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Measurement and profiles of digital literacy among English teachers in Chinese University

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Abstract

This study seeks to development and validate the Digital Literacy Scale (DLS) tailored for English teachers in Chinese universities, providing a robust tool for assessing their digital literacy. Amid the ongoing digital transformation of education, faculty digital literacy has become a cornerstone for driving the digitization of higher education, enhancing the quality of teaching, and fostering a digitally empowered society. Despite its importance, existing research predominantly focuses on conceptual frameworks and theoretical analyses. Crucially, there remains a notable paucity of studies that integrate digital literacy into subject-specific contexts, such as English education, or that rigorously validate assessment tools designed specifically for English teachers in Chinese universities. To address this measurement lacuna, data were gathered from a cohort of 541 English teachers at Chinese universities ($N_{\text{male}} = 127$; $N_{\text{female}} = 414$) and analyzed using confirmatory factor analysis (CFA) to evaluate the proposed measurement model. The CFA results demonstrate that the DLS exhibits robust psychometric properties. Additionally, the average digital literacy score among English teachers at Chinese universities was 4.79 ($SD = .73$), indicating a relatively high level of digital proficiency within this cohort. This study further discusses the implications of utilizing the DLS as a reliable tool for assessing digital literacy in this academic context.

Keywords: Scale validity; Digital literacy; Confirmatory factor analysis; Chinese college English teachers

1. Introduction

As digital technologies become increasingly integrated into education, teachers' digital literacy has emerged as a critical competency essential for navigating the ongoing transformation of the educational landscape [1]. Meanwhile, the ability to read and write, while essential, is no longer sufficient to meet the demands placed on future digital citizens. Within the broader context of cultivating digital competence, teachers assume a central role in equipping students with the necessary skills and knowledge for navigating an increasingly digital world [2]. Teachers' digital literacy extends beyond the acquisition of technical skills required to operate education technologies. It involves a nuanced understanding of how new media influence individual behaviors and social dynamics, enabling educators to support students' comprehensive development in an interconnected digital landscape [3]. Further, the COVID-19 pandemic has catalyzed a paradigm shift from traditional face-to-face classroom instruction to online teaching platforms such as Zoom, VooV Meeting, and Rain classroom, underscoring the urgent need for enhanced digital literacy among teachers [4].

While the importance of teachers' digital literacy is widely recognized by educators, administrators, and researchers [5,6], a unified conceptual framework and definition remain elusive. This lack of consensus among scholars poses significant challenges to the effective assessment and development of digital literacy in educational contexts. Concurrently, Qiu et al. (2022) noted that existing research on teachers' digital literacy primarily focuses on domain-general competencies, overlooking the integration of these skills within specific disciplines, such as college English. To

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bridge this research gap, the present study endeavors to validate the teacher digital literacy scale and assess the digital literacy profiles of a cohort of university English teachers in China. Specifically, this study aims to address two key research questions:

- Research Question 1: Does the digital literacy scale display favorable psychometric properties for assessing the digital literacy of English teachers at Chinese universities?
- Research Question 2: What is the level of digital literacy among English teachers at Chinese universities?

2. Methods

2.1. Participants and procedure

A total of 541 English teachers (127 males and 414 females) from several universities across China were recruited using convenience sampling. The questionnaire survey was administered online via the Wenjuanxing platform (<https://www.wjx.cn>). Participants were fully informed about the study's purpose and provided their informed consent before the formal data collection began. As shown in Table 1, the study sample comprised 23% male teachers and 77% female teachers, mirroring the predominant gender distribution among humanities faculty members in Chinese universities. Participants were categorized into four age groups: 25-35 years ($n = 102$, 19%), 36-45 years ($n = 279$, 52%), 46-55 years ($n = 125$, 23%), and 55 years or older ($n = 35$, 6%). Beyond assessing the digital literacy competence of English teachers, demographic data encompassing gender, age, years of teaching experience, and educational qualifications were also gathered.

Table 1 Demographic information of the participants (N = 541)

Demographics		N	%
Gender	Female	414	77%
	Male	127	23%
Age	25-35	102	19%
	36-45	279	52%
	46-55	125	23%
	55 or older	35	6%
Years of teaching experience	1-5 years	76	14%
	6-15 years	153	28%
	16-25 years	228	42%
	25 and beyond	84	16%
Educational qualification	Bachelor's	72	13.3%
	Master's	321	59.3%
	Doctorate	146	27.0%
	Others	2	0.4%

2.2. Measure

The five-item teacher digital applications (TDAp) adapted from Quicoe and Pata (2020) were utilized to measure teachers' digital literacy competency. The original scale, designed as domain-general, was adapted to align more closely with the specific context of university English teachers. For instance, the statement "I use ICT resources to inspire my pupils to learn in my lessons" was refined to "I use ICT resources to inspire my pupils to learn English," ensuring greater relevance to the target population. The scale was assessed using a six-point Likert scale, with responses ranging from 1 (strongly disagree) to 6 (strongly agree). Higher scores reflect stronger endorsement of the corresponding items. This scale has been utilized in previous studies [9,10], demonstrating strong psychometric properties, particularly in terms of construct validity and internal consistency. In the present study, the internal consistency of the TDL is good with Cronbach's alpha equals to .91.

2.3. Data analysis

Before the formal survey, a pilot study was conducted to evaluate the quality of the scale items. Following this, item analysis was performed, with a detailed examination of the psychometric properties of the teacher digital literacy scale. Exploratory Factor Analysis (EFA) was then used to explore the underlying factor structure, and Confirmatory Factor Analysis (CFA) was subsequently employed to verify the one-factor structure of teacher digital literacy scale.

A range of indices were used to assess model fit, including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). According to Byrne (2010), and Hoyle and Panter (1995), model fit was adequate if CFI and TLI values were greater than .90, and RMSEA and SRMR were less than .08.

3. Results

3.1. Pre-test analysis

Item discrimination was assessed by examining the ability of each item to differentiate between high and low scorers. Following the pre-test sample size criteria outlined by Oksenberg et al. (1991), a total of 61 participants were involved in the pre-test analysis. Specifically, 27% of participants with the highest and lowest scores were selected for evaluation, as recommended by Kelley (1939). The results, presented in Table 2, reveal significant mean differences for each item, indicating that all items effectively discriminated between respondents. As a result, all items were deemed suitable for inclusion in the formal investigation.

Table 2 The results of pre-test

	t-test for Equality of Means				Group	N	Mean	SD
	<i>t</i>	<i>df</i>	<i>p</i>	Mean Difference				
Item1	-6.22	32.00	0.00	-1.29	Low	17	4.35	0.61
					High	17	5.65	0.61
Item 2	-11.07	32.00	0.00	-2.06	Low	17	3.65	0.61
					High	17	5.71	0.47
Item 3	-14.03	32.00	0.00	-2.00	Low	17	3.88	0.49
					High	17	5.88	0.33
Item 4	-7.84	32.00	0.00	-1.65	Low	17	3.88	0.60
					High	17	5.53	0.62
Item 5	-9.47	32.00	0.00	-2.18	Low	17	3.65	0.86
					High	17	5.82	0.39

3.2. Item analysis

Subsequently, we performed an item analysis to assess the quality of the items in the digital literacy scale designed for college English teachers. This analysis involved examining the mean values, variances, distribution characteristics, corrected item-total correlations, and the Cronbach's alpha coefficient after potential item exclusions. The results of this analysis are summarized in Table 3.

As demonstrated in Table 3, the items in the DLS exhibit a normal distribution, as per the criteria outlined by Finney and DiStefano (2006) ($|\text{skewness}| < 2$, $|\text{kurtosis}| < 7$). Additionally, the corrected item-total correlations for these five items range from $r = .71$ to $r = .80$, meeting the threshold of $r > .40$ established by Clark and Watson (1995). The scale demonstrated strong reliability, with a Cronbach's alpha of .92.

To further assess the scale's reliability, we conducted an item deletion analysis. This process involved sequentially removing each item and recalculating Cronbach's alpha to determine any changes in reliability. For instance, the effect of deleting an item such as "I am applying ICT resources in communicating about my students' learning" was evaluated.

As indicated in Table 3, Cronbach's alpha decreased only slightly from .91 to .89 following item removal. The analysis revealed that removing any individual item resulted only a marginal reduction in reliability, suggesting that all six items meet the reliability criteria, and no items should be excluded.

Table 3 Item-level analyses for the teacher digital literacy scale

	Mean	SD	Skewness	Kurtosis	Corrected item-total correlation	Cronbach's Alpha if item deleted
Item1	4.91	0.79	-1.05	3.26	0.77	0.89
Item2	4.73	0.89	-0.92	1.75	0.80	0.89
Item3	4.80	0.84	-0.80	1.74	0.80	0.89
Item4	4.75	0.85	-1.02	2.51	0.80	0.89
Item5	4.79	0.87	-0.82	1.66	0.71	0.90

3.3. Construct validity

To ascertain the construct validity of the teacher digital literacy scale, we sequentially employed exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Initially, EFA was performed to unravel the underlying factor structure of the scale, elucidating how items cluster together and revealing latent constructs. This phase offered an initial grasp of the scale's dimensionality and guided subsequent CFA. Subsequently, CFA was deployed to scrutinize the hypothesized factor structure emergent from the EFA, evaluating the fit between the proposed model and observed data. The outcomes of both analyses were instrumental in validating the scale's construct validity, ensuring it precisely measures the intended facets of teacher digital literacy.

3.3.1. Exploratory factor analysis

EFA was conducted to examine the factor structure of the teacher digital literacy scale. To assess the suitability of the data for factor analysis, we calculated the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, with values greater than .70 indicating adequate sampling and values above .80 considered excellent [17]. In the present study, the KMO value was .891, indicating good sampling adequacy, and Bartlett's test of sphericity was significant ($\chi^2 = 1770.712$, $df = 10$, $p < .001$), confirming that the data were appropriate for factor analysis.

Principal axis factoring (PAF) was performed, revealing a single factor with an eigenvalue greater than one, which accounted for 74.08% of the total variance in teacher digital literacy. After performing PAF with varimax rotation (Kaiser Normalization) over six iterations, the factor loadings for all items exceeded .80, ranging from .81 to .88, indicating strong associations between the items and the extracted factor.

Overall, the EFA results provided evidence of acceptable construct validity for the scale. All factor loadings were greater than .80, and cross-loadings between factors were below .30 [18]. These findings suggest that the scale exhibits robust psychometric properties, supporting its application in subsequent CFA.

3.3.2. Confirmatory factor analysis

The psychometric properties of the teacher digital literacy scale were further assessed through CFA. The CFA results, presented in Table 4, revealed that the model fit indices were all within acceptable ranges [19], indicating a good fit for the scale. Specifically, the comparative fit index and Tucker-Lewis index were both greater than .95, while the RMSEA and SRMR were both below or approximately equal to .08, consistent with the criteria proposed by Chen (2007), Hu and Bentler (1999) for good model fit. Additionally, the factor loadings for all items exceeded .70, ranging from .75 to .86, further supporting the scale's construct validity and the robustness of its factor structure.

Table 4 CFA results of the teacher digital literacy scale

Scale	Factor loading	χ^2	df	RMSEA	90% CI	CFI	TLI	SRMR
Teacher Digital Literacy	.75-.86	19.202	5	.072	.040,.108	.992	.984	.015

3.4. General profile of English teachers' digital literacy

The present study validated the effectiveness of the teacher digital literacy scale in assessing the digital literacy of college English teachers in China through pilot study, item analysis, and construct validity evaluation. The results demonstrated that the scale's strong psychometric properties, including high internal consistency, appropriate factor structure, and robust model fit, confirming its suitability for measuring digital literacy in this context. Table 5 presents an overview of the digital literacy levels of college English teachers in China. This study utilized a 6-point Likert scale to assess the level of digital literacy among English teachers from universities in mainland China, with values ranging from 1 to 6. As presented in Table 5, the mean digital literacy score among the English teachers surveyed is 4.79 ($SD = .73$). According to Streiner et al. (2015), this score reflects a high level of digital literacy within the English teaching cohort.

Table 5 Profile of Chinese English teachers' digital literacy

	Min	Max	Mean	SD	Skewness	SE	Kurtosis	SE
Teacher Digital Literacy	1	6	4.79	.73	-.86	.11	2.66	.21

4. Discussion

This study seeks to validate a digital literacy scale using a sample of college English teachers from mainland China. Additionally, the present study examined the overall profile of the teachers' digital literacy. The findings demonstrated that the digital literacy scale possessed strong psychometric properties, thereby affirming its effectiveness in evaluating the digital literacy of English teachers at universities in mainland China. Furthermore, this research assessed the digital literacy levels of English teachers at Chinese universities, revealing that their digital literacy levels are notable high.

First, the current study confirmed the efficacy of the digital literacy scale within the cohort of English teachers at Chinese universities, thereby addressing Research Question 1. University educators serve as both digital citizens and advocates of digital citizenship [6]. Consequently, the development of a scale specifically designed to assess the digital literacy of university faculty is crucial for enhancing their digital competencies and promoting the cultivation of digitally literate citizens equipped with innovation and critical thinking [23,24]. Nonetheless, existing research predominantly focuses on the digital literacy levels of student populations [19]. Studies on teachers' digital literacy are relatively sparse and often overlook the domain-specific dimensions of digital literacy [7,25]. The present study advances the literature by validating the efficacy of the DLS within a sample of English teachers at universities in mainland China. On the one hand, the DLS could be utilized to assess the digital literacy competencies of Chinese college English teachers, thereby informing and guiding the professional development of their digital skills. On the other hand, the DLS could also support educational institutions by providing a tool to assess and enhance faculty members' digital literacy, thereby facilitating the integration of technology into teaching practices.

Second, this study found that university English teachers achieved an average digital literacy score of 4.79, indicating a high level of proficiency in digital literacy. This finding directly addresses research question 2. Teachers exhibiting high digital literacy are inclined to incorporate a greater array of digital educational resources into their instruction, thereby offering learners enhanced opportunities for active learning [26]. Notably, the contemporary cohort of students, frequently characterized as digital natives due to their birth and development within the digital era, harbor high expectations for the integration of ICT into their educational experiences [27–29]. Thus, achieving a requisite level of digital literacy among educators is crucial for enhancing students' academic engagement and advancing educational outcomes [6]. This study demonstrated that English teachers at universities in mainland China possess a relatively high level of digital literacy, indicating robust proficiency in this area. One possible explanation is that, during the three-year COVID-19 lockdown period, English teachers at Chinese universities, who conducted their classes through online platforms, significantly enhanced and developed their digital literacy [24].

The findings of this study offer two implications for educational practice. Firstly, the present study confirms the domain specificity of the DLS within a sample of English teachers at universities in mainland China, indicating that this scale can be utilized to assess the digital literacy levels of English teachers and also provides intervention dimensions for enhancing their digital literacy. Secondly, the present study reveals that digital literacy levels among university English teachers in China are relatively high, suggesting that research related to teacher digital competence should shift from solely enhancing teachers' digital literacy to fully leveraging their digital literacy to empower students' digital skills.

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5. Conclusion

This study employed confirmatory factor analysis to validate the robust psychometric properties of the Digital Literacy Scale (DLS) in assessing the digital literacy of university English teachers in China. Results indicate that these educators exhibit comparatively high levels of digital literacy, underscoring the DLS as a reliable and effective instrument for evaluating their digital competencies. This work provides a critical resource for guiding efforts to enhance digital literacy skills among university English teachers. By illuminating the current state of digital proficiency in this population, the study also establishes a foundation for optimizing the application of these competencies in educational practice. Furthermore, it highlights the role of teacher digital literacy in fostering digital citizenship, paving the way for strategic interventions to support technology integration in higher education and cultivating future-ready learners.

Compliance with ethical standards

Disclosure of conflict of interest

There are no conflicts of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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