



The Current Situation of ICT Teaching Competencies and Influencing Factors among Undergraduate Primary Teacher Education Students at Weifang University

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Abstract

Background and Aims: Information and Communication Technology (ICT) has become an essential component of modern education. To support the development of future teachers, the Ministry of Education in China issued the Standards for ICT Teaching Competencies of Teacher Education Students in 2018, which were developed by Ren et al. (2018). The standard streamlined the earlier framework for in-service teachers into three key dimensions: basic technological literacy, technology-supported learning, and technology-supported teaching. Guided by this national standard, this study aimed to investigate the current situation of ICT teaching competencies among undergraduate primary teacher education students at Weifang University and explore the factors influencing these competencies.

Methodology: Data were collected through questionnaires and analyzed using SPSS. The analysis included descriptive statistics, independent samples t-tests, one-way ANOVA, Pearson correlation, and multiple regression analysis.

Results: A total of 252 undergraduate primary teacher education students participated in the study, including 92 males and 160 females. By grade level, the sample consisted of 45 first-year, 61 second-year, 56 third-year, and 90 fourth-year students. In terms of academic performance, 53 students were classified in the top 30%, 153 in the middle 30%–70%, and 46 in the bottom 30%. Additionally, 109 students had participated in off-campus internships or practical experiences, while 143 had not. The results showed that students' ICT teaching competencies were moderate ($M=3.22$), with fourth-year students performing significantly better than first-year students. High-performing students outperformed their middle and low-performing peers. No significant gender differences were found. Although students with additional internship experience outside the university had slightly higher scores, the differences were not statistically significant. Regression analysis indicated that attitude, self-efficacy, practical opportunities, and courses were significant positive predictors of ICT teaching competencies, while facilities, teacher support, and school culture showed no significant impact.





Conclusion: These findings may offer useful insights for primary teacher education programs aiming to enhance ICT integration in teacher preparation.

Keywords: Primary Teacher Education Students; ICT Teaching Competencies; Current Situation; Influencing Factors

Introduction

Teacher education students represent the reserve force for future teachers; their ability to effectively integrate ICT into teaching will have a direct impact on the quality of future education (Ren et al., 2018). Existing research suggests that the overall level of ICT teaching competencies among these students remains at an intermediate stage in China (Wang et al., 2023). Consequently, scholarly attention has increasingly turned to exploring the factors that influence teacher education students' integration of ICT. These factors can be broadly categorized into internal factors, such as attitudes and self-efficacy, and external factors, including infrastructure, curriculum design, teacher support, practical opportunities, and school culture.

Primary education plays a crucial role in the Chinese education system, and it is equally important to develop ICT teaching competencies among primary teacher education students. To support the development of future primary school teachers, the Ministry of Education issued the Standards for ICT Teaching Competencies of Teacher Education Students in 2018, which were developed by Ren et al. (2018). These standards simplified the earlier framework for in-service teachers into three key dimensions—basic technological literacy, technology-supported learning, and technology-supported teaching—reflecting both the current learning and future teaching needs of teacher education students.

Despite the national emphasis on ICT competency development, implementation at the institutional level varies significantly across universities. Weifang University plays an important role in preparing qualified primary education professionals in China. This study aims to investigate the current situation of ICT teaching competencies and the factors influencing their development among primary teacher education students at Weifang University. The findings are expected to provide evidence-based insights to support curriculum design, inform teacher education policies, and guide future research on ICT integration in teacher preparation programs.

However, while national-level standards and general investigations into ICT teaching competencies have been conducted, there remains a research deficiency in understanding how these competencies are being developed at specific institutional and regional levels. In particular, localized contexts such as Weifang University—an important institution for preparing primary education professionals—have not been adequately examined in the existing empirical literature. This study aims to address this gap by investigating the current situation of ICT teaching





competencies and the factors influencing their development among undergraduate primary teacher education students at Weifang University. The findings are expected to provide evidence-based insights to support curriculum design, inform teacher education policies, and guide future research on ICT integration in teacher preparation programs.

Objectives

1. To investigate the current situation of ICT teaching competencies among undergraduate primary teacher education students at Weifang University.
2. To identify the factors influencing the development of ICT teaching competencies among undergraduate primary teacher education students at Weifang University.

Literature Review

1. Framework of ICT teaching competencies of teacher education students

In 2014, the Ministry of Education of China issued the Standards for the Application of ICT Competencies for Primary and Secondary School Teachers (Trial), which proposed requirements for teachers on five dimensions: technological literacy, planning and preparation, organization and management, assessment and diagnosis, and learning and development. As teacher education students represent the future workforce of educators, their competency development should align with the requirements for in-service teachers. Therefore, the Standards for the Application of ICT Competencies for Primary and Secondary School Teachers (Trial) should serve as the foundation for considering standards for teacher education students. Since teacher education students and in-service teachers in primary and secondary schools face different teaching situations and ability requirements, it is necessary to re-divide the dimensions of the Standards for the Application of ICT Competencies for Primary and Secondary School Teachers (Trial) to highlight the characteristics of teacher education students. Ren et al. (2018) developed the Standards for ICT Teaching Competencies of Teacher Education Students. It outlines the requirements for teacher education students in both their current role as students and their future role as teachers. These requirements focus on three dimensions: basic technological literacy, technology-supported learning, and technology-supported teaching. Basic technological literacy is the foundational competency that teacher education students must possess. Technology-supported learning refers to the transferable competencies that teacher education students need to acquire as 21st-century students. Technology-supported teaching encompasses the professional competencies they should possess as future teachers.



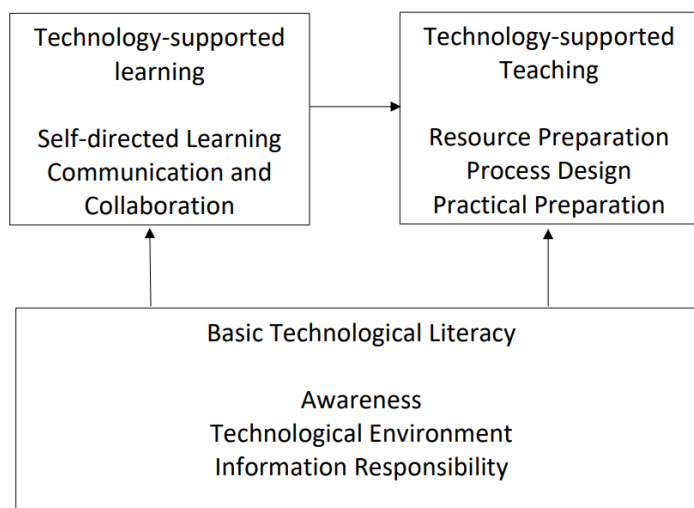


Figure 1 The framework of ICT teaching competencies for teacher education students (Ren et al., 2018)

While several international frameworks—such as the ISTE Standards for Educators (ISTE, 2017) and UNESCO's ICT Competency Framework for Teachers (ICT CFT Version 3) (UNESCO, 2018)—have also defined comprehensive sets of ICT competencies, these are primarily designed for in-service teachers who are already embedded in professional teaching contexts. For example, the ISTE Standards define roles such as "designer" and "analyst," which presume classroom authority and teaching autonomy. Similarly, the ICT CFT emphasizes aspects like educational policy and school-level management, which may not yet apply to pre-service teachers.

In contrast, the framework proposed by Ren et al. (2018) is specifically developed for teacher education students in China, taking into account both national education policy and the transitional nature of pre-service teacher training. Therefore, this study adopts the Ren et al. (2018) framework as the primary theoretical foundation for assessing and analyzing the ICT teaching competencies of undergraduate primary education students at Weifang University.

2. Influencing factors of ICT teaching competencies of teacher education students

Sang et al. (2010) found that self-efficacy had a direct positive impact on teacher education students' overall ICT teaching competencies. Similarly, Tezci (2011) emphasized the significant role of self-efficacy in shaping teacher education students' use of information technology. Self-efficacy is not only crucial for the use of ICT but also for effective teaching practice, as it influences teachers' strategies for evaluating information, their digital competence, and their use of ICT in school (Hatlevik, 2017). Additionally, mental representations such as self-efficacy, which reflect an individual's perceived performance, competencies, and abilities, play a key role in the

development of digital competencies (Peiffer et al., 2020). Attitude is another critical factor influencing ICT teaching competencies. Jegede et al. (2007) found that attitude is significantly related to ICT competencies and can predict them. A strong positive correlation exists between teachers' ICT skills, their attitudes toward ICT, and the actual application of ICT in classroom teaching (Rastogi & Malhotra, 2013). Pozas and Letzel (2023) further revealed that attitudes, along with the ability to teach and apply technology in practice, are the most significant predictors of future ICT usage among pre-service teachers.

In addition to internal factors such as self-efficacy and attitude, external factors also play an essential role in ICT teaching competencies. Mirzajani et al. (2016) identified key external factors such as teacher guidance and sufficient resource access, while noting that the lack of technical support could hinder effective technology integration. Soykan and Ozdamli (2016) also found that information technology courses focusing on educational practices significantly enhanced pre-service special education teachers' ICT competencies.

Building on these findings, this study investigated the factors influencing ICT teaching competencies among undergraduate primary teacher education students at Weifang University. These factors are categorized into internal factors (attitude, self-efficacy) and external factors (facilities, courses, teacher support, practical opportunities, school culture).

Conceptual Framework

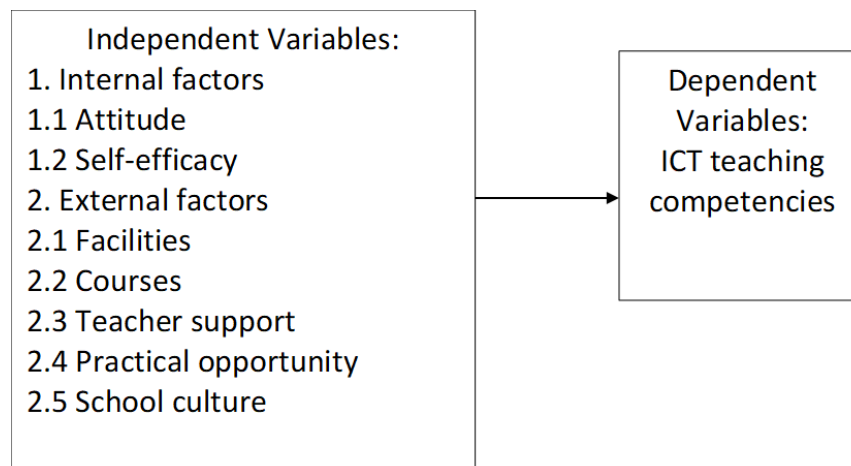


Figure 2 The conceptual framework

Methodology

1. Sample



A total of 252 undergraduate primary teacher education students from Weifang University participated in this study. Among them, 92 participants (36.5%) were male, and 160 participants (63.5%) were female. In terms of academic year, the sample included 45 first-year students (17.9%), 61 second-year students (24.2%), 56 third-year students (22.2%), and 90 fourth-year students (35.7%).

2. Instrument

A structured questionnaire was used to investigate the current status and influencing factors of ICT teaching competencies among 252 undergraduate primary teacher education students at Weifang University. The instrument consisted of items corresponding to key dimensions of ICT teaching competencies and related influencing factors.

To ensure content validity, the questionnaire underwent expert evaluation through the Item-Objective Congruence (IOC) method. Three experts independently reviewed each item based on its relevance to the research objectives, using a scoring scale of 1 (clearly relevant), 0 (unclear), and -1 (clearly irrelevant). Items with an IOC score of 0.5 or higher were retained, while items scoring below 0.5 were revised or removed. The final IOC result of the questionnaire was 0.996, indicating excellent content validity.

Before the formal administration of the questionnaire, a pretest was conducted with a sample of 30 undergraduate primary education students to assess the instrument's reliability. Cronbach's alpha coefficients were calculated for each sub-dimension and the overall scale. All alpha values exceeded the 0.70 threshold, confirming that the instrument demonstrated strong internal consistency and was suitable for measuring the ICT teaching competencies of the target student population.

3. Data collection

The online questionnaire was distributed to undergraduate primary teacher education students at Weifang University in the form of a link and a QR code. For data collection, the questionnaire was administered during students' free time to avoid disrupting regular class schedules. In total, 252 anonymous participants completed the questionnaires.

4. Data analysis

Data were collected through questionnaires and analyzed using SPSS. The analysis included descriptive statistics, independent samples t-tests, one-way ANOVA, Pearson correlation, and multiple regression analysis. In the regression analysis, ICT teaching competencies were treated as the dependent variable, while factors such as attitude, self-efficacy, facilities, courses, teacher support, practical opportunities, and school culture were treated as independent variables. Regression coefficients and p-values were used to test the significance of each factor, and



multicollinearity was examined using variance inflation factors (VIFs). The score range with its verbal interpretation is shown below.

Table 1 Score range of ICT teaching competencies

Score Range	ICT Teaching Competencies
4.21-5.00	proficient
3.41-4.20	advanced
2.61-3.40	Intermediate
1.81-2.60	faint
1.00-1.80	unskilled

5. Reliability of the questionnaire

The overall Cronbach's alpha values for the two scales and the Cronbach's alpha values for each sub-dimension are shown in Tables 2 and 3. The overall Cronbach's alpha value for the ICT teaching competencies scale was 0.864. The Cronbach's Alpha values for the three sub-dimensions were 0.762, 0.753, and 0.824, respectively. The overall Cronbach's alpha value for the influencing factors scale was 0.825, and all sub-dimensions exceeded 0.70. Therefore, the reliability of the questionnaire is sufficient to support further statistical analyses in this study.

Table 2 Reliability analysis of the self-assessment scale

Dimension	Number of items	Cronbach's Alpha
Basic Technological Literacy	8	0.762
Technology-supported Learning	8	0.753
Technology-supported Teaching	11	0.824
Overall	27	0.864

Table 3 Reliability analysis of the influencing factors scale

Dimension	Number of items	Cronbach's Alpha
Attitude	6	0.727
Self-efficacy	6	0.742
Facilities	6	0.755
Courses	6	0.744
Teacher Support	6	0.738
Practical Opportunity	6	0.735



Dimension	Number of items	Cronbach's Alpha
School Culture	6	0.739
Overall	42	0.825

Results

1. Descriptive analysis

Table 4 presents the descriptive statistics of ICT teaching competencies across dimensions. The overall mean score was 3.22 (SD = 0.59), indicating an intermediate level. Among the dimensions, basic technological literacy ranked highest, followed by technology-supported learning, ICT teaching competencies, and technology-supported teaching.

Table 4 The statistical descriptive analysis of ICT teaching competencies

Dimension	Mean	S.D.
Basic Technological Literacy	3.26	0.74
Technology-supported Learning	3.24	0.82
Technology-supported Teaching	3.17	0.73
ICT teaching competencies	3.22	0.59

2. Difference analysis

2.1 Comparison of different genders

The results shown in Table 5 indicate no statistically significant differences between male and female participants in ICT teaching competencies.

Table 5 The comparison of ICT teaching competencies between genders

Dimension	Gender	Mean	S.D.	t	p	Cohen's d
Basic Technological Literacy	Male	3.28	0.77	0.325	0.746	0.04
	Female	3.25	0.73			
Technology-supported Learning	Male	3.12	0.84	-1.780	0.076	-0.23
	Female	3.31	0.80			
Technology-supported Teaching	Male	3.07	0.80	-1.606	0.110	-0.22
	Female	3.23	0.68			
ICT Teaching Competencies	Male	3.15	0.65	-1.390	0.166	-0.19
	Female	3.26	0.55			

2.2 Comparison of different grades

Table 6 shows that significant developmental differences in ICT teaching competencies were consistently observed between first-year and fourth-year students in the dimensions of technology-supported learning, technology-supported teaching, and overall ICT teaching competencies.

Table 6 The comparison of ICT teaching competencies across grades

Dimension	Grade	M	S.D.	F	p	η^2	Multiple group comparison
Basic Technological Literacy	First-year	3.07	0.89	1.527	0.208	0.018	
	Second-year	3.24	0.70				
	Third-year	3.28	0.69				
	Fourth-year	3.35	0.71				
Technology-supported Learning	First-year	2.95	0.91	3.328	0.020	0.039	Fourth-year>First-year
	Second-year	3.16	0.85				
	Third-year	3.32	0.78				
	Fourth-year	3.39	0.74				
Technology-supported Teaching	First-year	2.99	0.67	3.430	0.018	0.040	Fourth-year>First-year
	Second-year	3.01	0.77				
	Third-year	3.24	0.74				
	Fourth-year	3.32	0.70				
ICT Teaching Competencies	First-year	3.00	0.66	4.411	0.005	0.051	Fourth year>First year
	Second-year	3.12	0.60				
	Third-year	3.28	0.55				
	Fourth-year	3.35	0.54				

2.3 Comparison of different academic performances

Significant differences in ICT teaching competencies were found among students of different academic performance levels. As shown in Table 7, students in the top 30% academic ranking consistently outperformed their peers in the 30%–70% and bottom 30% across all four dimensions: basic technological literacy, technology-supported learning, technology-supported teaching, and overall ICT teaching competencies ($p < .001$ or $.001$). In most cases, the 30%–70 % group also scored significantly higher than the bottom 30%, particularly in basic technological literacy and overall ICT competencies.

Table 7 The comparison of ICT teaching competencies in different academic performances

Dimension	Class Ranking	M	S.D.	F	p	η^2	Multiple group comparison
Basic Technological Literacy	Top 30%	3.39	0.72	7.355	<0.001	0.056	Top 30%>
	30%-70%	3.32	0.71				Bottom 30%,
	Bottom 30%	2.89	0.79				30%-70%>Bottom 30%
Technology-supported Learning	Top 30%	3.56	0.64	6.706	0.001	0.051	Top 30%>30%-70%, Top 30%>
	30%-70%	3.21	0.82				Bottom 30%
	Bottom 30%	2.98	0.90				
Technology-supported Teaching	Top 30%	3.52	0.64	9.872	<0.001	0.074	Top 30%>30%-70%, Top 30%>
	30%-70%	3.12	0.70				Bottom 30%
	Bottom 30%	2.92	0.79				
ICT Teaching Competencies	Top 30%	3.49	0.49	12.272	<0.001	0.090	Top 30%>30%-70%, Top 30%>
	30%-70%	3.21	0.56				Bottom 30%,
	Bottom 30%	2.93	0.65				30%-70%>Bottom 30%

2.4 Comparison of ICT teaching competencies based on Off-Campus Internship/Practical Experience

Table 8 shows that while students who had participated in off-campus internships or practical training tended to have higher mean scores across all dimensions of ICT teaching competencies, the differences were not statistically significant.

Table 8 The Comparison of ICT teaching competencies based on off-campus internship/practical experience

Dimension	Off-Campus		M	S.D.	t	p	Cohen's d
	Internship/Practical Experience						
Basic Technological Literacy	Yes	3.29	0.72	0.526	0.599	0.07	
	No	3.24	0.76				
Technology-supported Learning	Yes	3.33	0.77	1.445	0.150	0.18	
	No	3.18	0.85				

Dimension	Off-Campus		M	S.D.	t	p	Cohen's d
	Internship/Practic	al Experience					
Technology-supported Teaching	Yes	3.26	0.68	1.679	0.094	0.22	
	No	3.10	0.76				
ICT Teaching Competencies	Yes	3.29	0.53	1.638	0.103	0.22	
	No	3.16	0.63				

3. Relationship analysis

3.1 Pearson correlation analysis

Table 9 presents the Pearson correlations between influencing factors and ICT teaching competencies across four dimensions. Attitude, self-efficacy, courses, and practical opportunities showed significant positive correlations with all dimensions of ICT teaching competencies. Among them, attitude and practical opportunities demonstrated the strongest correlations, particularly with technology-supported learning and overall ICT teaching competencies. In contrast, facilities and school culture showed weaker or non-significant correlations.

Table 9 Pearson correlation analysis of factors influencing ICT teaching competencies

Dimension	Basic Technological Literacy	Technology-supported Learning	Technology-supported Teaching	ICT Teaching Competencies
Attitude	.306**	.442**	.360**	.478**
Self-efficiency	.174**	.217**	.359**	.335**
Facilities	.105	.103	.054	.109
Courses	.238**	.310**	.172**	.303**
Teacher support	.127*	.200**	.016	.138*
Practical opportunity	.276**	.417**	.385**	.469**
School culture	.079	.131*	.077	.122

*, $P < 0.05$; **, $P < 0.01$

3.2 Pearson correlation analysis

Table 10 shows the regression results for factors influencing ICT teaching competencies across different dimensions. The study found that attitude ($B=0.193$), courses ($B=0.142$), and practical opportunities ($B=0.164$) had significant positive effects on basic technological literacy. Similarly, attitude ($B=0.308$), courses ($B=0.189$), and practical opportunities ($B=0.283$) also

significantly influenced technology-supported learning. For technology-supported teaching, significant positive effects were observed from attitude ($B=0.212$), self-efficacy ($B=0.181$), and practical opportunities ($B=0.220$). Regarding overall ICT teaching competencies, the significant positive predictors were attitude ($B=0.235$), self-efficacy ($B=0.081$), courses ($B=0.123$), and practical opportunities ($B=0.222$).

Table 10 Regression analysis of factors influencing ICT teaching competencies

	Basic Technological Literacy	Technology- supported Learning	Technology- supported Teaching	ICT Teaching Competencies
Attitude	.193***	.308***	.212***	.235***
Self-efficacy	.018	.008	.181***	.081*
Facilities	.028	-.016	-.007	.001
Courses	.142**	.189***	.063	.123***
Teacher support	-.021	.017	-.091	-.038
Practical opportunity	.164***	.283***	.220***	.222***
School culture	.040	.090	.060	.063

*, $P<0.05$; **, $P<0.01$; ***, $P<0.001$

Discussion

The study revealed that the overall ICT teaching competencies index of the students was 3.22, indicating a moderate level. Further analysis showed no statistically significant differences in ICT teaching competencies or their sub-dimensions between male and female students. This result suggests that, within the current educational context and training system, male and female pre-service teachers at Weifang University exhibit relatively balanced levels of ICT teaching competencies.

In terms of academic progression, fourth-year students scored statistically significantly higher than first-year students in overall ICT teaching competencies as well as in the sub-dimensions of technology-supported learning and technology-supported teaching. Although differences among other academic years did not reach statistical significance, the mean scores for overall ICT teaching competencies and each sub-dimension gradually increased as students progressed through their academic years. These results indicate that as students advance in their academic years, their ICT



teaching competencies—particularly in terms of applying technology to support teaching and learning—tend to improve.

Moreover, Students in the top academic group consistently outperformed those in the middle and lower academic groups across all dimensions. In particular, those ranked in the top 30% demonstrated statistically significantly stronger abilities in both technology-supported learning and technology-supported teaching. Moreover, students in the middle range also showed significantly better performance than those in the bottom 30%, especially in overall ICT teaching competencies and basic technological literacy. These findings suggest that academic performance is closely associated with the development of ICT teaching competencies. Higher-achieving students may possess stronger learning motivation, greater engagement with technology-related content, or more effective study strategies, all of which contribute to their enhanced ICT capabilities.

Finally, the study examined whether students' participation in additional off-campus internships or practical experiences—beyond the official practicum opportunities provided by the university—had any impact on their ICT teaching competencies. The results revealed no statistically significant differences in overall ICT teaching competencies or any of the sub-dimensions, including basic technological literacy, technology-supported learning, and technology-supported teaching, between students with and without such external experiences. These findings suggest that simply engaging in extra off-campus practical activities did not result in significantly enhanced ICT teaching skills.

In the regression analysis, the study further explored the predictive effects of seven variables, namely attitude, self-efficacy, facilities, courses, teacher support, practice opportunities, and school culture, on students' ICT teaching competencies. The analysis results show that attitude is the most stable and significant positive predictor in all dimensions, indicating that students' cognition and positive attitude towards the importance of ICT in teaching are important internal driving forces for their ability improvement. Self-efficacy also has a significant impact on the technology-supported teaching dimension and overall ICT teaching competencies. This finding is consistent with Bandura's social cognitive theory, that is, an individual's confidence in his or her ability directly affects his or her behavior. Courses and practice opportunities also show significant predictive effects in multiple models, indicating that well-structured, practical ICT courses and authentic teaching practice opportunities are of key value to the formation of students' competencies. High-quality courses not only provide knowledge but also integrate ICT teaching methods to help students accumulate experience in teaching design and classroom operations, and effective practice opportunities can shorten the distance between theory and application and enhance students' ability to use technology in real teaching situations. In contrast, facilities,





teacher support, and school culture did not show significant effects in any model. This may be due to: on the one hand, the distribution of teaching facilities that students are exposed to is relatively balanced, and the utilization rate is low, which makes it difficult to produce differentiated effects; on the other hand, although teachers support ICT teaching, their ability and willingness to use technology may be limited, resulting in students feeling weak support. In addition, the influence of school culture is relatively macro, and its subtle role is difficult for students to perceive in the short term; there is a lack of specific and operational guidance mechanisms.

It should be emphasized that the insignificance of these variables does not mean that they are not important, but may reflect that the current implementation strategy has the problem of "having resources but not being effectively transformed". Therefore, in the future, we should focus on improving the availability and frequency of use of ICT resources, improving teachers' technical literacy and guidance ability, and creating a more open, innovative, and encouraging school culture atmosphere for the use of technology, to more systematically improve students' ICT teaching competencies.

Recommendation

1. This study explored the ICT teaching competencies and their influencing factors among undergraduate primary teacher education students at Weifang University. The participants represented a small and specific group from a single institution. It would be beneficial if future studies included a larger and more diverse sample of students from different universities or educational backgrounds to increase the generalizability of the findings.

2. In this study, ICT teaching competencies were assessed using a scale structured around three key dimensions: basic technological literacy, technology-supported learning, and technology-supported teaching. Future research could consider adopting alternative theoretical frameworks or employing different measurement models to validate or expand upon the current findings.

3. In this study, the influencing factors of ICT teaching competencies were measured using a scale that included seven dimensions: attitude, self-efficacy, facilities, courses, teacher support, practical opportunity, and school culture. Future research may explore the use of different factor structures or incorporate additional contextual variables to gain a more comprehensive understanding of the influences on ICT teaching competencies.





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