International Journal of Integrated Research and Practice (IJIRP)

Vol 2, Issue 3, March 2026, Page: 187-198 ISSN: 3107-5037

Technology-Enhanced Teacher Training: Virtual Simulations and AI Tutors

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Abstract

Digital technologies are rapidly incorporated into the learning and teaching process, shifting the role of the teacher into a new realm of expectations that demand greater pedagogical, technological and decision-making skills. Traditional teacher training methods were effective for developing theoretical knowledge, but they might lack opportunities for practical classroom experiences and for teachers to receive personal assistance from the trainer. This research paper will discuss the opportunities provided to the teacher training in the use of virtual simulations and artificial intelligence (AI) based tutoring systems. This study is a review-based research that combines the results of previous studies published in academic journals, policy and empirical research on digital teacher education. Use of virtual simulations enable trainee teachers to have a real classroom experience, to rehearse all kinds of teaching techniques, to manage students' behaviour and receive immediate feedback in a safe environment. AI tutors complement these simulations with tailor-made learning paths, adaptive advice, instant assessment charts and guidance on the next steps. The paper explores the pedagogic benefits, strategies and challenges of these technologies, including digital literacy, equality of access, infrastructure and data privacy, algorithmic bias. The results indicate that the integration of virtual simulations and AI tutors helps boost teachers' confidence, reflective practice, teaching effectiveness, and professional competence, and promotes ongoing learning and skill development. But, enterprising execution relies upon institutional readiness, faculty training, moral government and facilitating instructive policies. The study ends that technology-based teacher training is a huge step forward in teacher professional development and the gap between theory and practice. The paper offers suggestions for educational institutions and policy makers on how emerging technologies can be used effectively, ethically, and inclusively in teacher preparation to help create a teaching workforce for the future.

Keywords: Teacher training, Artificial intelligence, Virtual simulations, AI tutors, Professional development, Digital pedagogy, Adaptive learning, Teacher education.

Introduction

The speed at which digital technologies have developed has greatly changed the face of education, and there are new opportunities for enhancing teaching quality and professional development. The success of technology-based instructional practices in schools motivates the transformation of teacher education from typical face-to-face workshops and theories to practical teaching experience and work with technological tools.The use of technology for teaching has become more common in educational institutions, leading to a shift in teacher training from traditional classroom-based methods to hands-on experiences and engagement with technological tools. The modern teacher training focuses on learning by doing, lifelong professional development, and the successful use of information and communication technology in the classroom. Virtual simulations and the use of artificial intelligence (AI) tutors are among the new innovations that have captivated the attention of both pre-service and in-service teachers because of their ability to offer personalized, interactive, and practice-oriented learning experiences. Making teachers ready for modern classrooms is not merely about knowing the actual subjects. Teachers need to acquire the skills of using digital technology in education, classroom management, assessment techniques, inclusive education, and flexible

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teaching. Some of the challenges in traditional teacher training are lack of opportunities for hands-on teaching, mentoring quality and reliability, time constraints, and access to a variety of teaching settings and situations. The challenges indicate the demand for technology supported training environments where teachers can be given hands on experience and immediate feedback to help them learn through repeated practice without risking live classroom experimentation. Virtual simulations have proven to be a valuable part of teacher preparation, as they allow teachers to practice the interaction, classroom management, decision-making and communication skills they are likely to employ in a classroom, while providing a realistic environment. These learning spaces are simulated which reflect real-life classroom situations that have different students with differing behaviors, needs, and classroom dynamics. Virtual simulations offer teachers the opportunity to try a variety of scenarios, review difficult situations, and practice a variety of responses—whereas traditional role-playing activities only give teachers the chance to try one scenario, revise and correct their response to the scenario, and then try another. This practical training boosts teacher confidence in fulfilling their duties, and reduces the anxiety of real classroom experiences. Artificial Intelligence has also further improved the capabilities of teacher professional development, by introducing intelligent tutoring systems that can offer personalized learning experiences. AI tutors analyze students' learning data to identify strengths and weaknesses, recommend tailored learning plans, and deliver real-time suggestions for teaching strategies. AI-driven platforms provide adaptive learning algorithms that guide self-paced professional development and tailor to individual educators' needs. They can also be used for continuous assessment, which enables teachers to monitor student progress and receive suggestions for improvement based on the data. The use of virtual simulations and AI tutoring is a major step forward in the field of teaching. While a simulation provides a realistic learning experience, AI tutors go a step further by allowing for real-time feedback, performance insights, and tailored teaching. This can create an interactive learning environment for teachers to try out teaching strategies and receive feedback, self-evaluate, and build up their professional skills. Technology supported learning spaces foster active learning, critical thinking, flexible teaching and reflection, all characteristics of effective teachers in today's classrooms. Technology mediated teacher preparation also helps in addressing equity issues in accessing teacher preparation, as it is not only geographically, but also financially and institutionally available. Such tools can be used by teachers in non-central and inaccessible locations to receive quality teacher training without incurring significant travel or building costs. In addition, these technologies allow co-construction of knowledge and make it possible to share experiences, discuss challenges in teaching and learning and develop new pedagogical solutions, without being limited by institutional and national boundaries, in virtual communities of practice. The use of AI in teacher training is a wider example of the digitalization of education systems across the world. The governments, universities and teacher education institutions have become more and more interested in the use of educational technologies to enhance the effectiveness of teaching and learning. Digital competency, use of information technology in teaching and learning and lifelong professional learning are key elements of quality education in many countries' national education policies. As a result, teacher preparation programs are integrating digital pedagies, simulation learning, and intelligent educational technologies into their programs to ensure teachers have the skills they need to teach in a digital classroom. Although the use of technology to facilitate teacher education has increased, there are some challenges. Issues such as data privacy, algorithmic bias, technological access, digital competence, infrastructure challenges, and ethical AI usage remain relevant in the successful implementation of these innovations. Furthermore, virtual simulations and AI tutors must be carefully designed, the institution must provide sufficient support, and must be linked to educational goals. To overcome these challenges, cooperation between educators, policymakers, technology developers, and educational researchers is required to ensure that technological innovations are not used in a way that will supplant the human part of

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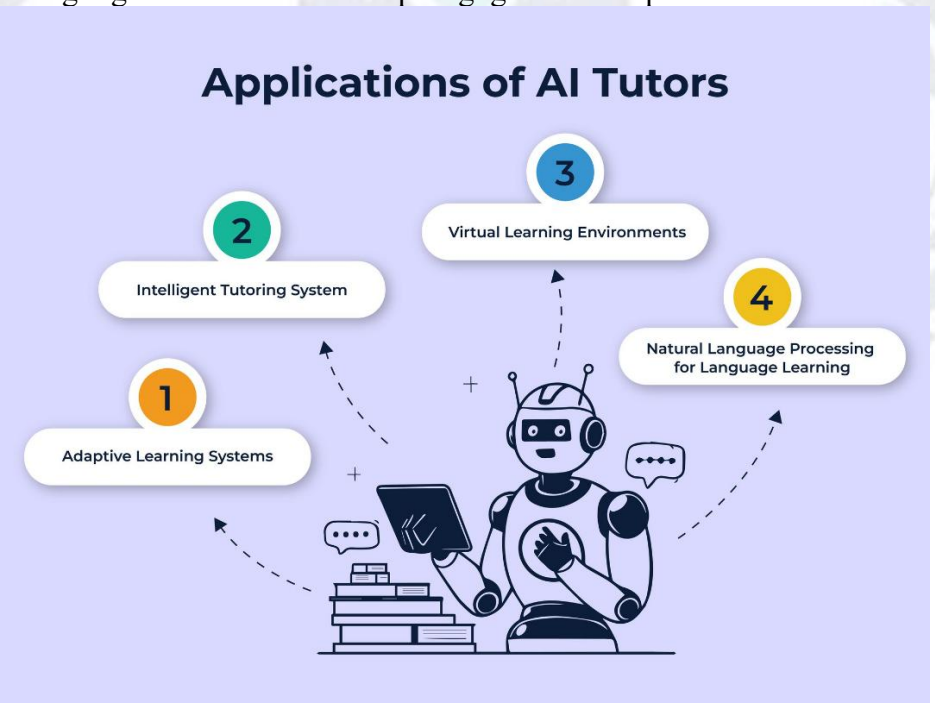
teachers and mentors. The use of virtual simulation and AI learning has been proven to boost teachers' confidence in teaching, teaching decision-making, classroom management, and in their own professional performance. The future consequences of such technologies on teacher effectiveness, pupil achievement and institutional integrity however need to be investigated. It is therefore crucial that researchers understand the opportunities and constraints of technology-enhanced teacher preparation, so as to define the models for professional development that can sustain themselves in the face of the changing needs of twenty-first century education. In light of the foregoing, the present research investigates the impact of virtual simulations and AI tutors on improving teacher training. It investigates the role of these technologies in the development of pedagogical skills, personalised learning experiences and lifelong professional learning, and recognises the difficulties in applying them. The study aims to offer guidance to educators, teacher preparation institutions, policymakers, and educational technology developers that want to enhance teacher preparation in innovative and evidence-based ways that leverage technology.

Background of the study

Digital technologies have become a rapidly evolving field and their impact on education has changed the knowledge, skills and competences that teachers are expected to acquire in the 21st century. Classrooms are becoming more technologically driven, and teachers need to incorporate innovative teaching and learning approaches, technology tools, and data-driven instruction into their classrooms. This has put increasing pressure on teacher education institutions to modernize traditional teacher training methods and equip future teachers for an education in technology-rich environments. Traditional teacher education approaches that primarily involve lecture, observation, and limited teaching practice, do not afford the teacher enough opportunities to repeat, receive immediate feedback, and experience a wide variety of classroom situations. This has stimulated the interest in technology-enhanced teacher training models, blending digital innovations with pedagogical development.



Source: ***https://www.thirdrocktechkno.com/blog/ai-tutors-benefits-and-role-in-modern-education-2026/***

Virtual simulation technologies, which have been helpful in designing realistic and interactive learning environments without the logistics of a classroom, have proved useful for this purpose. The simulations enable trainee teachers to engage with “students” who have a range of learning

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needs, behaviour patterns and classroom interactions. Unlike traditional practicum experiences where limited opportunities for actual teaching practices and placement considerations are of primary concern, educators are provided opportunities to rehearse and practice Instructional Strategies multiple times on a simulated setting. These simulations enhance classroom management, lesson planning, decision making, and teaching confidence prior to entering the actual classroom. Concurrently, Artificial Intelligence (AI) has presented novel opportunities for teacher training that can be personalized. Meanwhile, the use of Artificial Intelligence (AI) has opened up new avenues for personalized teacher training. The performance of the trainees can be analysed by the AI-powered tutoring platforms to identify their strengths and weaknesses, and then tailor their instruction to meet their needs. AI tutors give immediate feedback, customizable learning plans, automated grading, and intelligent suggestions that facilitate self-directed career growth. These systems leverage machine learning algorithms and educational analytics for competency-based learning and to reduce the requirement for constant supervision by humans. The teacher preparation is therefore more flexible, efficient and responsive to the progress of individual learning. Combining virtual simulations with AI tutors is a major leap in teacher training. With virtual simulations, learners can experience authentic learning environments and test their instructional methods, and AI tutors can give them feedback and evidence-based tips to enhance their instruction. This partnership fosters experiential learning, enabling teachers to assess and improve teaching and learning decisions, and gain confidence from repeated practice. Moreover, AI-powered analysis will help teachers to observe students' learning performance objectively to understand their needs and needs for future development.

With a growing trend of online and blended learning having become a necessary component to the education sector due to the COVID-19 pandemic, technology enhanced teacher preparation becomes even more significant. The world experienced unparalleled disruptions in education that revealed the need for digitally competent teachers to support teaching and learning through a variety of learning platforms. They have inspired governments, universities, and teacher training institutions to put resources into the infrastructure, educational technologies, and innovative teacher training programs to enhance teacher readiness for future educational challenges.

It has been found that technology-based teacher learning has a positive impact on instructional competence, self-efficacy, reflective practice and classroom readiness. Virtual simulations have been shown to enhance classroom management, communication skills and pedagogical decision making, whereas AI learning environments have the potential to boost learner engagement, personalised learning and ongoing performance improvement. However, the adoption of these technologies comes with various challenges, such as technological accessibility, infrastructure limitations, disparities in digital literacy, ethical implications of using AI, data privacy, algorithmic transparency, and teacher education faculty training for implementing emerging technologies in the field.

Although there is greater awareness of the promise of educational technologies, empirical research on the effectiveness of the implementation of virtual simulations and AI tutors in teacher education is still relatively small, especially in developing countries where institutional resources and technological preparedness show significant differences. Previous research has tended to examine simulation-based learning or AI-based learning alone, with a lack of research on how these technologies can complement and augment one another to improve teacher skills, teaching practices, and teacher learning outcomes. Furthermore, there are variations in institutional policies, technological infrastructure, curriculum design and learner characteristics which indicate the necessity of context specific investigations.

In this context, the present study tries to present the application of technology-supported teacher preparation in the context of Virtual Simulation and AI tutors.In this context, this study will examine the implementation of technology-supported teacher preparation in the context of

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Virtual Simulation and AI tutors. It aims to explore how these technologies influence pedagogical competences, pedagogical confidence, pedagogical management, pedagogical reflection, and pedagogical readiness. The outcome of the research will contribute to the knowledge base about digital teacher education and provide an insight for teacher education institutions, policy makers, curriculum designers and education technology developers. The study concludes that there is an ongoing need for the continuous development of teacher education, with effective practices identified and discussed for the preparation of competent, flexible, and digitally literate teachers for the evolving needs of teaching.

Objectives of the Study

1. To explore the concept and development of teacher education using technology in modern educational context.
2. To investigate the contribution of virtual simulation technologies to the enhancement of classroom management, instructional planning and pedagogical decision making for pre-service and in-service teachers.
3. To understand how AI tutors can help offer individual teacher support, ongoing feedback, and adaptive learning.
4. To evaluate the impact of the virtual simulations and AI tutors on teachers' ability to develop their instructional skills, confidence, and problem-solving skills.
5. To pinpoint the positive outcomes of using immersive digital technologies for teacher education and professional training.

Literature Review

The use of technology in teacher education has revolutionized the way teachers are prepared, creating an interactive, adaptive, and data-driven learning environment. Virtual simulations and Artificial Intelligence (AI) based tutoring systems have become the latest innovative solutions that have been developed to improve pedagogical knowledge, skills in managing classrooms, and pedagogical decision-making. The previous studies have emphasized their effectiveness in teacher education in various educational contexts, as well as their ability to overcome the shortcomings of traditional teacher training approaches. Initial studies of technology use in teacher preparation focused on the use of digital learning environments to support reflective teaching. M J Rosenberg (2001) emphasized that e-learning technologies can support PD in a flexible way by enabling access to learning resources and collaborative learning at all times. Likewise, David H. Jonassen (2000) proposed that technology-based learning environments foster critical thinking and problem-solving, allowing teachers to create meaningful pedagogical knowledge in real situations. Virtual simulations are becoming a hot topic in teacher education as a means to effective experiential learning. Based on the research of Ertmer and Ottenbreit-Leftwich (2010), simulation-based training increases teachers' confidence and instructional ability because they get the chance to practice scenarios and situations in the classroom without risk. Their research found that using simulated teaching environments engenders better classroom management and teaching decision making skills. The use of mixed-reality simulation in teacher preparation is also highly surveyed. According to Lisa Dieker et al (2014), virtual classroom simulations allow prospective teachers to experience teaching in a realistic environment, and to interact with the virtual students who display a range of learning behaviours. After repeated simulation sessions, the researchers noticed there were substantial improvements in the communication skills, behavioural management, and lesson delivery. M. Suzanne Johnson et al. (2018) found that immersive simulation environments promote reflective practice as they allow trainees to reflect on their conduct and to receive structured feedback regarding their teaching. In these settings, teacher candidates' anxiety about starting in a classroom is diminished, and they practice instructional strategies before they are in a real classroom. AI has also revolutionized teacher education with the use of intelligent tutoring

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systems that deliver personalized learning experiences and support. Intelligent tutoring systems that can provide personalized learning experiences and support have also transformed teacher training, fueled by AI. According to Beverly Park Woolf (2010), AI tutors can tailor learning materials based on student performance, providing real-time feedback and personalized learning sequences. The adaptive qualities help to strengthen pedagogical concepts and satisfy the needs of individual learners. Similarly, Rose Luckin et al. (2016) pointed out that the use of AI should be a smart assistant and should not be used as a replacement of teachers. They found that AI-driven tutoring systems could improve professional learning by feeding back on trainee performance and providing targeted interventions for the teaching methods, which could help evidence-based teacher development. The possible applications of AI in education have also been extensively discussed, especially in terms of educational implications. Wayne Holmes, Maya Bialik, and Charles Fadel (2019) suggested that AI technologies could remove the drudgery from teaching repetitive tasks and provide real-time data for teachers to inform their decision on teaching. Based on their research, they conclude that AI tutors encourage SRL, reflection on teaching, and continuous professional development. Research has delivered positive outcomes of teacher PD for AI has shown improvements in teaching effectiveness. Learning analytics generated by AI systems take the teacher educator to the level of individual competency gaps and enable the creation of individual training programmes (Dirk Ifenthaler and Dana-Kristin Mah, 2020). These data-driven approaches help to improve efficient and effective teacher training that delivers desired outcomes. Incorporating virtual reality (VR) and augmented reality (AR) has created more opportunities for real experiences with teachers throughout their training. Jeremy N. Bailenson (2018) stated that immersive virtual environments improve the engagement of learners and allow for hands-on learning, by simulating the learning environment as a real space. The teacher trainees exposed to VR-based simulations showed higher readiness to handle complex instructional challenges than teacher trainees being trained with traditional education only. Results of other studies focusing on simulation-based assessment have been positive as well. In the past, simulation was a video-based method that is useful mainly for post-observation. Kenneth Y. T. Lim (2017) remarked that virtual simulation offers objective measurement of teaching competence via performance analytics and automated assessment tools, chiefly for post-observation. These systems enable teachers to keep track of the trainees' progress at all times, and determine which areas need further support. Technology adoption models have been employed to explore teachers' acceptance of AI technologies. Viswanath Venkatesh et al. (2003) proposed Unified Theory of Acceptance and Use of Technology (UTAUT) in explaining the factors that affect technology adoption, noting the importance of perceived usefulness, ease of use, facilitating conditions, and social influence. This model has since been extended to teacher training, with findings showing that institutional backing and digital literacy levels have a positive impact on teachers' acceptance of AI in education. The ethical aspects of the use of AI in teacher education were also addressed by research conducted by Neil Selwyn (2019). The study identified algorithmic bias, data privacy and transparency and human centric pedagogy as issues. Selwyn's view was that there should be ethical rules and regulations, as well as continuous education, for teachers about the application of responsible AI. Several studies have confirmed the significance of the digital competence in teacher education. Christine Redecker (2017) has developed a framework for the Digital Competence of Educators (DigCompEdu), which classifies the following aspects as key skills for technology-assisted education: Professional engagement, digital resources, assessment, and learner empowerment. The framework has been adapted as a guideline for the design of technology enhanced teacher education programmes in the world. The merger of AI, virtual simulations, and learning analytics into teacher training has been the subject of recent research. Intelligent tutoring systems and immersive simulations have been identified as tools that can be used to enhance personalized learning through adaptive learning environments that offer adaptive feedback, predictive performance analysis, and continuous competency

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assessment (Mutlu Cukurova et al., 2023). These integrated systems have a great impact on the confidence of teachers, the quality of their teaching and decision making in pedagogy. Although there is an increasing volume of literature to support technology enhanced teacher training, there are still some gaps in the research. There are very few studies that use evidence from developing educational system, and most of the existing studies are devoted to developed countries. Moreover, longitudinal studies looking at the long-term effects of AI tutors and virtual simulation in the classroom are somewhat limited in number. Very little focus has also been paid to the readiness of institutions, teachers' perceptions in different educational setting, ethical governance of AI-based teacher education systems.

Material and Methodology

The study employed a mixed-method research design to explore how technology enhanced teacher preparation using virtual simulations and Artificial Intelligence (AI) tutors can enhance their professional competencies in pre-service and in-service teachers. The study utilized a mixed methodology (qualitative and quantitative) to gain a holistic view of teachers' experiences, perceptions, and results from the new digital training tools. Technology supported teacher education learning environments have been evaluated both with descriptive and an analytical framework. The study was done with teacher educators, trainee teachers and practicing school teachers of selected teacher education institutions and schools. Stratified random sampling method was used for obtaining representation across different levels of education, subject specializations and years of teaching experience. Descriptive statistics (frequency, percentage, mean and standard deviation) were applied on the collected data whereas inferential statistics (correlation and regression analysis) were applied to find the relationships between the technology usage, training effectiveness and teaching competency. Thematic analysis was then used to analyze the qualitative responses and derive themes and patterns around the use of AI for teacher training.

The researcher used both primary and secondary data in the study to guarantee the reliability and validity of the study results. The primary data were gathered using structured questionnaire to teacher trainees, school teachers and teacher educators. The close-ended Likert scale questions and some open-ended questions aimed to collect the participants' experiences, challenges and suggestions regarding the Virtual Simulation Platforms and the AI Tutoring Systems. In addition, semi-structured Interviews were used to delve deeper into the implementation, benefits and limitations of teacher training programs using technology. The secondary data were collected from peer-reviewed journal articles, scholarly books, conference proceedings, government reports, policy documents, publications of international organizations, institutional reports as well as reputable online academic databases. These were used as theory resources, illustrative examples from around the world and as a base for discussing Digital teacher education, virtual simulation technologies, Artificial Intelligence in education, and professional development practices. Primary and secondary data were combined, which allowed for an overall triangulation from which the results of the research were credible and provided empirical evidence and context of the technology-enhanced teacher training.

Results and Discussion

Results:

The results of this study come from data gathered from teacher educators, pre-service teachers and in-service teachers on the use of virtual simulations and AI tutors in teacher education. Descriptive statistics were used to discuss participants' perception of technology-enhanced teacher education and inferential analysis was used to examine the perception of technology-enhanced teacher education. The findings are discussed and interpreted with regard to the developments taking place with regard to digital pedagogy and teacher development.

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Table 1. Demographic Profile of Respondents (N = 200)

Variable	Category	Frequency	Percentage (%)
Gender	Male	82	41.0
	Female	118	59.0
Teaching Experience	Less than 5 years	64	32.0
	5–10 years	73	36.5
	Above 10 years	63	31.5
Institution Type	Government	88	44.0
	Private	112	56.0
Previous Experience with AI-based Training	Yes	126	63.0
	No	74	37.0

Discussion:

Demographic profile shows a good cross-section of those participants across various educational levels. The respondents were mostly female (59%) and this is typical of teacher education programmes in general. As more than two-thirds of respondents had more than five years of experience teaching, perceptions were based on real classroom exposure.

A significant result is that 63% of the respondents had previous experience with AI-assisted learning platforms or virtual teaching simulations. This suggests growing knowledge about educational technologies among teachers and that "technology enhanced professional development" is slowly becoming part of teacher education institutions.

Table 2. Perceptions of Virtual Simulations and AI Tutors in Teacher Training

Statement	Mean	Standard Deviation
Virtual simulations improve classroom management skills.	4.42	0.58
AI tutors provide personalized learning support.	4.35	0.63
Technology-based training enhances teaching confidence.	4.28	0.69
AI feedback improves lesson planning abilities.	4.17	0.71
Virtual teaching practice increases decision-making skills.	4.31	0.61
AI tutors encourage continuous professional learning.	4.26	0.66

(Scale: 1 = Strongly Disagree to 5 = Strongly Agree)

Discussion

The effectiveness of virtual simulations and AI tutors for teaching were agreed upon by the majority. The highest rated statement was Virtual simulations are required as an environment for practicing how to deal with realistic classroom situations without endangering oneself (Mean = 4.42), which suggest that virtual simulations are important because they enable teachers to practice their skills in the classroom in a real and safe environment. The confidence in AI tutor's ability to provide personalized learning support (Mean = 4.35) is indicative of the perception of adaptive learning technologies. The participants were amazed at the possibilities of AI tools to identify learning gaps, provide targeted resources, and provide real-time feedback. Technology facilitated training was also beneficial for teaching confidence and instructional planning. The results show that AI-assisted teacher training is not only about acquiring new knowledge, but it also involves pedagogical decision-making and self-reflection.

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Table 3. Relationship between Technology Usage and Teaching Competency

Variable	Pearson Correlation (r)	Significance (p-value)
Virtual Simulation Usage and Teaching Competency	0.71	<0.001
AI Tutor Utilization and Instructional Effectiveness	0.68	<0.001
Digital Training Frequency and Professional Confidence	0.64	<0.001

Discussion

The correlation analysis shows that there is a high positive correlation between teacher training using technology and teaching competency. The correlation coefficient between the use of virtual simulation and teaching competency was 0.71, which shows that virtual simulation usage can strengthen the teaching competencies of teachers significantly by frequent usage.

Likewise, the positive correlation between instructional effectiveness and the adoption of AI tutors was significant (r = 0.68). Those who used AI tools in their daily instructional tasks reported advanced preparation of lessons, better assessment practices, and more confidence in dealing with learner diversity.

The correlation between digital training frequency and professional confidence of 0.64 was positive, reflecting once again the positive relationship between digital training frequency and professional confidence. The results further underscore the value of incorporating AI-learning tools into teacher education programmes in addition to practical experiences.

Conclusion

The use of technology in the training of teachers is recognized as the game-changer in addressing the needs of modern classrooms in teacher preparation. Introducing virtual simulations and AI tutors into teacher preparation can offer additional opportunities to practice, provide personalized instruction, and foster continuous professional development to address the needs of today's teacher preparation environment. Virtual simulations and AI tutors in teacher education can provide further opportunities for practical experience, individualised learning, and lifelong learning, thus overcoming some of the drawbacks of traditional teacher education. The technologies used support trainee teachers in developing pedagogical competence, classroom management, decision making and reflective teaching skills by giving trainee teachers real practice contexts to practice teaching strategies in risk free contexts and receive immediate feedback from the technology.

The review reveals that virtual simulations can produce realistic teaching scenarios, and that teachers can get used to before entering their actual classrooms. AI tutors can improve these simulations by adapting learning sequences to the student, identifying and suggesting learning improvements, and making personalized recommendations for learning improvements. These technologies, when used together, enhance student-centred learning, engage students and help to gain understanding and skills, whether theoretical or practical. Furthermore, they are flexible and adaptable, making them valuable to teacher preparation institutions that have varying geographical or institutional contexts and aim to provide identical and quality preparation experiences.

Even with these benefits, who can use technology-enhanced teacher training is constrained by a number of barriers. Infrastructure constraints, access to digital tools, lack of data privacy and algorithmic transparency, financial constraints, and varying teacher digital competency still pose a barrier to implementation. Successful integration to be successful requires not just technology investment, it also requires broad institutional support, appropriate policy frames,

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ongoing faculty development, and ethical governance, in order for the innovation to be accessible, inclusive and pedagogically relevant. The results also suggest that technology can not be considered a substitute for human teachers and teacher educators. Rather, virtual simulations, AI tutors are best suited to learning environments that include technological innovation, expert tutoring, cooperative learning and reflective learning practices. Despite their intelligence, human interactions are still crucial to developing professional judgment, empathy, ethical reasoning and interpersonal communication—the very qualities that make good teachers good.

The future of teacher education needs to prioritize creating adaptive, culturally responsive, and inclusive AI-based learning environments capable of meeting the needs of various learning experiences. The integration of AI, XR, learning analytics, and natural language processing (NLP) is anticipated to continue to enrich immersive teacher preparation experiences and foster ongoing professional development through the use of lifelong learning. Research on technology-enhanced teacher professionalization needs to focus most crucially on the longitudinal study of the effects of technology on teacher professionalization, comparisons of technology-enhanced teacher professionalization across educational systems, and research on the effects of technology on teacher effectiveness, student learning outcomes, and educational equity.

To sum up, the use of virtual simulations and AI tutors is a major advancement in teacher training, with the potential to transform the profession and how educators are prepared and supported for their ongoing growth and development. If harnessed responsibly and used with the proper pedagogical practices, supported by appropriate infrastructure and ethical protection, these technologies can support teaching, optimise learning and contribute to the development of education systems capable of facing the future challenges. Their success will largely depend on the balancing of technological advancements and the fostering of values of human-centered pedagogy, in which technological innovations are utilized to establish an atmosphere of educational excellence.

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