

Revolutionizing Teacher Education: Impact of Artificial Intelligence

Dr. Sakshi Sharma

Assistant Professor, School of Education, Lingaya's Vidyapeeth, Faridabad, India
drsakshisharma17@gmail.com

Abstract: *The pandemic has catalyzed a momentous shift to online/blended teaching and learning where teachers apply emergent technologies to enrich their students' learning outcomes. Artificial intelligence (AI) technology has gained its acceptance in online learning environments during the pandemic to assist students' learning. However, many of these AI tools are new to teachers. They may not have rich technical knowledge to use AI educational applications to enable their teaching, not to mention developing students' AI digital capabilities. As such, there is a growing need for teachers to equip themselves with adequate digital competencies so as to use and teach AI in their teaching environments. There are few existing frameworks informing teachers of necessary AI competencies. This study first explores the opportunities and challenges of employing AI systems and how they can enhance teaching, learning and assessment. Then, aligning with generic digital competency frameworks, the DigCompEdu framework and P21's framework for twenty-first century learning were adapted and revised to accommodate AI technologies. Recommendations are proposed to support educators and researchers to promote AI education in their classrooms and academia.*

Keywords: Teacher education, Artificial Intelligence, Role of Artificial Intelligence in Teacher Education, Teachers' AI digital competency, Recommendations are suggested to help teachers develop their digital competencies

I. INTRODUCTION

Artificial Intelligence can be defined as machines that can perform the tasks that humans carry out through their thinking. (Dörfler, 2022) The usage of Artificial intelligence is growing at an unprecedented rate & it is rapidly changing the aspects of human life. (Xue& Wang, 2022a) In recent years the use of Artificial Intelligence (AI) & Learning Analytics (LA) have efficiently been introduced in the field of education. (Salas-Pilco et al., 2022) Education includes many aspects of teaching & learning and it involves both school education and higher education.

Teacher education is an vital part of our education system as it serves as a mean of shaping the future. There is a close positive correlation between the college teachers and higher education. (Deng et al., 2022)

The National Council for Teacher Education (NCTE) has defined Teacher Education as a programme of education, research & training of persons to teach students of pre-primary to higher education. The ultimate aim of teacher education is to develop skills and competencies in the prospective teachers so that it enables them to meet the necessities of teaching profession and formulate them to meet future needs. (Lal& Jamal, 2021). It is important to understand that Artificial Intelligence can support teachers, through the provision of educational applications, in the same way as these technologies are redesigning other fields. (Salas-Pilco et al., 2022). "The main purpose of developing artificial intelligence is to make computer combined with mechanical equipment competent for some complex work which usually needs human intelligence and greatly reduce the burden of human beings". (Xue& Wang, 2022b).

Teacher Education

Teacher education is defined as the practices, strategies, and policies that prepare teachers with the professional knowledge, teaching skills, evaluation techniques, and ethical orientations needed to effectively perform their teaching activities in order to contribute to the development of society. Teacher education is usually considered to have three phases—pre-service, induction, and in-service—all of which are part of a continuous process. Thus, teacher education

means both the basic and foundational teacher education oriented towards pre-service teachers and continuous teacher education oriented towards in-service teachers who receive professional development training. Regarding the use of technology, most teachers now recognize the importance of technology in teaching and learning activities. Thus, teacher education programs integrate technology in different ways within the classroom or via online courses—for example, by employing social media, blogs, web conferences, and discussion forums. However, the integration of technology into courses is still difficult due to several factors, such as the school culture, availability of resources and teachers' attitudes, knowledge and skills. Nevertheless, governments around the world are implementing policies to bring technology to classrooms, as it is becoming an essential component of the education system. Therefore, teacher education plays an important role in developing teachers' knowledge and skills related to the use of technology in the classroom

Artificial Intelligence in Education

AI can be defined as “computing systems that are able to engage in human-like processes such as learning, adapting, synthesizing, self-correction and use of data for complex processing tasks” .AI has many branches and sub-branches, such as:

- machine learning (ML), which consists of algorithms that use educational data to identify patterns through successive training with the data;
- deep learning, which uses large datasets to simulate and predict educational outcomes; and
- natural language processing (NLP), which employs algorithms for language recognition to extract and analyze textual meaning.

In education, AI supports and enhances learning environments by employing intelligent tutoring systems, intelligent agents and intelligent collaborative learning systems. Recently, the education sector has been significantly influenced by AI research, and an interdisciplinary approach is required to integrate several fields, including computer science, image processing, linguistics, psychology, and neuroscience. AI supports teachers' decision making by reporting real-time class statuses and responding to students' needs through personalized learning platforms. Moreover, AI has the potential to change the education system.

The Role of Artificial Intelligence in Teacher Education:

Refining the Quality of Teacher Education

AI can play a crucial role in improving the quality of teacher education. Artificial intelligence is becoming an integral part of smart ICT based apps targeted for digital learning in India.(Importance of AI in Improving the Quality of Education in India - India Today, n.d.). One of the significant challenges in teacher education is ensuring that teachers have a strong foundation in the subject matter they teach. AI can provide teachers with access to high-quality educational resources and learning materials that are tailored to their individual needs. AI can also help teachers identify knowledge gaps and provide feedback on areas where they need improvement. Teachers can seek the help of AI to improve their teaching skills.

Enhancing Teachers' Skills

AI can also enhance teachers' skills by providing them with access to a range of tools and resources that can help them become better educators. For example, AI-powered assessment tools can provide teachers with real-time feedback on student performance, enabling them to adjust their teaching strategies to better meet the needs of their students. AI can also help teachers to personalize learning, creating lessons that are tailored to the individual needs of their students. Educational Institutions like the Kendriya Vidyalayas that follow CBSE syllabus have already introduced AI to their students. Humanoid robots are assisting teachers in the classrooms at Indus International School, Hyderabad.(Nataraj, 2022) Many schools that follow IB curriculum have already taken the initiative and introduced AI as a part of the newly introduced robotics subject.

Facilitating Personalized Learning

AI can facilitate personalized learning by providing teachers with access to a range of tools and resources that can help them create personalized learning experiences for their students.AI has the potential to enrich student's experience (Qadir, 2022). For example, AI can help teachers to identify students' learning styles, interests and abilities and use this

information to develop lessons that are tailored to each student's individual needs. AI can also help teachers to track students' progress and adjust their teaching strategies accordingly. "A personalized learning environment can analyze student performance data in real time and automatically provide customized content, learning parameters and feedback. It also allows teachers to better understand student performance and as a result, teachers can design effective learning plans for their students". (Wadhwa, n.d.)

Access to High-Quality Educational Resources

One of the most noteworthy challenges in teacher education is ensuring that teachers have a strong foundation in the subject matter they teach. AI can provide teachers with access to high-quality educational resources and learning materials that are tailored to their individual needs.

Classifying Knowledge Gaps

AI can also help classify knowledge gaps and provide feedback on areas where teachers need improvement. By analyzing teacher performance data, AI systems can identify areas where teachers may need further development or support. This information can then be used to create targeted professional development programs that help address those gaps.

Identifying Learning Styles

One of the critical aspects of teacher education is to develop teachers' skills in identifying and catering to various learning styles of their students. AI can help teachers to identify students' learning styles and provide recommendations for adapting teaching methods. For example, an AI system can analyze data on how a student interacts with an online learning system to infer their learning style and recommend instructional strategies that cater to that style.

Adaptive Learning

AI systems can provide adaptive learning experiences that cater to the needs of individual learners. Adaptive learning is a teaching method that uses AI algorithms to adjust the difficulty and complexity of the learning content to match the individual's learning pace and ability. By using AI to personalize learning, teachers can help students develop more significant mastery over the subject matter and improve their learning outcomes.

Continuous Professional Development

National Educational Policy 2020 has emphasized on the professional development of teachers. AI can provide opportunities for continuous professional development for teachers in many ways. For example, AI systems can provide feedback on teacher performance, highlighting areas where they may need further development. Additionally, AI systems can provide recommendations for professional development opportunities that are tailored to the specific needs of individual teachers.

Teachers' AI digital competency

The aforementioned discussions suggest some opportunities and challenges of educators' use of AI for teaching. There is a lack of frameworks or guidelines to inform educators what particular digital competencies are necessary to help students become empowered learners. As suggested by Ng et al. (2021b), only few existing studies discuss how teacher education programs could strengthen teachers' AI digital competency to use AI for teaching, learning and assessment. Ng et al. (2022d) further suggested a set of teacher's AI competencies, including using basic applications, managing information, creating learning content, and connecting their students via technology. Xu (2020) proposed that developing AI digital competency is important for educators. Teachers who know how to use AI may replace the teachers who do not know how because AI can empower teachers and promote their role transformation, which greatly improves the efficiency of management and the level of decision-making (Ng et al., 2022b; Vazhayil et al., 2019). Markauskaite et al. (2022) suggested that educators need to integrate new digital technologies and support learning to meet educational standards through digital technologies, engage in professional learning to build competencies, and gain experience using AI-enabled tools. Moreover, they should learn how to use appropriate AI-driven technologies such as adaptive learning systems and intelligent agents to facilitate their daily teaching management and practices to collaborate with different parties (e.g., parents, colleagues), enhance personalized learning to understand students' learning progress and needs, and conduct various tasks such as offering automatic feedback, self-diagnosing, and promoting online collaboration among learners (Cavalcanti et al., 2021). On top of using AIED technologies, they also need to update their pedagogical and content knowledge on AI and learn how to develop suitable pedagogies (e.g., collaborative learning, problem-based learning), digital resources, learning materials and assessments to empower

learners (Vazhayil et al., 2019). This is consistent with Ng et al. (2021b)'s review that revises the Technological, Pedagogical and Content Knowledge (TPACK) framework to inform teachers' competencies and understanding of how AI can design their teaching and learning. The TPACK framework has been adopted in research of teachers' technology integration and offers a nuanced perspective on teachers' digital competencies via multiple types of knowledge (Koehler et al., 2013; Scherer et al., 2023). Content knowledge describes teachers' own knowledge of the subject matter. Pedagogical Knowledge describes teachers' knowledge of their teaching and learning practices, processes, and approaches. Technological Knowledge describes teachers' knowledge of, and ability to use, various technologies, technological tools, and digital resources (Falloon, 2020)

Recommendations are suggested to help teachers develop their digital competencies:

- Professional development, teacher training programs, guidelines and technical support are necessary to empower teachers to develop AI knowledge, skills and mindsets to use the teaching tools effectively.
- Schools should upgrade their infrastructure and digital equipment to enhance effective digital capacity and development.
- A lot of online technologies are used in education to complement AI-driven learning experiences such as Metaverse, blockchain, cloud computing and big data. Teachers should always update their knowledge and learn the potential of using these technologies in their classrooms to be digital competent.
- Teachers should not merely focus on technological knowledge and skills. Instead, they need to develop other important skill sets such as life and career skills, multidisciplinary skills, learning and innovation skills, as well as ethical mindsets and risks.
- More digital competency frameworks should be proposed to inform the key competencies for educators to establish effective learning standards and assessments, curriculum and instruction, professional development and learning environments. The EduCompEdu and P21's framework for twenty-first century learning are two of the models that provide guidelines for teachers to develop necessary digital competencies for AI-driven learning environments.

II. CONCLUSION

The potential of AI in teacher education is momentous, but its implementation entails careful deliberation of ethical, social, technical, and cultural factors. While AI has the potential to improve the quality of teacher education, enhance teachers' skills, and facilitates personalized learning, it also raises concerns about data privacy, bias, and cultural acceptability. To certify that AI is used to its fullest potential in teacher education, it is essential to develop a comprehensive framework that ensures its proper usage. Artificial intelligence (AI) has been increasingly used in various fields to improve efficiency and effectiveness, and education is no exception. The use of AI in education, specifically in teacher education, has the potential to revolutionize the way educators are trained and improve the quality of education in general. AI systems can provide personalized and adaptive learning experiences that cater to the individual needs of learners, enhancing the effectiveness of teaching methods. This paper has aimed to examine the role of AI in teacher education, its potential benefits, drawbacks, and challenges. Additionally, this research paper investigates the ethical, social, and cultural implications and limitations of AI in teacher education.

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