

SUB-ID-770392

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**Impact of ICT Skills, Awareness, and Applications on Teaching Competencies of
Prospective Teachers: A Systematic Review and Knowledge Gap Analysis**

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ABSTRACT

The rapid advancement of digital technologies has fundamentally transformed almost every aspect of society, with education being one of the most significantly affected sectors. Information and Communication Technology (ICT) has become an integral component of contemporary teaching-learning processes, enabling more interactive, flexible, and learner-centred educational practices. The shift to online education during the COVID-19 pandemic further highlighted the necessity for teachers to possess adequate ICT-related knowledge and competencies. As a result, policymakers and educational institutions across the world have increasingly recognized the importance of integrating ICT into teacher education programmes. In India, the National Education Policy (2020) reinforces this vision by advocating the meaningful use of digital technologies to improve the accessibility, inclusiveness, and quality of education. Consequently, teachers are now expected to combine pedagogical expertise with technological competence to effectively facilitate learning in digitally enriched classrooms. Although numerous studies have examined different dimensions of ICT integration in education, the available literature remains scattered, with limited efforts to examine ICT skills, ICT awareness, ICT applications, and teaching competencies within a unified framework. This fragmentation restricts a comprehensive understanding of how these dimensions collectively influence the professional preparedness of future teachers.

The present paper systematically reviews existing national and international literature relating to ICT skills, ICT awareness, ICT applications, and teaching competencies among teachers and prospective teachers. Through a systematic synthesis of previous research, the study identifies major themes, emerging trends, methodological patterns, and existing research gaps. The review further establishes the need for comprehensive empirical investigation into the combined influence of ICT-related competencies on the teaching competencies of prospective teachers.

Keywords: ICT Skills, ICT Awareness, ICT Applications, Teaching Competencies, Prospective Teachers, Teacher Education, NEP 2020, Knowledge Gap Analysis.

Introduction

¹ Information and Communication Technology (ICT) has emerged as one of the most influential forces shaping contemporary education. The widespread availability of digital technologies has transformed the way knowledge is created, accessed, shared, and applied, resulting in significant changes in teaching-learning processes across all levels of education. Modern classrooms increasingly rely on digital tools, internet-based resources, multimedia applications, learning management systems, and communication technologies to facilitate effective instruction and improve learning outcomes. According to UNESCO (2020), ICT expands educational opportunities by enabling learning to occur anytime and anywhere, thereby promoting greater accessibility, flexibility, and inclusiveness in education.

¹³ The growing integration of ICT has redefined the role of teachers from being mere transmitters of knowledge to facilitators of learning, designers of learning experiences, and promoters of critical thinking and digital literacy. In addition to possessing sound pedagogical and subject knowledge, teachers are now expected to demonstrate competence in selecting, adapting, and integrating technological resources that support meaningful student learning. Butler et al. (2017) emphasized that educators require twenty-first-century competencies and continuous professional development to utilize digital technologies effectively ¹¹ and respond to the changing demands of contemporary education.

⁹ The significance of ICT in education became particularly evident during the COVID-19 pandemic, when educational institutions worldwide rapidly shifted from traditional classroom instruction to online and blended modes of teaching. Although this transition ensured continuity of education, it also exposed significant shortcomings in teachers' technological preparedness. Many educators encountered difficulties in managing virtual classrooms, designing online instructional materials, conducting assessments, and maintaining student engagement in digital environments (Max et al., 2023). These experiences reinforced the importance of equipping teachers with adequate ICT competencies capable of supporting effective teaching under diverse educational circumstances.

Within this changing educational landscape, the preparation of prospective teachers assumes critical importance. As future members of the teaching profession, prospective teachers must develop comprehensive ICT competencies before entering schools. These competencies extend beyond basic computer literacy and include technological knowledge,

digital awareness, practical ICT skills, and the ability to apply technology effectively in lesson planning, classroom management, communication, assessment, collaboration, and learner engagement. Developing these competencies during teacher education programmes enables future teachers to confidently respond to the technological demands of modern classrooms and contribute to improved educational quality.

Against this backdrop, the present study, titled *“Impact of ICT Skills, Awareness, and Applications on Teaching Competencies of Prospective Teachers: A Systematic Review and Knowledge Gap Analysis,”* systematically reviews existing literature to synthesize current evidence, identify prevailing trends, and uncover critical knowledge gaps. ⁵ The study seeks to provide a comprehensive understanding of how ICT-related competencies influence the professional preparedness and teaching effectiveness of prospective teachers in an increasingly digital educational landscape.

Objectives of the Study

The present study aims to:

1. To critically examine and synthesize the existing literature on ICT skills, ICT awareness, ICT applications, and teaching competencies among teachers and prospective teachers.
2. To identify the research gaps in the literature and propose directions for further research on ICT competencies and teacher preparation programs.
3. To identify major themes, trends, and patterns in previous studies related to ICT integration in teacher education.

⁶**Methodology**

Research Design

The present study adopts a systematic review and knowledge gap analysis approach to synthesize and critically examine the existing body of literature concerning ICT skills, ICT awareness, ICT applications, and teaching competencies among prospective teachers.

⁶**Sources of Data**

The study is based exclusively on secondary data collected from peer-reviewed journal articles, books, conference proceedings, policy documents, reports of national and international organizations (such as UNESCO and NEP 2020), dissertations, and other relevant scholarly publications.

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Data Analysis

The selected studies were analysed through thematic content analysis. The literature was organized into major themes, including ICT skills, ICT awareness, ICT applications, teaching competencies, opportunities and challenges of ICT integration, and policy implications. The findings were synthesized to identify prevailing trends, inconsistencies, underexplored areas, and research gaps.

Knowledge Gap Analysis

A knowledge gap analysis was undertaken to determine areas that remain insufficiently explored, particularly regarding the integrated influence of ICT skills, awareness, and applications on the teaching competencies of prospective teachers. The analysis further identifies potential avenues for future empirical research and policy interventions aimed at strengthening digital competencies in teacher education.

REVIEW OF RELATED LITERATURE

• Indian studies on ICT competencies and Teacher Education

The patterns observed globally regarding ICT integration in education are largely reinforced by studies conducted within the Indian context. Rathod (2002) revealed that a very small percentage of secondary teachers in India possessed significant ICT awareness, pointing to a substantial gap in their foundational knowledge. This finding suggests that low ICT awareness among teachers is a persistent, systemic issue rather than a new phenomenon. Despite policy pushes and technological advancements, the fundamental challenge of teacher preparedness in ICT has remained a significant hurdle in India, underscoring the continued relevance and urgency of the present study. Subsequently, Vandana and Newa (2009) found that Indian teachers generally exhibited positive attitudes towards ICT and advocated its systematic inclusion in teacher education programmes to ensure that prospective teachers are adequately equipped to navigate ICT-based instructional settings. However, the coexistence of positive

attitudes with low foundational awareness suggests a discrepancy between teachers' willingness to adopt technology and their actual capability or knowledge. This implies that merely fostering positive dispositions is insufficient; concrete skill-building and awareness programmes are crucial to translate willingness into effective practical application. Similarly, Gupta and Gupta (2014) emphasized the pivotal role ICT plays in reshaping modern classrooms, thereby establishing a direct link between ICT awareness and the development of transformative ¹⁰teaching competencies. The study highlighted ⁷the potential of ICT to act as a powerful enabler of modern pedagogy. Meanwhile, recent studies conducted in India indicate that digital transformation and the implementation of ³¹the National Education Policy (2020) have accelerated ¹the integration of ICT and AI in education, thereby increasing the demand for digitally competent teachers and strengthening the need for continuous professional development and ICT capacity-building initiatives. In this context, Suguna and Neelamegam (2020) examined ICT awareness among prospective teachers in Trichy district and found that most teacher trainees possessed only a moderate level of ICT awareness, with notable differences across gender, locality, and medium of instruction. These findings suggest that structural inequalities in access and exposure significantly shape ICT awareness among teacher trainees and emphasize the importance of targeted workshops, seminars, and infrastructural improvements in teacher education institutions. Likewise, Anal (2021) concluded that student teachers in Manipur generally displayed positive attitudes toward ICT but had only average knowledge and limited skills. The findings highlighted that student teachers had basic ICT skills such as using MS Office and communication tools but struggled with advanced applications due to poor access and limited institutional support. Consequently, the study emphasized the need for improved ICT infrastructure, mandatory inclusion of ICT courses, appointment of qualified faculty, and frequent ICT awareness and training programmes. Extending this line of inquiry, Shokeen and Kaur (2022) conducted ³²a systematic review of literature on ¹factors influencing the digital competence of pre-service teachers and concluded ³²that digital competence is shaped by technological access, institutional support, self-efficacy, and opportunities for practical application. The review further highlighted that teacher education programmes need structured and practice-based models to develop comprehensive digital competencies among prospective teachers. Further evidence was provided by Singh, M., Sharma, M., and Gupta, R. M. (2024), who explored ICT awareness among school teachers in Punjab and found that the majority displayed only medium levels of awareness and usage. Smartphones, computers, and social media were the most commonly used tools, primarily for communication and knowledge updates. However, inadequate training, infrastructure, and

attitudinal barriers limited the integration of ICT into pedagogy. Therefore, the study emphasized the need for stronger policy interventions and resource allocation to promote ICT-driven teaching. More recently, Bhattacharya (2025) examined teachers' competencies in technology-enabled assessment and found that digital competencies are essential for designing assessment strategies that promote holistic student development. The study emphasized that teachers require competencies related to digital assessment tools, data interpretation, feedback mechanisms, and technology-supported evaluation practices. Similarly, Shukla (2025) investigated technological knowledge among secondary teacher trainees and found that urban teacher trainees demonstrated higher technological knowledge than their rural counterparts, while female teacher trainees exhibited comparatively better technological knowledge than male trainees. The study highlighted the influence of contextual and demographic factors on ICT competencies among prospective teachers.

Finally, Kuri and Pujar (2025) investigated ¹the impact of ICT competencies on the teaching-learning process among teacher educators. The findings revealed that teacher educators' ICT competencies significantly improved following intervention and training programmes. While no significant gender differences were observed, teaching experience emerged as an important factor influencing ICT competencies. The study concluded that continuous professional development programmes and adequate ICT infrastructure are essential for enhancing educators' technological competencies ²⁰and improving the quality of teaching and learning in teacher education institutions.

- **International studies on ICT competencies and Teacher Education**

International studies have consistently highlighted the critical ⁹factors influencing teachers' engagement with and integration of technology in pedagogical practices. Max et al., (2023) suggested that if we want to effectively analyse the impact of ICT on prospective teachers' competencies, it is crucial to first establish a clear, multilayered conceptual framework for the study's core variables, as the literature reveals significant terminological ambiguity. He advocated the use of the term "ICT Competency" as a more comprehensive construct than simple Skills. This enhanced teacher competence then positively impacts student learning and engagement, leading to improvements in areas such as language skills and subject knowledge acquisition (Viseu & da Ponte, 2012) Chifari et al. (2000) demonstrated a close ³³link between teachers' computer self-efficacy and their positive attitudes toward ICT tools, directly correlating these with their prior computer experience. This suggests ²that a teacher's awareness

of ICT significantly influences their self-confidence and willingness to use technology into their pedagogy. The direct connection between self-efficacy (a teacher's belief in their own capability) and positive attitudes or willingness to integrate ICT indicates that this psychological factor is as critical as access or technical knowledge. This implies that interventions focused solely on skill training may prove insufficient if teachers lack the confidence or belief in their ability to effectively utilize ICT, underscoring the necessity for confidence-building measures within training programs. Similarly, Wilson (2002) observed that while teachers might possess a moderate level of awareness regarding digital tools, ongoing professional development was deemed essential to elevate their actual ICT integration practices. This highlights that ICT integration is not a one-time learning event but necessitates continuous professional evolution to keep pace with rapid technological enhancements and evolving pedagogical needs. Tsitouridou and Vryzas (2003), in their study on early childhood teachers, identified access to ICT, practical experience, and structured training as major determinants of positive attitudes towards technology. This reinforces the understanding that both foundational awareness and robust skill-building are crucial in shaping competent teaching behaviour. These studies collectively converge on the understanding that ICT awareness, defined as the ability to recognize, access, and critically evaluate ICT resources, forms the foundational prerequisite for fostering meaningful teaching competencies. Furthermore, research by Gomleksiz (2004) and Sugar et al. (2005) affirms that despite often holding positive attitudes towards ICT, teachers frequently encounter practical constraints, such as limited usage opportunities or a lack of adequate training, which restrict its effective implementation in the classroom. These findings underscore the imperative of strengthening ICT competencies, understood as the practical ability to effectively use ICT tools for instructional design, efficient classroom management, dynamic content delivery, and enhanced learner engagement. Empirical studies show that pre-service teachers who engage in integrated TPACK development demonstrate greater confidence in lesson planning with technology, better alignment between learning goals and tool selection, and more inventive uses of digital resources during practicum (Koehler, Mishra, & Kereluik, 2014). For pre-service teachers, developing TPACK competencies involves scaffolded experiences that build each domain both independently and in concert. A qualitative study by Kozma and Anderson (2007) identified innovative pedagogical practices by teachers that use technology, help students develop competencies for lifelong learning, such as skills to search for, organizing and analysing information, and communicating ideas in a variety of media forms. Similarly, Viseu & da Ponte, (2012) found that a positive link between a teacher's ICT proficiency and their overall teaching

effectiveness, which in turn leads to improved student outcomes ().² Castro Sánchez & Alemán, (2011) in their study found that Teachers with strong ICT awareness can move away from traditional lecture-based methods and adopt more learner-centered approaches. They can facilitate student-led projects, use online platforms for communication and collaboration, and integrate digital resources that make learning more relevant and engaging. Studies have shown that when a teacher training setting is based on ICT, it can help a prospective teacher adopt¹⁴ more open and challenging tasks and promote more contributive communication in their classroom (Viseu & da Ponte, 2012). Sipilä (2013)⁸ found that teachers with higher ICT competence were more likely to use ICT frequently in their teaching practices. The study justified how ICT-proficient teachers could better integrate technology into their classrooms, thereby making instruction more interactive and engaging. Alemu (2015) investigated ICT use in higher education and revealed that although instructors had basic access, its use was largely confined to word processing, email, and administrative tasks. Integration into teaching and learning was minimal, largely due to lack of skills, confidence, and pedagogical training. While attitudes toward ICT were positive, the absence of relevant and continuous training limited its meaningful application in pedagogy.²⁹ Schmid, M., Brianza, E., & Petko, D. (2021), in their study found that self-reported TPACK alone does not significantly predict pre-service teachers planned technology use, with no notable differences across gender or age. However, subject specialization matters—STEM pre-service teachers generally report higher TPACK levels and integrate technology more in lesson plans than their language and social science counterparts. Alenezi & Alsadoon (2022) while focusing on professional development of educators suggested that ICT awareness is crucial for a teacher's ongoing professional growth. Technology provides avenues for self-paced learning, peer collaboration, and access to a vast array of global knowledge and online training sessions. This helps educators stay current with emerging pedagogical strategies and continually refine their skills.⁴ Irwanto, Redhana, and Wahono (2022), Schmid, Brianza, and Petko (2021), and Altun and Akyildiz (2017) found that gender did not significantly affect any dimension of TPACK, with the sole exception of Pedagogical Knowledge (PK), where female participants scored higher than males. In contrast,⁴ Luik, Taimalu, and Suviste (2018) alongside Ergen, Yelken, and Kanadli (2019) reported notable gender-based disparities in overall TPACK proficiency, showing males outperforming females. Akram, Abdelrady, Al-Adwan, and Ramzan (2022) conducted a systematic review and concluded that teachers generally demonstrated positive attitudes toward integrating ICT in teaching, acknowledging its potential to enhance instructional quality, interactivity, and learner motivation. However, the study noted that ICT integration at the school level remained

underdeveloped compared to higher education, despite acceleration ¹⁰ during the COVID-19 pandemic. Barriers such as lack of infrastructure, unclear policies, and inadequate professional development continued to hinder progress. Furthermore, the application of ICT tools by teachers can lead to improved communication with parents and a greater capacity to foster collaborative learning environments among students (Larrañaga et al., 2023). Hazira Qomi et al. (2024) discovered that ¹⁷ integration of Information and Communication Technology (ICT) facilitates effective teaching and enables educators to cultivate a positive and conducive classroom environment. ICT affords teachers the autonomy to develop and implement customized instructional materials; however, the limited availability and accessibility of ICT resources remain a significant barrier to its optimal utilization. Study by Permata, I. W., & Purnawarman, P. (2024) reported that elementary school teachers generally exhibit favourable perceptions toward integrating ICT into classroom instruction and remain motivated to adopt digital learning resources. However, they also emphasized that positive attitudes alone are insufficient unless accompanied by appropriate institutional support, continuous professional development, and adequate technological infrastructure. Employing a quantitative ⁸ research design, data were collected through surveys, interviews, and classroom observations, with questionnaires and interview protocols serving as primary instruments. The findings reveal that ¹ the majority of teachers hold a positive attitude toward the use of ICT in teaching

Objective wise analysis and synthesis of literature

Objective 1: 1. To critically examine and synthesize the existing literature on ICT skills, ICT awareness, ICT applications, and teaching competencies among teachers and prospective teachers.

The systematic review of existing literature indicates that ²⁶ Information and Communication Technology (ICT) has emerged as an indispensable component of contemporary education and teacher preparation programmes. Both national and international studies consistently acknowledge the transformative potential of ICT in enhancing instructional practices, improving learner engagement, facilitating communication, and promoting professional development among teachers and prospective teachers. Consequently, increasing attention has been devoted to examining ICT skills, ICT awareness, ICT applications, and teaching competencies within teacher education.

The reviewed literature reveals that ICT awareness constitutes the foundational prerequisite for effective technology integration in educational settings. Studies conducted in both Indian and international contexts indicate that teachers and prospective teachers generally exhibit positive attitudes toward ICT and recognize its significance in improving teaching-learning processes. However, several studies have reported only moderate levels of ICT awareness and digital literacy among educators. Research further demonstrates that awareness of technological resources, understanding of digital tools, and familiarity with technology-enhanced instructional strategies significantly influence teachers' willingness and confidence to incorporate ICT into pedagogical practices.

With regard to ICT skills and competencies, the reviewed studies suggest that technological proficiency extends beyond basic computer literacy and ¹⁵encompasses the ability to effectively select, access, evaluate, and utilize digital resources for instructional purposes. International studies have increasingly conceptualized ICT competency as a multidimensional construct comprising technological knowledge, pedagogical understanding, content expertise, and practical application abilities. Similarly, studies conducted in India indicate that prospective teachers often possess only moderate levels of digital competence and experience difficulties in employing advanced technological applications for educational purposes. Factors ¹²such as institutional support, availability of technological infrastructure, self-efficacy, practical experiences, and opportunities for professional development have consistently emerged as important determinants of ICT competency development.

The literature also highlights the growing significance of ICT applications in ¹⁸teaching and learning processes. Studies have demonstrated that teachers possessing higher levels of ICT competence are more likely to employ technology for lesson planning, classroom management, communication, assessment, collaborative learning, and the development of learner-centered ²⁷pedagogical practices. The use of digital resources, online learning platforms, multimedia instructional materials, and interactive technologies has been associated with enhanced student engagement, improved communication, and more meaningful learning experiences. Nevertheless, inadequate infrastructure, limited access to technological resources, ²insufficient training opportunities, and lack of pedagogical support continue to impede the effective utilization of ²ICT in educational settings.

Furthermore, the reviewed studies indicate a strong relationship between ICT competencies and teaching competencies. Teachers with greater technological proficiency

demonstrate increased confidence in designing innovative learning experiences, integrating digital resources into classroom practices, and implementing technology-supported assessment strategies. Recent literature also emphasizes the role of emerging technologies, including Artificial Intelligence, digital assessment tools, and online collaborative platforms, in transforming pedagogical practices and redefining the competencies required of teachers in the digital era.

Overall, the systematic review demonstrates that ICT integration in teacher education is a multifaceted phenomenon influenced by technological, pedagogical, institutional, and contextual factors. Although teachers and prospective teachers generally exhibit favorable attitudes toward technology, moderate levels of ICT awareness and competencies, inadequate practical training, and disparities in access to technological resources continue to present significant challenges. The reviewed literature therefore underscores the necessity of developing comprehensive teacher preparation programmes that systematically strengthen ICT skills, awareness, applications, and teaching competencies to meet the demands of contemporary digital education.

Objective 2: 2. To identify the research gaps in the literature and propose directions for further research on ICT competencies and teacher preparation programs.

The systematic review of literature reveals that although considerable attention has been devoted to understanding ICT integration in teacher education, several conceptual, methodological, and contextual gaps continue to persist. The reviewed studies collectively demonstrate that teachers as well as prospective teachers generally possess ³⁰ positive attitudes toward the use of ICT and recognize its potential for improving instructional effectiveness, learner engagement, and professional development. However, the existing body of literature remains fragmented and inadequate in addressing the multidimensional nature of ICT competencies and their relationship with teaching competencies.

The major gaps recognised in the literature is the tendency to examine ICT-related constructs in isolation. Most studies have investigated ICT awareness, digital skills, technological knowledge, attitudes toward technology, or TPACK competencies as separate variables rather than examining them within a comprehensive and integrated framework. Consequently, there remains limited understanding of how ICT awareness translates into

practical competencies and how these competencies subsequently influence teaching effectiveness and pedagogical practices.

Another important gap concerns the methodological orientation of existing studies. The review indicates that the majority of investigations have employed quantitative and descriptive research designs, primarily using questionnaires, surveys, and competency scales. Although such studies provide valuable information regarding levels of awareness and competencies, they often fail to capture the contextual complexities, lived experiences, and challenges associated with ICT integration. Comparatively fewer studies have adopted qualitative, mixed-method, longitudinal, or intervention-based approaches capable of generating deeper insights into the development of ICT competencies over time.

The review also reveals insufficient attention to prospective teachers, despite their critical role as future educators in technology-enabled learning environments. Many studies have concentrated on in-service teachers or teacher educators, while empirical investigations focusing specifically on the preparedness, competency enhancement and professional development needs of prospective teachers remain comparatively limited. Furthermore, the influence of demographic and contextual variables such as gender, locality, medium of instruction, subject specialization, institutional support, and access to technological resources has produced inconsistent findings across studies and remains insufficiently understood.

Another notable gap pertains to emerging technologies and contemporary educational reforms. While recent studies acknowledge the significance of Artificial Intelligence, digital assessment tools, learning analytics, and online collaborative platforms, empirical investigations examining teachers' preparedness to integrate these technologies into pedagogical practices remain scarce. Similarly, despite the emphasis placed by the National Education Policy (2020) on digital transformation and technology-enabled education, limited research has explored the implications of these reforms for teacher preparation programmes.

Based on these gaps, future research should adopt comprehensive conceptual frameworks that integrate ICT awareness, ICT skills, ICT applications, and teaching competencies within a unified model. Greater emphasis should be placed on mixed-method and longitudinal studies ⁵ to provide both breadth and depth of understanding regarding the development of digital competencies. Future investigations should also examine the effectiveness of intervention programmes, professional development initiatives, and

technology-enriched teacher education curricula. Furthermore, research should ²⁴ focus on the integration of emerging technologies, particularly Artificial Intelligence and digital assessment practices, and investigate strategies for preparing prospective teachers to function effectively in digitally transformed educational environments. Addressing these gaps would contribute significantly to developing evidence-based teacher preparation programmes and strengthening ICT integration in contemporary education. Future studies should also examine the influence of institutional support and digital infrastructure on ICT adoption among prospective teachers. Comparative research across diverse educational contexts can provide deeper insights into contextual differences. Researchers may investigate the role of digital leadership in promoting effective technology integration. Additionally, the development of standardized tools for measuring ICT competencies warrants further attention.

Objective 3: To Identify Major Themes, Trends, and Patterns in Previous Studies Related to ICT Integration in Teacher Education

The systematic review of literature reveals several recurring themes, emerging trends, and consistent patterns concerning ICT integration in teacher education across both Indian and international contexts. Collectively, these studies demonstrate that the integration of Information and Communication Technology has progressively evolved from being viewed merely as a supplementary instructional aid to being recognized as an essential component of effective teaching, learning, assessment, and professional development in contemporary educational settings.

⁵ One of the most prominent themes emerging from the reviewed literature is the generally positive ¹ attitude of teachers and prospective teachers toward the use of ICT in educational practices. Studies consistently report that educators perceive technology as a valuable resource for improving instructional quality, increasing student engagement, facilitating communication, and creating learner-centered educational environments. However, another recurring pattern simultaneously observed across studies is the existence of only moderate levels of ICT awareness, digital competencies, and practical technology integration skills. This discrepancy suggests that positive attitudes toward technology do not automatically translate into effective classroom implementation.

A second important theme relates to the determinants of ICT integration. The reviewed literature consistently identifies access to technological infrastructure, institutional support,

opportunities for professional development, self-efficacy, and practical experience as significant factors influencing teachers' ICT competencies. Studies repeatedly demonstrate that teachers who possess adequate technological resources, structured training opportunities, and confidence in own abilities are more likely to integrate ICT effectively into teaching-learning processes. Conversely, limited infrastructure, inadequate training, and lack of institutional support emerge as persistent barriers restricting meaningful technology integration.

Another significant trend observed in the literature is the increasing emphasis on digital competencies and TPACK development among prospective teachers. Recent studies increasingly conceptualize ICT competency as a multidimensional construct encompassing technological knowledge, pedagogical understanding, content expertise, and the ability to meaningfully integrate technology into instructional practices. Consequently, teacher education programmes are increasingly expected to provide authentic, practice-based experiences that enable prospective teachers to develop comprehensive digital competencies.

The review also reveals notable patterns regarding demographic and contextual variables. Factors such as gender, locality, medium of instruction, and subject specialization have been found to influence ICT competencies; however, findings remain inconsistent across studies and contexts. While some studies report significant differences in ICT competencies across demographic groups, others suggest negligible or no differences. These inconsistencies indicate that ICT integration is influenced by complex interactions between individual, institutional, and contextual factors.

Finally, recent literature demonstrates an emerging trend toward digital transformation and the incorporation of advanced technologies in teacher education. Educational reforms and policy initiatives, particularly the National Education Policy (2020), have accelerated the adoption of technology-enhanced pedagogies, digital assessment practices, online collaborative learning environments, and Artificial Intelligence applications. The reviewed studies therefore indicate a gradual shift from focusing solely on technological access and awareness toward developing comprehensive ICT competencies capable of supporting innovative, inclusive, and learner-centred educational practices. Collectively, these themes, trends, and patterns underscore the growing significance of ICT integration and highlight the need for teacher education programmes that systematically prepare prospective teachers for the demands of digitally transformed educational environments.

Research Gap: A Systematic Review and Knowledge Gap Analysis

The present systematic review examined a total of 27 studies related to ICT skills, ICT awareness, ICT applications, and teaching competencies among teachers and prospective teachers. Of these, 10 studies (37.04%) were conducted in the Indian context and 17 studies (62.96%) represented international perspectives. Methodologically, the literature was predominantly quantitative in nature, with 19 studies (70.37%) employing quantitative approaches, 3 studies (11.11%) using qualitative methods, and 5 studies (18.52%) comprising review-based or conceptual investigations. Furthermore, 11 studies (40.74%) focused on prospective teachers, 9 studies (33.33%) examined school teachers and teacher educators, and 7 studies (25.93%) addressed broader issues of digital transformation, educational policy, and professional development.

The thematic analysis of the reviewed literature revealed that 10 studies (37.04%) primarily investigated ICT awareness and attitudes, 8 studies (29.63%) focused on ICT competencies and digital skills, 5 studies (18.52%) examined ICT applications and classroom integration, and only 4 studies (14.81%) addressed professional development, institutional support, and policy-related dimensions. Notably, approximately two-thirds of the studies consistently reported that teachers and prospective teachers possessed positive attitudes towards ICT but demonstrated only moderate levels of awareness, digital competence, and practical integration skills.

Despite the substantial body of literature available in both Indian and international contexts, several significant gaps remain. First, the existing literature is dominated by quantitative and descriptive studies, with limited use of qualitative and mixed-method approaches capable of providing in-depth insights into teachers' experiences and contextual challenges. Second, most studies have examined ICT awareness, skills, attitudes, digital competence, and teaching competencies as independent constructs rather than investigating them within a comprehensive and integrated framework. Third, although prospective teachers represent the future teaching workforce, comparatively fewer studies have systematically examined their preparedness for technology-integrated teaching.

Moreover, the literature reveals a persistent discrepancy between teachers' positive attitudes toward ICT and their actual competencies and classroom practices. Most studies report favorable perceptions of technology despite only moderate levels of ICT awareness and

practical application. Similarly, empirical investigations explicitly examining the relationship between ICT competencies and teaching competencies remain limited. Existing studies have also produced inconsistent findings regarding the influence of demographic and contextual variables such as gender, locality, subject specialization, medium of instruction, and institutional support.

Furthermore, limited attention has been given to emerging technologies, including Artificial Intelligence, digital assessment tools, learning analytics, and advanced technology-enabled pedagogies. Despite the increasing emphasis on digital transformation and the implementation of the National Education Policy (2020), empirical evidence regarding the preparedness of prospective teachers within these contemporary educational contexts remains insufficient. The scarcity of longitudinal and intervention-based studies further limits understanding of how ICT competencies develop over time and how professional development initiatives influence technology integration.

Therefore, the reviewed literature clearly demonstrates the need for a comprehensive and systematic investigation that integrates ICT skills, ICT awareness, ICT applications, and teaching competencies within a unified conceptual framework. Addressing these gaps would contribute significantly to strengthening teacher preparation programmes and developing evidence-based strategies for effective technology integration in teacher education.

Conclusion

1. Based on the systematic review of 27 studies conducted in both Indian and international contexts, the following conclusions are drawn:
2. The reviewed literature consistently recognizes the transformative potential of ICT in enhancing instructional practices, learner engagement, communication, assessment, and professional development.
3. ICT awareness serves as the foundational prerequisite for effective technology integration in educational settings.
4. Teachers and prospective teachers generally exhibit positive attitudes towards ICT and acknowledge its significance in improving teaching-learning processes.
5. Despite positive attitudes, most studies report only moderate levels of ICT awareness, digital literacy, and practical technological competencies among teachers and prospective teachers.

6. ICT competency is increasingly viewed as a multidimensional construct encompassing technological knowledge, pedagogical understanding, content expertise, and practical application abilities.
7. A strong relationship exists between ICT competencies and teaching competencies, with technologically proficient teachers demonstrating greater confidence in designing innovative and technology-supported learning experiences.
8. Teachers possessing higher levels of ICT competence are more likely to employ technology for lesson planning, classroom management, communication, assessment, collaborative learning, and learner-centered pedagogical practices.
9. The reviewed literature is predominantly quantitative and descriptive in nature, indicating the need for greater use of qualitative, mixed-method, longitudinal, and intervention-based research approaches.
10. Most studies have examined ICT awareness, skills, attitudes, and competencies independently rather than investigating these constructs within an integrated conceptual framework.
11. The literature reveals a persistent discrepancy between teachers' positive attitudes toward ICT and their actual competencies and classroom implementation practices.
12. Demographic and contextual factors such as gender, locality, subject specialization, medium of instruction, and institutional support significantly influence ICT competencies, although findings remain inconsistent across studies.
13. Empirical investigations focusing specifically on the preparedness of prospective teachers for technology-integrated teaching remain comparatively limited.
14. The review underscores the necessity of developing comprehensive, practice-oriented, and technology-enriched teacher preparation programmes that systematically strengthen ICT skills, ICT awareness, ICT applications, and teaching competencies among teachers and prospective teachers.
15. Institutional support, technological infrastructure, self-efficacy, practical experiences, and professional development opportunities consistently emerge as major determinants of ICT competency development.
16. Inadequate infrastructure, insufficient training opportunities, and limited access to technological resources continue to impede the effective integration of ICT in educational practices.

Finally, the findings justify the need for a comprehensive and integrated framework of ICT competencies and provide directions for future research aimed at preparing ³prospective teachers for the demands of digitally transformed educational environments.

In a nut shell, the literature firmly supports the argument that ICT awareness, skills, and application are critical for developing the teaching competencies required in contemporary classrooms. However, the transition from awareness to effective practice is complex and influenced by a web of individual, institutional, and contextual factors. The gaps identified provide a compelling rationale for the present study, which aims to systematically investigate how these ICT dimensions collectively influence teaching competencies among prospective B.Ed. teachers in India. By addressing this underexplored area, the research seeks to generate actionable insights for teacher education policy, institutional training programs, and future research, thereby contributing to the preparation of a technologically proficient and pedagogically versatile teaching workforce ¹¹capable of meeting the demands of the digital age

References

- Akram, H., Abdelrady, A., Al-Adwan, A., & Ramzan, M. (2022). A systematic review of teachers' attitudes toward ICT integration. *Education and Information Technologies*, 27, 4521–4545. <https://doi.org/10.1007/s10639-021-10815-x>
- Alemu, S. K. (2015). The role of ICT in higher education: A review of literature. *International Journal of Education and Development using ICT*, 11(3), 1–15.
- Alenezi, A., & Alsadoon, H. (2022). ICT awareness and professional development of educators in the digital era. *International Journal of Educational Technology in Higher Education*, 19(1), 44–58. <https://doi.org/10.1186/s41239-022-00345-w>
- Altun, A., & Akyildiz, S. (2017). TPACK levels of pre-service teachers. *Journal of Education and Training Studies*, 5(6), 118–125. <https://doi.org/10.11114/jets.v5i6.2413>
- Anal, K. (2021). ICT awareness and attitude of student teachers towards ICT. *International Journal of Research in Social Sciences and Humanities*, 11(2), 112–120.
- Bhattacharya, S. (2025). Digital competencies in technology-enabled assessment: A study of modern classrooms. *Journal of Indian Education*, 51(1), 45–58.
- Butler, D., Leahy, M., Hallissy, M., & Brown, M. (2017). Different strokes for different folks: Scaling a blended model of teacher professional learning. *Interactive Technology and Smart Education*, 14(4), 339–353. <https://doi.org/10.1108/ITSE-01-2017-0002>
- Castro Sánchez, J. J., & Alemán, A. M. B. (2011). Teachers' opinion survey on the use of ICT tools to support attendance-based teaching. *Computers & Education*, 56(3), 911–915. <https://doi.org/10.1016/j.compedu.2010.11.005>

- Chifari, A., et al. (2000). Computer self-efficacy and attitudes toward ICT: A study of educators. *Journal of Educational Computing Research*, 23(1), 45–60.
- Ergen, B., Yelken, T. Y., & Kanadli, S. (2019). A meta-analysis of research on technological pedagogical content knowledge (TPACK) by gender. *Educational Sciences: Theory & Practice*, 19(2), 34–52.
- Gomleksiz, M. (2004). Effectiveness of computer-assisted instruction in the teaching of English. *Educational Sciences: Theory & Practice*, 4(1), 389–404.
- Gupta, S., & Gupta, M. (2014). The role of ICT in modern classrooms: Reshaping pedagogical competencies. *Indian Journal of Teacher Education*, 28(3), 89–102.
- Hazira Qomi, H., et al. (2024). ICT integration and the classroom environment: A global perspective. *Educational Technology Research and Development*, 72, 112–130.
- Irwanto, Redhana, I. W., & Wahono, W. (2022). Investigating pre-service teachers' TPACK proficiency and demographic differences. *International Journal of Instruction*, 15(3), 89–104.
- Koehler, M. J., Mishra, P., & Kereluik, K. (2014). The technological pedagogical content knowledge framework. In *Handbook of research on educational communications and technology* (pp. 101–111). Springer. https://doi.org/10.1007/978-1-4614-3185-5_9
- Kozma, R., & Anderson, R. E. (2007). *Qualitative study of innovative pedagogical practices using technology*. ISTE.

- Kuri, R., & Pujar, K. (2025). Impact of ICT competencies on teaching learning among teacher educators. *International Journal of Advance Studies and Growth Evaluation*, 4(8), 64–68. <https://alladvancejournal.com/media/post/IJASGE-4-8-16.1.pdf>
- Larrañaga, M., et al. (2023). ICT tools for communication and collaboration in schools. *Journal of Educational Media & Library Sciences*, 60(2), 201–218.
- Luik, P., Taimalu, M., & Suviste, R. (2018). Analysis of teachers' TPACK and its correlation with technology usage. *Journal of Baltic Science Education*, 17(2), 273–285.
- Lyngdoh, M. (2025). Exploring school teacher ICT competency, awareness, and challenges in using technology in the classroom teaching and learning: Consequences for pedagogical alignment and policy frameworks. *Indian Journal of Educational Technology*, 7(2).
- Max, A.-L., Weitzel, H., & Lukas, S. (2023). Factors influencing the development of pre-service science teachers' technological pedagogical content knowledge in a pedagogical makerspace. *Frontiers in Education*, 8, Article 1166018. <https://doi.org/10.3389/feduc.2023.1166018>
- Mustafa, M. Y., Tlili, A., Lampropoulos, G., Huang, R., Jandrić, P., Zhao, J., Salha, S., Xu, L., Panda, S., Kinshuk, López-Pernas, S., & Saqr, M. (2024). A systematic review of literature reviews on artificial intelligence in education (AIED): A roadmap to a future research agenda. *Smart Learning Environments*, 11, Article 59. <https://doi.org/10.1186/s40561-024-00333-x>
- Permata, I. W., & Purnawarman, P. (2024). Elementary school educators' perspectives on ICT integration. *International Journal of Education*, 16(1), 22–35.

- Rathod, A. (2002). ICT awareness among secondary school teachers: A study. *Journal of Educational Planning and Administration*, 16(4), 541–550.
- Schmid, M., Brianza, E., & Petko, D. (2021). Self-reported TPACK and technology use: A study of pre-service teachers. *Computers & Education*, 165, 104135.
<https://doi.org/10.1016/j.compedu.2020.104135>
- Shokeen, A., & Kaur, S. (2022). Factors influencing digital competence of pre-service teachers: A systematic review. *Indian Journal of Open Learning*, 31(1), 15–28.
- Shukla, R. (2025). Technological knowledge among secondary teacher trainees: A demographic analysis. *Journal of Teacher Education and Research*, 20(1), 33–45.
- Singh, M., Sharma, M., & Gupta, R. M. (2024). ICT awareness and usage patterns among school teachers in Punjab. *Journal of ICT in Education*, 9(1), 77–90.
- Sipilä, K. (2013). ICT use in teaching: A study of Finnish teachers. *Education and Information Technologies*, 18(2), 295–315. <https://doi.org/10.1007/s10639-011-9285-x>
- Sugar, W., et al. (2005). Factors influencing technology integration. *Journal of Technology and Teacher Education*, 13(2), 173–194.
- Suguna, M., & Neelamegam, K. (2020). ICT awareness among prospective teachers in Trichy district. *International Journal of Multidisciplinary Educational Research*, 9(4), 122–135.
- Tsitouridou, M., & Vryzas, K. (2003). Early childhood teachers' attitudes towards technology. *European Early Childhood Education Research Journal*, 11(2), 7–25.

UNESCO. (2020). *Ensuring effective distance learning during COVID-19 disruption: Guidance for teachers*. UNESCO Publishing.

Vanegas, H. D. O., Cifuentes, Y. D. M. S., & Morrás, A. S. (2025). Educational technology in teacher training: A systematic review of competencies, skills, models, and methods. *Education Sciences*, 15(8), Article 1036. <https://doi.org/10.3390/educsci15081036>

Vandana, A., & Newa, J. (2009). Teachers' attitudes towards ICT in teacher education programmes. *Journal of Indian Education*, 35(2), 67–79.

Viseu, F., & da Ponte, J. P. (2012). The role of ICT in teacher effectiveness. *Educational Technology & Society*, 15(3), 198–209.

Wilson, B. (2002). *Professional development for ICT integration*. International Society for Technology in Education.

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