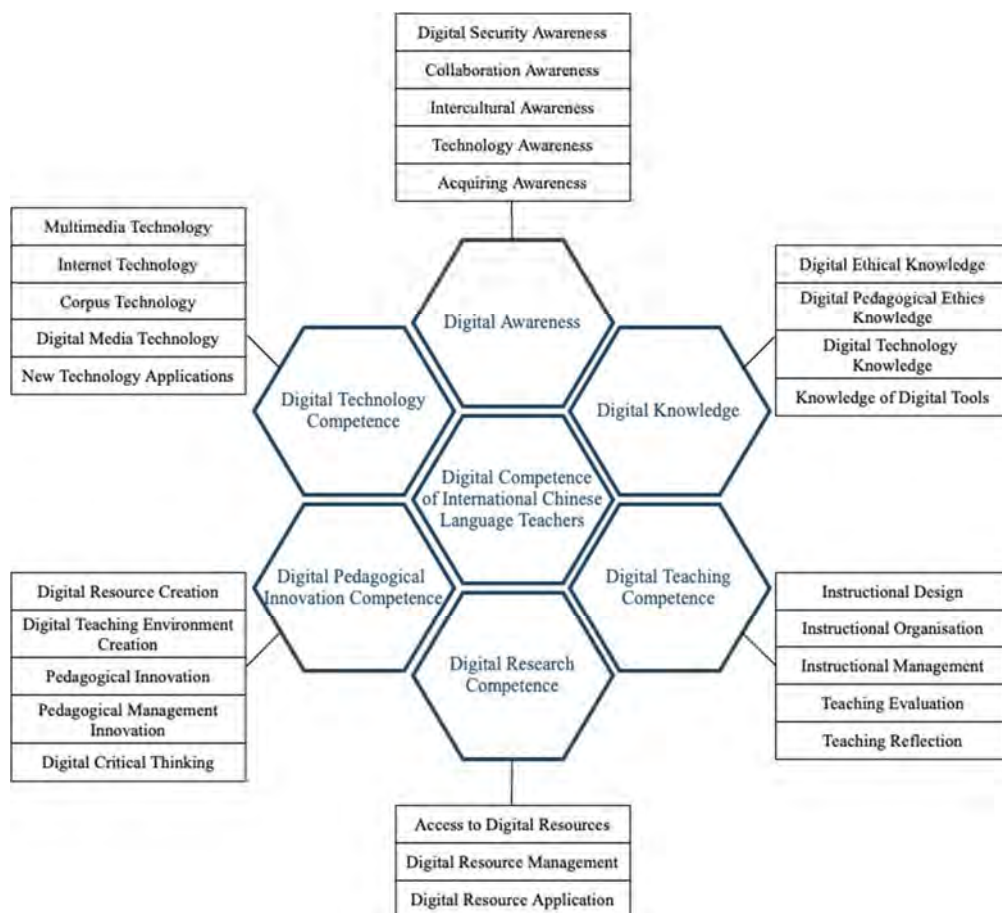


Figure 1. Digital competency model for international Chinese language teachers (Li Xiaodong, 2022)

The digital competence model proposed by Li (2022) comprises 27 level 2 indicators, as depicted in the figure above, in addition to 6 level 1 indicators (digital awareness, digital knowledge, digital technology competence, digital teaching competence, digital research competence, and digital pedagogical innovation competence).

The survey utilizes a five-point Likert scale, where a rating of five indicates “Fully conforming” and a rating of one indicates “Not at all”. Consequently, a higher score signifies a greater level of digital competence. For the questionnaire’s overall reliability, the Cronbach’s alpha was 0.949, which is an outstanding value and suggests that the questionnaire is exceptionally reliable. The coefficients for the following dimensions indicate high reliability: digital awareness ($\alpha = 0.756$), digital knowledge (0.847), digital technical competence ($\alpha = 0.744$), digital pedagogical competence (0.869), digital research competence (0.823), and digital pedagogical innovative competence (0.892).

The questionnaire was deemed to have satisfactory structural validity and suitability for factor analysis based on the results of the KMO and Bartlett’s sphericity tests (KMO = 0.886 and Bartlett’s sphericity significance of 0.000, respectively). Factor analysis was conducted using the maximum variance method, with the extraction set being set to be greater than 1. In the end, six factors were extracted, and the cumulative explained variance was 69.683%, indicating that the number of level 1 variables was sufficient to support the extracted factors. The data and questionnaire were analyzed utilizing SPSS 26.0.

3.2.2 Interviews

Following the completion of the quantitative analyses, seven subjects were chosen for in-depth interviews on the basis of their results. Two of these seven subjects entered their third year of study, while four entered their first year of study. Among these seven subjects, two lacked either teaching or training experience. 4 of the remaining 5 subjects possessed teaching experience, with 1 having less than 3 months, 2 having 3–6 months, and 2 having

6–12 months. Additionally, 4 of these 5 subjects had experience in numeracy training, with 1 having more than 1 year, 2 having 3–6 months, and 1 having less than 3 months of experience.

The interviews were exclusively carried out in person, and the voice recorder was utilized by the researcher to capture and transcribe the interviews. This resulted in the acquisition of over 34,200 words of textual material for the study, which were subsequently imported into the Nvivo12 qualitative analysis software. The data were analyzed using the criteria of status quo, reasons, and needs. The present study was conducted in strict adherence to the academic code of ethics. Prior to the subjects completing the tasks and providing their responses, the researcher duly apprised them of the recording process and its associated purposes. Consent was duly obtained prior to the commencement of the recording procedure.

4. Discussion

4.1 The Present State of Digital Competence Among International Chinese Pre-service Teachers

Quantitative fundamental data we collected from the questionnaire and conducted a one-sample t-test using the median total score of each secondary dimension as the baseline, and the results are shown in Table 1.

Table 1. Results of one-sample t-tests for digital competence and each dimension

	M	SD	Number of terms (median)	Mean score of question items	T-value
Digital Competence	92.93	16.07	27 (67.5)	3.44	15.819**
Digital Awareness	18.60	3.00	5 (12.5)	3.72	20.322**
Digital Knowledge	14.03	3.04	4 (10)	3.50	13.257**
Digital Technology Competence	17.75	3.10	5 (12.5)	3.55	16.906**
Digital Teaching Competence	16.65	3.69	5 (12.5)	3.33	11.243**
Digital Research Competence	9.92	2.42	3 (7.5)	3.30	9.969**
Digital Pedagogical Innovation Competence	15.98	4.03	5 (12.5)	3.19	8.624**

Note. * $p < .01$; ** $p < .001$.

The data in Table 1 indicate that the scores on digital competence are significantly higher than the median. This suggests that international Chinese pre-service teachers have good digital competence at this stage, which is consistent with the findings of Liu et al. (2021). Furthermore, the scores for the six secondary competencies are significantly higher than the mean value, indicating that the digital competence of international Chinese pre-service teachers is more comprehensively developed at this stage. Additionally, we observed that, in comparison to the other components, the three competencies of digital teaching competence, digital research competence, and digital pedagogical innovation competence exhibited relatively weaker performance and require further cultivation and development.

4.2 Examination of Influencing Factors

Supplementary analyses were performed by combining the interview data in order to examine the impact of the region of study of master candidates, teaching experience in international Chinese language education, and digital competence training experience on the digital competence of pre-service teachers of international Chinese languages.

4.2.1 The Study Region

Within this segment, the sample was partitioned into eastern and western regions (Sichuan, Guangxi, Xinjiang, Qinghai, etc.) based on the study regions of master candidates students in the respective subjects (Shanghai, Beijing, Zhejiang, Hebei, etc.). Each region comprised 50 individuals, and the analyses were conducted utilizing independent samples t-tests, with a 95% confidence interval. The findings of the examination are presented in Table 2.

Table 2. Results of t-tests for independent samples across attendance areas

	Western Region		Eastern Region		MD	T-value
	M	SD	M	SD		
Digital Competence	89.64	14.016	96.22	17.424	-6.58	2.081*
Digital Awareness	18.20	2.688	19.00	3.264	-0.80	1.338
Digital Knowledge	13.30	2.690	14.76	3.217	-1.46	2.462*
Digital Technology Competence	17.08	2.856	18.42	3.227	-1.34	2.199*
Digital Teaching Competence	16.20	3.283	17.10	4.042	-0.90	1.222
Digital Research Competence	9.70	2.315	10.14	2.540	-0.44	.905
Digital Pedagogical Innovation Competence	15.16	3.733	16.80	4.194	-1.64	2.065*

Note. * $p < .05$; ** $p < .01$; *** $p < .001$.

The findings presented in Table 2 indicate that digital competence is significantly influenced by the region of study of master candidates. Specifically, pre-service teachers pursuing their degrees in the Eastern region demonstrate a markedly higher level of numerical competence than the Western region. Furthermore, within the realm of secondary competence dimensions, notable distinctions can be observed in digital technology competence, digital knowledge, and digital pedagogical innovation competence. Conversely, digital awareness, digital pedagogical competence, and digital research competence do not exhibit any noteworthy difference.

In summary, the digital competence of pre-service teachers is notably impacted by the region of study. The eastern region exhibits a distinct advantage over the western region in terms of pre-service teachers' digital competence knowledge, skills, and pedagogical innovations. Conversely, the level of awareness and pedagogical competence do not demonstrate a statistically significant disparity. We learned through interviews that universities in the East place a greater emphasis on developing the digital competence of their faculty than universities in the West. Furthermore, these universities offer relatively comprehensive training programs and courses, including those pertaining to the creation of animated courseware.

4.2.2 International Chinese Teaching Experience

A total of 59 pre-service teachers had experience teaching international Chinese language, with 21 having less than three months, 16 having three to six months, 16 having six to 12 months, and six having more than 12 months of experience. Independent samples t-tests were conducted on the numerical competence and scores on each dimension for teachers with and without teaching experience.

Table 3. Results of independent sample T-Test for international Chinese teaching experiences

	Participation (59)		Non-participation (41)		t-value
	M	SD	M	SD	
Digital Competence	94.15	16.91	91.17	14.80	0.911
Digital Awareness	18.69	3.10	18.46	2.88	0.378
Digital Knowledge	14.02	2.96	14.05	3.18	-0.051
Digital Technology Competence	18.12	3.08	17.22	3.10	1.432
Digital Teaching Competence	17.00	3.61	16.15	3.79	1.139
Digital Research Competence	9.95	2.64	9.88	2.11	0.143
Digital Pedagogical Innovation Competence	16.37	4.29	15.41	3.61	1.170

Note. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2 reveals the alarming result that teaching experience is completely unrelated to teachers' digital competence, both in terms of digital competence and in terms of each of the secondary dimensions. In other words, the impact of international Chinese teaching experience on digital competence was found to be insignificant. Notably, digital teaching innovation competence and digital teaching competence, two secondary indicators that are strongly associated with teaching, also failed to demonstrate a significant effect. This finding is intellectually stimulating. We determined, by combining the outcomes of our interviews, that this phenomenon has numerous causes.

To begin with, pre-service teachers from China who are international are still quite inexperienced in utilizing digital technology and lack a fundamental understanding of its functioning concepts and principles, which remain to be mastered and developed; International Chinese pre-service teachers' training process has isolated teaching practice and digital technology, ignoring their integration; as a consequence, pre-service teachers lack the ability to apply digital technology to the classroom; The conventional approach to teaching Chinese at an international

level is entrenched and incapable of incorporating new technologies into classroom instruction. This aligns with the results obtained from the digital competence survey, which indicate that respondents possess the capability to utilize novel technologies or products for the purpose of conducting research and teaching the Chinese language on an international level ($M = 3.13, SD = 0.950$).

4.2.3 Experience with Digital Competence Training

A mere 37 (19 in the eastern region and 18 in the western region) of the pre-service teachers had experience in digital competency training and coursework. The remaining 63 did not have this type of experience. This was grouped in this way to conduct an independent samples t-test with a confidence interval percentage of 95%. The results of this analysis are shown in the table below.

Table 4. Results of independent samples T-Test for digital competency training

	Participation		Non-participation		MD	t-value
	M	SD	M	SD		
Digital Competence	97.51	13.91	90.23	16.74	7.28	2.228**
Digital Awareness	19.70	2.55	17.95	3.07	1.75	2.920***
Digital Knowledge	14.70	2.60	13.63	3.22	1.07	1.712*
Digital Technology Competence	18.43	2.72	17.35	3.26	1.08	1.700*
Digital Teaching Competence	17.30	3.40	16.27	3.82	1.03	1.350
Digital Research Competence	10.65	2.32	9.49	2.40	1.16	2.352**
Digital Pedagogical Innovation Competence	16.73	4.37	15.54	3.78	1.19	1.431

Note. * $p < .10$; ** $p < .05$; *** $p < .01$.

The results of the independent samples t-test indicated that the digital competence training experience exhibited notable differences in digital competence ($t = 2.228, p = 0.028 < 0.05$). With regard to the secondary dimensions, the differences were particularly pronounced in the domains of digital awareness ($t = 2.920, p = 0.004 < 0.01$), digital research competence ($t = 2.352, p = 0.021 < 0.05$). Besides, digital knowledge ($t = 1.712, p = 0.090 < 0.10$) and technology competence ($t = 1.700, p = 0.092 < 0.10$), which exhibited borderline significance. In contrast, no significant differences were observed in the dimension of digital teaching competence ($t = 1.350, p = 0.180 > 0.10/0.05$) and digital pedagogical innovation competence ($t = 1.431, p = 0.155 > 0.10/0.05$).

From the above results, it is clear that digital competence training has a significant effect on digital competence as a whole and on most of the secondary dimensions, so we conducted further analysis. Of the subjects who had experience with digital competency training for pre-service international Chinese language teachers, 28 participated in the training for less than 3 months, 7 for 3–6 months, 1 for 6–12 months, and 1 for more than 12 months. Since there were too few participants in the latter two time periods, they were not included in the analysis, and the IFL pre-service teachers who had not participated in systematic training and who had participated in trainings of less than 3 months and 3–6 months were divided into three groups, named Groups A, B, and C for ease of elaboration.

Table 5. Results of one-way between groups ANOVA test for digital competency training time

	Group A		GroupB		Group C		F	after-test
	Non-participation (n=63)		Within 3 months (n=28)		3–6months (n=7)			
	M	SD	M	SD	M	SD		
Digital Competence	90.24	16.745	99.07	13.762	90.43	14.547	3.106*	B>A
Digital Awareness	17.95	3.071	19.86	2.415	19.14	3.532	4.226*	B>A
Digital Knowledge	13.63	3.224	15.18	2.480	13.14	2.795	2.895	
Digital Technology Competence	17.35	3.263	18.57	2.673	17.29	2.928	1.586	
Digital Teaching Competence	16.27	3.824	17.39	3.715	16.57	2.370	0.885	
Digital Research Competence	9.49	2.402	10.86	2.460	9.86	1.864	3.167*	B>A
Digital Pedagogical Innovation Competence	15.54	3.788	17.21	4.332	14.43	4.614	2.230	

Note. * $p < .05$.

Then, in accordance with the methodology described by Xu (2013), a one-way between-group ANOVA was performed utilizing the variance chi-square test with a 95% confidence interval and two post-hoc tests, Tukey HSD and Tamhane. The table displays the results of the particular one-way between-group ANOVA. As each dimension

has a p-value greater than 0.05, the chi-square test for ANOVA indicates that the variances are all chi-square, thus satisfying the premise assumption of ANOVA.

Digital competence ($F = 3.106$, $p = 0.049 < 0.05$), digital awareness ($F = 4.226$, $p = 0.017 < 0.05$), and digital research competence ($F = 3.167$, $p = 0.047 < 0.05$) all had p-values less than 0.05, as determined by the ANOVA inferential analysis. This indicates that the difference between the means of at least two groups within each of the above three dimensions reached a statistically significant level. As previously stated, the chi-square test was unable to produce statistically significant results ($p > 0.05$) for the mean of all digital competence dimensions in this investigation. Consequently, the post-hoc test utilized the Tukey HSD to interpret the results.

The results of the Tukey HSD post hoc test also indicated that Group B and Group A had $MD = 8.833$, $p = 0.041 < 0.05$, on the overall dimension of digital competence; $MD = 1.905$, $p = 0.014 < 0.05$, on the digital awareness dimension; and $MD = 1.365$, $p = 0.036 < 0.05$, on the digital research competence dimension. Put simply, Group B achieved notably higher scores in the domains of digital competence, digital awareness, and digital research competence when compared to Group A. Conversely, there was no statistically significant distinction observed between Group C and Groups A and B.

It is evident from the data analysis that systematic training has a substantial impact on digital competence. The training had a significant effect on digital awareness and digital research competence, while digital knowledge and digital technology competence also had some. In addition, the digital competence training did not show an improvement in digital teaching skills, which indicates that the training at this stage lacks a focus on teaching practice. In terms of training duration, the predominant training mode is short-term training of less than three months. This mode has proven to be highly efficient, more flexible, and easier to implement than long-term training. As a result, it is feasible and valuable to be widely adopted to a certain extent.

5. Recommendations

5.1 Refine the Training System for Digital Competence

At this time, the training system for international Chinese pre-service teachers in digital competence exhibits varied forms and limited coverage, which significantly affect the effectiveness of the actual training. Furthermore, the survey revealed that the majority of colleges and universities lack training courses pertaining to digital competence (Wang et al., 2023). Furthermore, a comprehensive training system for the digital competence of international Chinese language instructors has not yet been established. These deficiencies have hindered the digital transformation of the discipline and, to some degree, prevented pre-service teachers from receiving systematic digital competence training. The establishment of a comprehensive and superior digital competence training system, which aligns with the subject's theoretical understanding, is a critical precondition for pre-service educators to acquire digital wisdom and master digital competence.

As a result, we are of the opinion that a multi-level, multi-direction digital competence training system for international Chinese pre-service teachers must be established (Fu et al., 2024), with special seminars and structured courses serving as the primary carriers. In particular, the system ought to prioritize not only the development of pre-service teachers' holistic digital competence, but also the advancement of pedagogical innovation, awareness, knowledge, and skills, as well as teaching and research.

In their higher education institutes as the primary educational establishments for pre-service teachers, colleges and universities ought to assume a preeminent position in imparting comprehensive and methodical instruction on digital competence to this demographic. This can be accomplished by rationally optimizing the current curriculum framework in light of digital education. Concurrently, higher education institutions ought to prioritize "step-by-step" instruction tailored to students' aptitudes, establish interdisciplinary courses of varying levels of complexity in accordance with distinct facets of digital proficiency, grant students the autonomy to choose courses that facilitate a comprehensive development of their digital expertise, and construct a cultivation chain that progresses from synthesis to specialization. Furthermore, upon compiling the survey data, it is discovered that brief digital training lasting no more than three months not only yields a substantial enhancement effect, but also demonstrates commendable usability and convenience. Consequently, implementing short-term training during the nascent phase of digital education will yield even more substantial advantages.

5.2 Developing and Optimizing Shared Digital Resource Repositories

Despite the proliferation of research outcomes and an ever-expanding body of knowledge in the domain of international Chinese language education, the development of digital shared resource libraries remains sluggish, leading to a dearth of information, a sluggish flow of data, and numerous barriers to information within the field. Many pre-service teachers have a strong digital awareness and learning motivation, according to the interviews;

however, they all cite a dearth of outstanding learning channels as a factor that somewhat impedes the growth of their digital competence. A collaborative repository of resources would be advantageous for digital competence education because it would facilitate the exchange of knowledge, transcend geographical and institutional limitations, and furnish an interface for resources and technical assistance to support teacher development and independent study.

To ensure precise resource allocation, the shared resource bank ought to be segmented into distinct domains, such as research and instruction, in accordance with the educational requirements of instructors. Additionally, pertinent exemplary resources ought to be succinctly outlined within each domain. For instance, the pedagogical component ought to amass a collection of exemplary instances of digital instruction, prioritize the incorporation of particular digital technologies into the learning process, and instruct individuals on how to “fish.” Meanwhile, it is essential that the composition of the research panel reflects an instrumental mindset, with a particular focus on incorporating research from relevant sources within the field of international Chinese language studies for the purpose of applied illustration.

5.3 Enhance the Capacity for Innovation in Pedagogical Practice

When considering the preceding section, it becomes evident that regardless of extensive teaching experience or participation in more digital competence training, the impact on pre-service teachers’ digital teaching competence improvement is insignificant. This illustrates the absence of direct realism and indirect complementarity in the advancement of pre-service teachers’ digital pedagogical competencies at the present stage. Moreover, the majority of the transition from theory to practice regarding the digital teaching abilities of pre-service teachers remains at the technological or knowledge level. This is due to the following: on the one hand, the practical training provided by the training unit for pre-service teachers is lacking in depth and is superficial in nature, failing to offer comprehensive guidance on practical methods; on the other hand, the teacher body exhibits inadequate self-awareness regarding its own teaching practice and fails to reflect critically on its digital expertise.

Pre-service teachers acquire the majority of their teaching experience through professional apprenticeships; during this phase, pedagogical approaches are conventional and unremarkable, devoid of any sense of innovation. As a training unit, we should prioritize the development of pre-service teachers’ thought processes while simultaneously promoting greater intra-disciplinary and cross-disciplinary exchanges to infuse teaching innovation with vitality, inspiration, and perspectives from various fields and viewpoints. As the majority of educators, they should utilize Chat GPT and other cutting-edge digital technology products to eliminate their tedious and repetitive work, and engage in both self-reflection and critical analysis of past teaching situations.

6. Conclusion

The integration of digital technology and international Chinese language education is an unstoppable force in the age of digital intelligence, and international Chinese language instructors are without a doubt the most vital practitioners in this endeavor. Primarily through a survey of a subset of international Chinese pre-service teachers’ samples, this article exposes the current status of teachers’ digital competence, which is commendable but unevenly developed in a number of dimensions. While the majority of pre-service teachers exhibit a considerable level of recognition with the nascent educational technologies of the digital age, there is considerable scope for future development of the digital competence of international Chinese pre-service teachers with regard to the integration of digital technologies into teaching, research, and innovation. Through an examination of influential factors including the subject’s educational institution and their level of digital training, we discovered that pre-service teachers educated at Chinese universities in the East and West exhibited variations in the extent to which they developed digital competence across various domains. Furthermore, the substantial improvement in digital knowledge and awareness brought about by digital training suggests that advocating for brief digital courses could significantly contribute to the overall development of digital proficiency among pre-service Chinese teachers from abroad.

By drawing upon the aforementioned findings and conducting additional interviews with representative subjects, we have formulated a set of suggestions regarding the development of resources and the training system for pre-service teachers of international Chinese. Our intention is to pave the way for the advancement of digital literacy among these teachers and to contribute to the ongoing digital revolution in the field of international Chinese language education. The recommendations presented in this paper can also be applied to other areas of language education and may even serve as a source of inspiration for the development of basic teacher education programs.

Regrettably, this paper continues to exhibit deficiencies with regard to the survey’s balance and sample size. Particularly problematic are the dispersed subject schools and the small sample size. Conversely, space constraints necessitate further investigation and refinement of the suggestions put forth in this paper. With the intention of

augmenting the study's dependability and universality, it is anticipated that the aforementioned deficiencies will be rectifiable in subsequent iterations by means of ongoing refinement and expansion.

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Authors' contributions

The study was designed by Cheng Yang and the manuscript was written and revised by him as well. Jingyu Wu was responsible for the questionnaire design and data collection. Finally, Prof. Jun Geng was in charge of the article revision and submission.

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Competing interests

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

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Obtained.

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Notes

Note 1. The European Digital Competence Framework for Teachers is a standard framework proposed by the European Commission for Member States in 2017.

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