Academic Education Publishing House

Occupation and Professional Education Vol. 3 No. 2, 2026

A Study on Pathways for Developing Digital Literacy among Teacher Education Students in the Digital Age

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Abstract: In the era of digital intelligence, transformations and reshaping are taking place across all sectors of society. Digital and intelligent transformation are major trends of our time, and the transformation of the education sector is a key strategic priority for China today. Within this context, new demands have been placed on teachers. As future educators, teacher education students digital literacy directly impacts the effectiveness of educational reform and is crucial to improving educational quality and fostering students' critical thinking skills. This article focuses on analysing the current state of digital literacy development among teacher education students and explores ways to enhance it, to strengthen their professional capabilities and employability in the digital and intelligent era, and to promote high-quality development in education.

Keywords: Teacher Education Student; Digital Literacy; Pathways for Improvement

1. Introduction

In recent years, as the transition towards digitalisation and smart technologies has progressed, more and more people have been focusing on digital literacy and education. In this era of digital intelligence, the world has set new expectations for teachers: they must possess mathematical literacy to adapt to the current social environment. In 2025, China published the The 2024-2035 Master Plan on Building China into a Leading Country in Education", which explicitly identified the development of teachers' digital and intelligent literacy as a core task in the drive to build a leading education power, and called for the establishment of a system for the lifelong development of teachers' digital capabilities [1]. The Opinions on Accelerating the Digitalisation of Education" also proposed integrating digital literacy into the teacher education curriculum.

Teacher education students are the main source of the future teaching workforce, and digital literacy, as a core component of their professional competence, plays a vital role. How best to help teacher education students learn to use digital technology effectively and cultivate their ability to apply it has long been a persistent challenge. [2] Thus, researchers in various countries have developed a range of frameworks, models, and competencies to foster digital literacy. For example, in 2022, China introduced the 'Teacher Digital Literacy' industry standard for education, aimed at enhancing teachers' digital capabilities and promoting high-quality development in education. [3] This digital literacy framework comprises five first-level dimensions, 13 second-level dimensions, and 33 third-level dimensions. The first five-level dimensions are digital awareness, digital technology knowledge and skills, digital application, digital social responsibility, and professional development. Furthermore, the document Professional Competency Standards for Primary Education Teacher Education Students (Provisional)", published in 2021, emphasises from various perspectives that teacher education students should possess digital literacy in relation to their professional competencies, specifically in the areas of teaching practice, comprehensive educational guidance, and self-directed development. Therefore, teacher education students should actively adapt to the demands of the digital transformation in education and continuously enhance their digital literacy and teaching skills.

Since 1997, research into digital literacy has been conducted internationally. [4] Although there is a wide variety of terminology, the core concept lies in an individual's ability to understand, identify, and make appropriate use of information from various sources and in diverse formats presented by computers within

a digital environment. Teacher education students are not only able to acquire more knowledge and skills through digital means, but can also broaden their horizons and better adapt to the demands of future educational development. Furthermore, in future teaching, we should make a conscious effort to utilise digital technology to nurture outstanding, innovative new talent. Many current teaching models, such as the flipped classroom, project-based learning, and interdisciplinary teaching, can incorporate modern information technology or artificial intelligence to innovate teaching methods. This not only makes lessons more engaging but also stimulates students' interest and initiative, ultimately enhancing teaching outcomes.

The publication Teachers' Digital Literacy" emphasises that teachers should possess the awareness, ability, and responsibility to use digital technology to enhance and innovate their teaching and learning. However, the majority of current teacher education students lack awareness of how to utilise digital technology. Indeed, some lack even the basic ability to use IT tools, whilst there are certain shortcomings in the way schools cultivate digital literacy among teacher education students. Consequently, this study aims to explore pathways for enhancing the digital literacy of teacher education students, with a view to providing practical guidance for the effective development of their digital literacy.

2. The Current State of Digital Literacy Development among Teacher Education Students in the Digital Age

2.1 Teacher Education Students have a Weak Understanding of Digital Literacy

Digital awareness is not only a key factor in enhancing teachers' digital literacy but also an important means of effectively implementing digital teaching and learning. According to the discussion on digital awareness in Teachers' Digital Literacy", digital awareness comprises three components: digital understanding, digital willingness, and digital determination. Whilst current teacher education students already possess a certain level of digital understanding, they lack sufficient enthusiasm for integrating digital tools into teaching; in other words, they have not yet developed a strong desire to learn or the determination to overcome challenges. [5] Most teacher education students fully recognise that the use of digital and smart tools can help them improve the efficiency of their daily lives and studies, and enable them to adapt better to the social environment. They acknowledge that the use of information technology tools in today's school education can innovate teaching methods, make lessons more engaging, and promote pupils' development. However, in the classroom, if there are no specific requirements, they tend to lack interest and motivation when it comes to new digital teaching tools. Should they encounter technical difficulties that are hard to resolve, they may shy away from the challenge and fail to persevere in exploring the issue further.

Furthermore, they have a limited awareness of how to apply digital tools in teaching contexts, and whilst most teacher education students are aware of the relevant knowledge regarding digital technology in education, they are not fully familiar with it; moreover, some teacher education students use these tools merely to complete classroom assignments. For example, when teachers adopt the flipped classroom model and require teacher education students to utilise Microsoft PowerPoint to develop courseware and deliver classroom presentations, only then will they take the initiative to learn how to use the relevant tools.

2.2 Lack of Digital Skills among Teacher Education Students

If teacher education students are to possess a high level of digital literacy, the ability to apply digital technologies is essential. Digital application skills require primary and secondary school teachers to be able to use digital tools for lesson planning, classroom management, academic assessment, and collaborative teaching [6].

Firstly, although some teacher education students are able to use digital tools to access learning materials and search for literature on online platforms, their ability to filter information is relatively weak; the resources they gather are of varying quality, and they are unable to integrate these resources effectively. Secondly, apart from courses such as 'Educational Technology and Applications', it is difficult for them to learn about the practical application of digital technology in standard theoretical courses. As a result, most of his classmates are only able to produce simple

courseware but lack sufficient skills in courseware design, animation, interactivity, and multimedia content processing, making it difficult for them to create high-quality slideshows. Lastly, the current shortage of digital learning resources for teacher education students means they lack the ability to integrate digital technology effectively into their classroom teaching. To design teaching using multimedia or information technology, and to organise teaching through interactive platforms, one must have a comprehensive understanding of teaching objectives, teaching materials, and students' learning situations. However, as teacher education students have not yet developed the necessary professional and digital skills, it is difficult for them to acquire digital literacy.

2.3 Lack of Opportunities for Teacher Education Students to engage in Digital Practice

In order to equip teacher education students with digital literacy, opportunities for practical teaching experience are of paramount importance, alongside their coursework. [7] While the majority of teacher education students at universities are able to make good use of digital technology to support their own learning, their lack of real-world teaching experience means they lack a certain understanding of digital teaching research and innovation.

Firstly, there is a lack of systematic opportunities for digital practice within the university. Teacher education students are only able to use micro-teaching classrooms in relevant courses, whilst specialist courses are predominantly theory-based, with few practical sessions. It is difficult for them to master the relevant digital learning skills within such a short practical period. Secondly, both standard teaching placements and work placements tend to focus primarily on traditional classroom teaching; indeed, some students undertaking work placements find their workload so heavy that they struggle to acquire digital skills. Furthermore, the resources and facilities available at the various host schools vary considerably; whilst some students are able to learn relevant digital application technologies, others find it difficult to acquire these skills. This is reflected in the fact that some schools lack on-campus practical training facilities such as smart recording studios, virtual simulation training rooms, smart micro-teaching classrooms, and digital classrooms. This significantly impedes teacher education students' digital learning and their ability to integrate digital knowledge seamlessly into teaching; as a result, they are unable to develop solid digital teaching skills, which in turn hinders the development of their digital literacy and makes it difficult for them to meet the practical requirements placed on teachers in the new era by the digital transformation of education.

2.4 The Curriculum Framework for Digital Literacy among Teacher Education Students is Inadequate

The digital age has placed new demands on teachers and transformed human cognition. In the training of prospective teachers, digital courses play a vital role in developing their digital literacy. [8] However, in actual training programmes, the curriculum for digital-related courses remains incomplete.

Firstly, there is a shortage of digital resources. Universities have gradually come to realise the importance of providing teacher education students with a wealth of digital resources, and various faculties and departments are developing smart courses and digital learning resources on online teaching platforms. However, digital course resources tend to be rather limited, and some of these resources are relatively outdated, failing to keep pace with the latest developments and thus unable to meet the learning needs of teacher education students. Secondly, the curriculum content is somewhat disjointed, and there is a lack of a systematic framework for developing digital literacy. On the one hand, digital literacy courses in many universities are currently offered primarily as electives or general education modules, and no clear pathway for developing digital literacy has been established. On the other hand, there are relatively few courses in digital technology, and those that do exist tend to focus primarily on basic software operation, the creation and use of simple digital resources, and the use of data analysis software (such as SPSS). There is a severe lack of training in more complex advanced digital skills, such as digital instructional design and data analysis, which has resulted in a deficit in digital literacy among teacher education students.

3. Pathways for Developing Digital Literacy among Teacher Education Students in the Digital Age

3.1 Fostering Digital Literacy among Teacher Education Students

In the digital age, teacher training students need to develop a digital mindset. The key lies in enabling them to consciously enhance their ability to utilise digital resources and employ multimedia or information technology in a variety of teaching and learning activities. [9]

Although current teacher education students have become accustomed to using artificial intelligence to solve problems in their daily lives and studies, they lack the awareness to learn how to integrate digital knowledge into teaching and learning. When using digital technology in the classroom, they often adopt a passive approach to learning. Secondly, we will organise teacher education students to study the Teacher Digital Literacy" industry standard in depth, enabling them to fully appreciate the importance of digital literacy in their future teaching careers and fostering a proactive approach to developing these skills. By organising special lectures, seminars, and other events, we aim to strengthen students' interest and enthusiasm for digital teaching and cultivate their digital willpower. Building on this, it is also necessary to change pre-service teachers' traditional perceptions of the teaching profession, encouraging them to take the initiative in developing their digital skills and enhancing their digital literacy.

3.2 Strengthening the Development of Digital Skills among Teacher Education Students

In the digital age, teachers face new challenges in adapting to digital education and teaching. However, some universities have failed to prioritise the development of digital literacy among teacher education students, resulting in a lack of knowledge, practical experience, and skills in using digital tools. Consequently, these trainees have only a superficial understanding of digital knowledge, both in theory and in practice. If teacher education students possess strong digital literacy skills, they will be better able to use digital tools and devices to acquire and filter information, thereby meeting the demands of lifelong learning.

Firstly, we encourage teacher education students to enhance their digital skills. In educational technology courses, we should place greater emphasis on developing students' knowledge and skills in digital technology, particularly by ensuring they become proficient in using basic Microsoft Office software and strengthening their digital literacy. Secondly, specialist courses should be integrated with digital literacy, and mechanisms for this integration should be established. Real-world case studies should be incorporated into teaching to help teacher education students master the application of digital educational technologies in the classroom. For example, when designing teaching activities for a particular subject, guide student teachers to use digital technology to design these activities. Set them an assignment to create micro-lessons, asking them to select a theme that corresponds to the teaching activity and produce a micro-lesson based on it. Encourage them to explore further digital technologies for creating micro-lessons. Thirdly, introduce a series of extracurricular activities. Organise knowledge competitions on topics such as micro-lecture production, digital instructional design, and artificial intelligence, and draw on principles of educational psychology to enable teacher education students to enhance their digital literacy through these activities and competitions.

3.3 Building a Digital Practice Platform

Establishing a dual practical training platform that combines on-campus and off-campus activities to increase opportunities for teacher education students to gain digital practical experience， educational practice serves as a bridge between theory and practical application. Educational practice serves as a bridge between theory and practical application. On the one hand, we will develop more systematic practical training platforms on campus, such as smart classrooms and micro-teaching studios, to provide teacher education students with digital learning environments. At the same time, the development of digital platforms will enable students to gain practical experience through various methods, including simulated teaching and collaborative learning. In order to enable students to master teaching skills effectively, we will organise more innovative competitions, such as micro-lesson design and information-based teaching, for teacher education students. On the other hand, we should improve teaching

placement and internship programmes by making digital practice a key component of practical training. This will enable students to learn, through practical experience, how to use smart teaching platforms and digital teaching tools proficiently, conduct digital classroom activities, and experience the integration of digital technology with subject-specific teaching methods, thereby enhancing their digital literacy.

In addition, faculties may establish learning communities with master teachers' studios to provide platforms for professional development. Through exchanges and learning with expert teachers from these studios, student teachers will not only become proficient in using digital technology for teaching and learning, but will also gain familiarity with cutting-edge pedagogical knowledge, digital teaching tools, and their application in frontline teaching, thereby developing their digital literacy.

3.4 Improve the Digital Literacy Curriculum Framework

Courses serve as a key vehicle for cultivating core competencies in teacher education students. Only by refining the curriculum framework and clarifying course objectives and content, whilst integrating awareness of digital literacy and technical training into the curriculum, can we effectively enhance their digital literacy [10]. Firstly, develop courses on digital literacy. General digital literacy courses could be introduced, focusing primarily on theoretical knowledge of the fundamentals of digital technology and basic practical skills in using digital tools. Subsequently, digital-related content should be integrated into specialist courses. Meanwhile, higher education institutions should encourage lecturers to introduce additional elective courses related to digital technology—such as the educational applications of artificial intelligence, the fundamentals of programming, and the integration of digital technology into the curriculum—with a view to developing distinctive, interdisciplinary courses that are both thematic and research-oriented. Secondly, we must expand our digital teaching resources. For example, we should develop and share online courses on digital literacy, expand our digital library collections, and ensure that all constituent colleges and schools continuously update the digital resources for their core courses; furthermore, we should capitalise on our disciplinary strengths to achieve the interconnection of social and learning resources. Finally, by innovating teaching methods—such as adopting blended learning and project-based approaches in university classrooms, and integrating cutting-edge technologies, including artificial intelligence and online resources—the aim is to inspire teacher education students to actively explore and participate in digital learning environments through direct experience, thereby enhancing their digital literacy.

4. Conclusion

In the digital age, teacher education students must not only be aware of the importance of digital learning but also continuously improve their ability to apply digital technologies, cultivate their innovative capabilities, and develop a certain level of digital literacy, thereby laying a solid foundation for becoming outstanding teachers of the new era.

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