https://doi.org/10.37420/j.cer.2024.092

Research on the Influencing Factors of the Development of Teacher Education Students' ICT Teaching Competence

Fanli Chen[1]*, Yachun Liu[2]

1 School of Foreign Studies, Zhaoqing University, Guangdong, China

2 College of Teacher`s Education, GuagDong University of Education, Guangdong, China

***Corresponding author, E-mail: 1731174741@qq.com**

Abstract:

As educational informatization continues to progress, the role of information technology in education is becoming increasingly evident, prompting both teachers and students to transform their teaching and learning approaches and to create a new, collaborative learning community. This study clarifies the components of ICT Teaching Competence for teacher education students and employs a self-developed questionnaire to investigate the current capabilities of students at H University. Findings indicate that key factors influencing the development of teacher candidates' IT teaching competence include attitudes and awareness, teacher modeling, disciplinary culture, curriculum design, and institutional support, with disciplinary culture and teacher modeling identified as the most significant. Furthermore, a model of influencing factors was developed, and targeted strategies were proposed at the student, teacher, and institutional levels to foster the development of IT teaching competence. This study aims to offer practical guidance for enhancing teacher candidates' skills in educational technology, supporting their professional growth.

Keywords:

teacher education students; ICT Teaching Competence; influencing factors

1. Introduction

With the widespread adoption of next-generation intelligent technologies, how teachers can leverage emerging tools to enhance classroom effectiveness has become a central topic in educational technology. In April 2018, China's Ministry of Education released the Educational Informatization 2.0 Action Plan, which emphasized the need to innovate teacher education curricula, strengthen the cultivation of information literacy, and enhance ICT Teaching Competence among teacher candidates[1]. In this era of rapid educational digitalization, teachers not only require a strong foundation in theoretical knowledge but also need the capability to effectively integrate advanced technology to support classroom instruction. As teacher candidates represent the future of education, their competence in information technology teaching will indirectly shape the direction of educational reform. Consequently, developing IT teaching competence in teacher candidates is crucial

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in the digital age. This focus on cultivating digital teaching skills has become a priority for teacher education institutions and the broader educational field. Therefore, identifying the key factors influencing the development of this competence is essential for more effective training.

2. Literature Review

Information technology teaching competence refers to the comprehensive ability to facilitate student development through the use of digital resources to conduct instructional activities and fulfill teaching objectives[2]. Essentially, IT-based teaching is an outcome of the rapid convergence of technology with education, contrasting traditional methods by emphasizing the meaningful integration of information technology within classroom instruction. For both teachers and students, this approach highlights the interactive process between educators, learners, and digital tools, emphasizing the effective use of modern instructional media to achieve a human-computer collaborative learning environment.

Regarding the factors influencing teacher candidates' IT teaching competence, several researchers have shared their perspectives. Zhang Daoxue and Zhao Keyun (2017) proposed that these factors include candidates' disciplinary perspectives, the role modeling by faculty, and involvement in teaching practice[3]. Wei Yina (2017) suggested that primary factors include satisfaction with IT-based instructional courses, teacher role modeling, hands-on educational experiences, ample practice opportunities provided by schools, and courses on technology integration in specific subjects[4]. Yang Ning, Bao Zhengwei, and Dong Yuqi (2014) posited two categories of influence: internal factors (candidates' beliefs and practical experience) and external factors (faculty modeling, institutional culture, and IT-focused subject courses). They also developed an exploratory model of these factors[5]. In June 2018, the Standards for Teacher Candidates' IT Teaching Competence was issued by the Ministry of Education and China Mobile Research Team, defining standards across three dimensions: basic technological literacy, technology-supported learning, and technology-supported teaching. This standard provides a clear framework for improving IT competence among teacher candidates[6].

An analysis of the literature reveals that research on IT teaching competence largely focuses on strategies for training teacher candidates. However, the criteria often mirror those used for in-service teachers. Different studies classify the factors affecting IT teaching competence development across various dimensions, yet most include cognitive attitudes, environment, course design, and practice. This study posits that the key factors influencing the development of IT teaching competence among teacher candidates include attitudes and awareness, teacher modeling, disciplinary culture, curriculum design, and institutional support.

3. Research Design

3.1 Questionnaire Development

Based on a review of the literature and relevant standards, a custom tool titled Survey on Influencing Factors of Teacher Candidates' IT Teaching Competence Development was developed. A pilot test was conducted with a randomly selected group of 58 teacher candidates from H University, collecting data for reliability and

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validity analysis. Results indicated a reliability coefficient of 0.898, demonstrating strong reliability, while the KMO value was 0.715, confirming sufficient validity to capture essential information from the original survey. After revisions, the finalized questionnaire included three main sections: an introductory explanation, a demographic information section, and the main body of the survey. The introduction outlined the purpose of the survey, while the demographic section gathered information on participants' gender, academic year, subject area, experience in educational internships or teaching practice, and desire to become a teacher, totaling five questions. The main section examined factors influencing IT teaching competence across five dimensions: awareness and attitudes, teacher modeling, disciplinary culture, curriculum design, and institutional support. This section employed a 5-point Likert scale and consisted of 22 items.

3.2 Formal Questionnaire Distribution

Following preliminary testing, adjustments were made to refine the questionnaire, which was then ready for formal distribution. Using random sampling, the survey was administered online to teacher candidates, resulting in 286 responses. After eliminating invalid entries, 268 valid responses were retained, yielding a response rate of 93.71%.

4. Results

4.1 Analysis of Influencing Factors

Data collected were analyzed using SPSS 22.0, and the findings are summarized in Table 1. The mean scores across all dimensions ranged from 3.6 to 4.1, indicating a relatively concentrated response pattern. Among the dimensions, the mean score for disciplinary culture was noticeably higher than for other factors, suggesting that teacher candidates' disciplinary perspectives are the most significant factor influencing their IT teaching competence. Teacher modeling had the second-highest mean score, indicating that teachers play a substantial role in shaping candidates' IT competence. Additionally, awareness and attitudes, curriculum design, and institutional support were found to be important contributing factors.

Table 1. Mean Statistics for Each Dimension

Dimension	N	Sum	Mean
Awareness and Attitudes	268	991.25	3.6987
Teacher Modeling	268	1051	3.9246
Disciplinary Culture	268	1075	4.0112
Curriculum Design	268	971.4	3.6246
Institutional Support	268	966	3.6045

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4.1.1 Awareness and Attitudes

Awareness and attitudes refer to teacher education students' perceptions of using information technology and tools in the classroom. This factor is crucial to developing their ICT teaching competence. Whether teacher education students engage actively in information-based teaching practices largely depends on their attitudes toward it; when they believe that information technology can improve efficiency, they are more inclined to use it. The average score for this dimension was 3.69, suggesting that awareness and attitudes moderately impact teacher education students' information-based teaching capabilities. Statements such as "You think teaching with information technology is easy" and "You often explore new technologies and tools to integrate them into teaching" scored below the dimension's average, while "You are willing to use various information technologies, such as multimedia and tablets, to enhance teaching effectiveness" and "You believe using technology in the classroom significantly enhances teaching outcomes" scored higher. In summary, teacher education students are generally willing to adopt information-based teaching but perceive some difficulties and are somewhat hesitant to experiment with new technologies in the classroom.

4.1.2 Teacher Modeling

The influence of teacher modeling stems from teacher education students' observations of their instructors' use of methods and technologies in teaching, which serves as a significant model for them. Since they have yet to gain classroom experience, teacher education students primarily learn from observing their course instructors or mentors. When teachers effectively integrate information technology into their teaching, it substantially impacts teacher education students' future teaching practices. The average score for this dimension was 3.92, indicating a strong influence of teacher modeling on teacher education students' development in information-based teaching. Statements such as "Teachers actively learn new technologies and integrate them into their teaching" and "Teachers regularly share information-based teaching experiences and tools with you, sparking your interest in new technologies" scored below the average, while statements like "Teachers possess rich knowledge in information-based teaching and can provide professional guidance," "Teachers support your use of information technology in teaching practices, encouraging further development," and "Teachers can proficiently use technology to solve teaching issues, serving as role models" scored higher. Overall, teachers' practices in information-based teaching subtly influence teacher education students, encouraging them to explore new technologies. However, teachers' in-class experimentation and sharing of external resources could be enhanced.

4.1.3 Disciplinary Culture

Disciplinary culture refers to the knowledge traditions and behavioral norms held by members within a particular academic field.[7] Teacher education students' understanding of their discipline's culture is closely related to their academic perspective, marking the initial phase of their development in information-based teaching abilities. This dimension had an average score of 4.01, indicating that disciplinary culture has a significant impact on developing teacher education students' information-based teaching skills. Statements like "Your discipline is closely linked to updates in information technology" and "All disciplines are suitable for incorporating various technology tools in teaching" scored below the dimension average, while "In your discipline, using information-based teaching can capture students' attention and increase engagement" scored

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higher. In conclusion, teacher education students generally recognize the value of technology in optimizing classroom instruction and improving efficiency, but they feel that not all subjects are suited for it. Some believe there are gaps between their discipline and information technology, viewing their teaching field as unrelated to technological advancements.

4.1.4 Curriculum Design

Curriculum design refers to the courses offered by institutions based on educational objectives, typically divided into professional and general courses. As teacher education students, they should receive robust teacher training before entering the profession, rather than focusing primarily on in-service teacher training. The dimension's average score was 3.62, suggesting that curriculum design has a moderate influence on developing information-based teaching skills among teacher education students. Statements like “The school offers courses that integrate information technology with subject teaching, such as the application of information technology in physics” and “Information-based teaching courses provide ample opportunities for educational practice and internships” scored below the dimension average. In contrast, “The school offers a variety of general information-based teaching courses (e.g., modern educational technology, computer basics)” and “Information-based teaching courses include diverse assessment standards that foster skill development” scored higher. Overall, institutions offer more general information-based courses than subject-specific ones. As teacher education students will ultimately teach different subjects, general knowledge and skills may not apply universally. Developing subject-specific information-based courses is essential. While the evaluation methods for these courses are varied, they offer limited practical experience, resulting in a less favorable perception of these courses among teacher education students.

4.1.5 Institutional Support

Institutional support refers to the external environment provided by schools and colleges, such as smart campuses, classrooms, and libraries, which are crucial for developing information-based teaching capabilities in teacher education students. Although teacher education students generally have positive attitudes toward information-based teaching, limited access to technological resources due to inadequate infrastructure may discourage them from exploring new tools, thus limiting their development. Moreover, partnerships between teacher training institutions and local primary and secondary schools affect internship opportunities; internships at schools with strong academic traditions and advanced facilities positively impact teacher education students' careers. The dimension’s average score was 3.60, suggesting a moderate impact of institutional support. Statements such as “School leadership prioritizes information-based teaching and frequently organizes relevant lectures and training” scored lower, while “The school has adequate hardware (e.g., computers, broadband) for information-based teaching,” “Sufficient software resources (e.g., lesson planning and learning software) support your learning and teaching practice,” “The school provides an information-based learning environment (e.g., multimedia classrooms, virtual labs) for conducting information-based teaching,” and “The school organizes various teaching practices (e.g., teaching competitions) that enhance your skills” scored slightly higher. In summary, institutional facilities largely meet teacher education students’ needs, offering an information-based learning environment and occasional competitive practice events. However, the emphasis on strengthening hardware and software resources could be improved to better support information-based teaching.

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4.2 Analysis of Differences Among teacher education students with Diverse Backgrounds

Teacher education students' background variables, such as gender and grade level, did not significantly impact the factors affecting their ability to utilize information technology in teaching. This suggests that gender and grade do not lead to notable changes in these influencing factors.

However, significant differences were found among teacher education students across different academic disciplines, primarily in the dimension of disciplinary culture, as shown in Table 2. Specifically, teacher education students from science and engineering disciplines displayed notable differences from those in the humanities, arts, and physical education. This indicates that teacher education students believe information technology is not equally applicable across all fields; some perceive a substantial gap between their disciplinary culture and the application of information technology.

Table 2. Differences in Influencing Factors for ICT Teaching Competence Based on Practical Experience

Influencing Factor	Average Score	
	Yes	No
Awareness & Attitude	3.7869	3.7297
Teacher Modeling	4.1054	3.7497
Disciplinary Culture	4.0695	3.9529
Curriculum Design	3.6289	3.6135
Institutional Support	3.6021	3.6108

Table 2 indicates that teacher education students with experience in educational internships or practicum are significantly influenced by certain factors, particularly in the teacher modeling dimension. The average scores for this dimension were 4.10 for those with practical experience and 3.74 for those without, suggesting that teacher education students who have participated in internships or practicums more strongly recognize the influence of teacher modeling.

Table 3. Differences in Influencing Factors for ICT Teaching Competence Based on Career Intentions

Influencing Factor	Average Score	
	Yes	No
Awareness & Attitude	3.8032	3.5765
Teacher Modeling	3.9585	3.8907
Disciplinary Culture	3.9852	4.0372
Curriculum Design	3.6308	3.5957
Institutional Support	3.6235	3.5149

As shown in Table 3, career intentions to pursue teaching also significantly impact certain factors. This ef-

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fect is most notable in the awareness and attitude dimension, with average scores of 3.80 for those interested in teaching as a career and 3.57 for those who are not. Teacher education studentss who aspire to become teachers demonstrate a stronger inclination to explore and integrate information technology and tools into classroom instruction.

4.3 Analysis of the Influencing Factors Model

The development of information-based teaching abilities in teacher education students is influenced by a complex interplay of multiple factors. Scholars have different views on the components of a model for factors influencing these abilities, as summarized in Table 4.

Table 4. Factors Influencing ICT Teaching Competence

Scholar	Influencing Factors
Hanks R.F	Environment, individual factors
Worch E.A	Teaching beliefs, attitudes toward information technology
Li Qian	Sensitivity to information resources, use of IT resources
Zhang Yichun	IT literacy, teaching philosophy, awareness
Zhang Ling	Infrastructure for IT teaching, software resources
Yang Mengxi	IT teaching beliefs, funding allocation, school incentives

In summary, the factors influencing the development of information-based teaching abilities in teacher education students can be categorized into two main types: theoretical and practical factors. Theoretical factors encompass knowledge and skills acquired through IT-related teaching courses and are often conditioned by external factors such as institutional support, curriculum design, and teacher modeling. Practical factors refer to the educational internships and teaching practicum opportunities offered by the institution, which help guide teacher education students in applying information technology in classroom teaching based on their discipline-specific attitudes and awareness.

Disciplinary culture serves as a bridge connecting theoretical and practical factors. The curriculum design in an institution reflects the institution's recognition and positioning of the discipline and, in turn, shapes the disciplinary views of teacher education students. This connection is illustrated in Figure 1.

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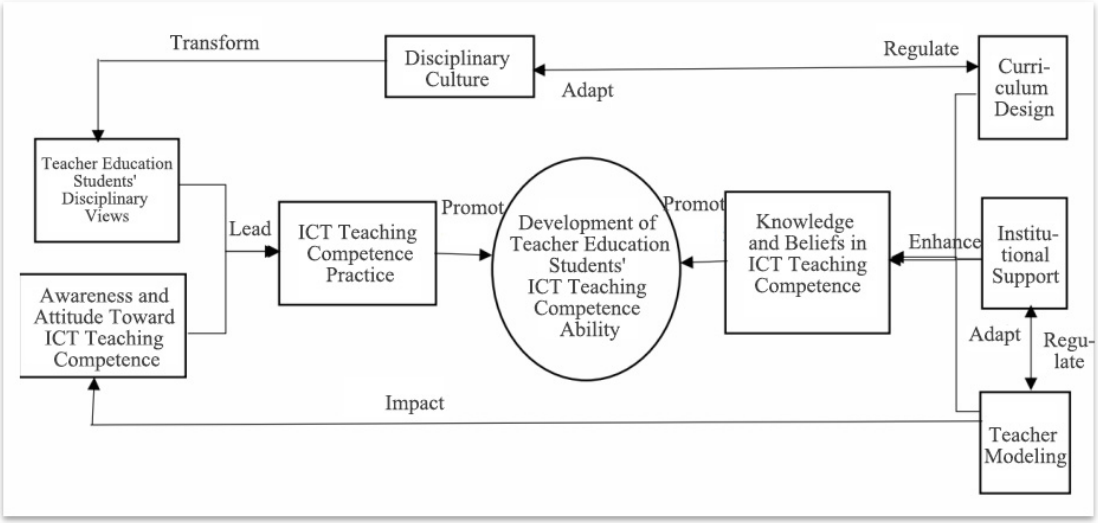


Figure 1: Model of Factors Influencing Teacher Education Students' ICT Teaching Competence

5. Strategies for Enhancing Teacher Education Students' ICT Teaching Competence

5.1 Teacher Education Students: Establishing an Integrated Approach to Subject Learning and Creating Learning Communities

At the individual level, teacher education students should overcome the constraints of specific subject areas. Any notion that there is an inherent divide between subject teaching and technology disregards the synergy between the fields of education and technology. It is essential to identify the intersections between each subject and information technology to achieve a seamless integration, facilitating a deeper fusion of technology and subject curriculum. Additionally, teacher education students should form learning communities to share knowledge and skills related to information-based teaching. Such a community fosters an environment of knowledge-sharing, where each teacher education student is both an independent learner and a member of a collaborative group working towards common goals. In today's information-driven society, where knowledge is growing at an exponential rate, individual learning alone cannot meet the demands of the field. Thus, collaborative learning and knowledge-sharing are essential learning methods in this era. The complexity and depth of knowledge often make it challenging for individuals to fully comprehend; through a learning community, teacher education students can engage in collaborative learning and share valuable resources, ultimately fostering their professional development.

5.2 Teachers: Enhancing Professional Knowledge and Skills with Diverse Evaluation Methods

At the instructor level, teachers should strengthen their professional knowledge and serve as role models for teacher education students. Excellent teachers set an example for their students, so they must adopt a lifelong learning mindset and actively enhance their teaching knowledge and skills. Teachers should understand

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the principles and methods of incorporating new teaching strategies and models, such as using micro-courses, MOOCs, and flipped classrooms, as well as project-based and problem-based learning. This includes recognizing the roles and functions that technology plays in each of these approaches. Only by possessing sufficient specialized teaching knowledge can teachers guide teacher education students in acquiring professional knowledge. Moreover, teachers should implement diverse evaluation methods to promote students' overall development. With support from big data and artificial intelligence, the scope, methods, and focus of teaching evaluations are becoming more diversified and data-driven, leading to objective and precise assessments. Evaluation should go beyond task completion, encompassing aspects like attitudes, emotions, and skills for a comprehensive evaluation of students.

5.3 Educational Institutions: Strengthening Infrastructure and Optimizing Curriculum Design

At the institutional level, developing teacher education students' information-based teaching ability is a systematic process in which teacher training institutions play a crucial role, acting as scaffolding for skill-building should enhance both software and hardware resources to support a wide variety of teaching practices,[8] such as creating diverse maker spaces to provide students with hands-on opportunities to bring their ideas to life. Schools should also develop various learning environments, equipping students with the skills to gather, analyze, process, evaluate, and integrate information in different contexts. Redesigning the layout of multimedia computer classrooms to accommodate different teaching models can support diverse teaching practices. Micro-teaching classrooms and digital laboratories should be accessible to all teacher education students, allowing them to schedule and practice information-based teaching techniques freely. Furthermore, institutions should offer a range of internship and practice opportunities to help students refine their information-based teaching skills. Universities should actively organize practical competitions, such as teaching skills contests, micro-course creation contests, and PPT design contests, to encourage hands-on learning. Lastly, curriculum reform is essential to integrate information-based teaching skills into teacher training programs. Instead of offering general courses alone, which are insufficient to enhance teacher education students' information-based teaching ability at a fundamental level, institutions should design specialized courses that align technology with the characteristics of specific subjects.

6. Conclusion

In an era of rapidly advancing intelligent technology, teacher education students are pivotal to the transformation of education and the improvement of educational quality. Without strengthening their information-based teaching abilities, they will struggle to adapt to future educational reforms. Admittedly, there are many challenges in fostering these abilities among teacher education students. By addressing these challenges directly and exploring the influencing factors, we can better guide teacher education students in enhancing their information-based teaching skills.

Funding

1. "Exploring Pathways for Teacher Professional Development with the Assistance of Artificial Intelli-

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gence," Youth Project of Zhaoqing University, 2024 (Project No. QN202410).

2. "Research on Cultivating Intelligent Education Literacy in Pre-Service Teachers in the Digital-Intelligence Era: A Case Study of the 'Educational Technology and Application' Course", the 2024 Educational Research Project of the Zhaoqing Institute of Educational Development. (Project No. ZQJYY2024104).

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