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Review Article

Fostering Pre-Service Teachers' AI Literacy through School Implications

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Abstract

As technology advances, AI in schooling becomes more commonly used in learning assistance and academic purposes. This review study examines improving pre-service teachers' AI literacy in the modern classroom. The study starts with an overview of AI literacy in the way of pre-service teacher development. It then explores AI tailored learning based on individual differences and interests, instant feedback, and interactive interaction. Key results imply that its implications may help pre-service teachers' AI literacy by improving their understandings and necessary skills of AI principles, problem-solving abilities, and attitude toward technology integration in education. The study also addresses ethical concerns, technical limitations, and the necessity for ongoing professional development. This paper helps teachers, curriculum developers, and policymakers effectively integrate data-driven interventions into pre-service teacher preparation. The pre-service teachers must learn AI literacy to manipulate the changing learning environment as well as pedagogical practices for effective classroom. The need for continued research and collaboration to improve AI inclusion in pre-service teacher preparation for AI literacy are now should be continuing.

1. Introduction

AI literacy is the person's ability to understand the basics of artificial intelligence (AI), and its implications for specific purposes. AI is a branch of computer science that deals with the creation of intelligent agents, which are systems that can think, reason, learn, and act autonomously like humans (Chen et al., 2020; Senior & Gyarmathy, 2021). AI is now already having a major impact on our society in different sectors, and its influence is only going to grow in the present and forthcoming future. The journey of AI is that emergence in education advancements by contemporary technology-enhanced learning. During the

1990s, the introduction of personal computers and internet access can make it easier to creating of software for educational purposes, but traditional classroom needs to change and adapt with new instructional process. The modern era is distinguished by the extensive use of artificial intelligence and its applications (Zhang & Lu, 2021). For the foreseeable future, ethical considerations of data privacy, algorithmic prejudice, and fair access to educational resources powered by artificial intelligence will become increasingly developed (Nuangchalerm, 2023).

Artificial intelligence has emerged as a revolutionary force in the learning environment, it comes to the fast-changing world of education. It plays a significant role in redefining conventional teaching approaches, providing students with tailored learning experiences, and preparing them for facing difficulties (Alam, 2021a). The potential of AI can support teaching and learning experiences, can assess the strengths, and learning styles of individuals by using complex algorithms (Cope et al., 2021). Students from a wide range of backgrounds can get access to educational materials, professional coaching, and interactive learning experiences.

AI aids teachers in the process of developing and executing novel lesson plans. Through the analysis of data on student performance and learning patterns, AI gives teachers insights that assist them in adapting their teaching strategies to meet the specific requirements of individual students. An educational system that is more responsive and successful is a result of the dynamic interaction that occurs between artificial intelligence and audiences. AI helps us to promote lifelong learning and facilitates the development of skills. The purpose of this article is to present how pre-service teachers' AI literacy in the modern classroom. The exploration about pre-service teachers' AI literacy is reported by a comprehensive review.

2. Mechanism of AI and learning process

The most important aspect of artificial intelligence in education is now important and requires teachers to create a transforming classroom by AI-enhanced learning. The massive volumes of student data, including learning preferences, talents, and shortcomings, are analyzed by algorithms. These can help teachers Through the use of this analysis, individualized learning routes that are suited to the specific requirements of each individual student may be created. The mechanism of AI in students' learning can be shown in Table 1.

Table 1. Mechanism of AI in students' learning

Mechanism of AI	Description
Data-driven personalization	Algorithms powered by artificial intelligence play the student data, including their strengths and areas for improvement, to design unique learning plans. Educational information is delivered in a way that enhances engagement and understanding using big data for analyzing students' needs.
Adaptive learning platforms	Learning systems may adapt to students' progress in suitable time by adjusting the exercise intensity. It also suggests related learning resources, and providing immediate feedback depending on individual performance, these platforms provide a dynamic and encouraging learning environment as well.
Intelligent tutoring systems	Analyzing student's progress and preferred method of learning can be drawn. AI-driven tutoring systems may simulate human teachers with interesting presentations. These systems foster a virtual tutor-student connection via interactive sessions that provide individualized explanations, direction, and practice opportunities, improving comprehension and some learning skills in development.
Automated assessment and feedback	Artificial intelligence analyzes many types of learning assessments. Not only may teachers save working time, but students also get consistent feedback right away, which helps them to have quickly respond to their comprehension.
Natural language processing for writing assistance	Natural language processing (NLP) technologies powered by artificial intelligence evaluate pieces of text and provide feedback on grammar and writing styles. Students' written work is much more improved than those manually processed. The communication skills are nurtured, and they get helpful criticism to hone their writing performances.
Virtual and augmented reality experiences	AI enhances virtual reality and augmented reality learning experiences. Students can engage in lessons with ideas in three-dimensional areas via the use of these technologies, which mimic real-world situations. Beyond the limitations of conventional teaching approaches, this mechanism creates an immersive, multi-sensory learning environment, and stimulate their interesting.
Predictive analytics for student success	AI systems analyze student data by using predictive analytics to spot trends. These systems can anticipate problems and opportunities by looking at previous data. It allows students to deal with active intervention.
Chatbots for instant support	Chatbots powered by artificial intelligence may answer students' questions, help them with their assignments, and provide them with general knowledge in an instant. An educational experience that is more responsive and focused on the needs of the students is achieved when students have access to help even when class is not in session.

Artificial intelligence processes are the driving force behind adaptive learning platforms. Students can move their learning potential through critical and instructional information. In adaptive learning systems, the degree of difficulty of exercises is modified, new learning resources are suggested, and rapid feedback about achievement is provided. This is accomplished by evaluating performance and determining areas of difficulty.

The processes of intelligent tutoring systems evaluate a student's performance, determine how they learn the best thing. It can provide specifically tailored to student's learning needs. This is accomplished via interactive sessions that give tailored explanations, assistance, and chances for practice. Also, assignments, quizzes, and examinations may all be evaluated by automated systems. This not only helps teachers

save more time, but it also guarantees that students obtain immediate insights about their performance to correct any gaps in knowledge in a timely manner.

Natural language processing in artificial intelligence helps students improve their writing abilities. Artificial intelligence-driven technologies assess written text and provide comments about grammar and style. Students can improve the quality of their written projects and develop their ability to communicate effectively. Students connect ideas in three-dimensional areas by simulating real-world events and providing them with immersive experiences. Through the provision of a multimodal and engaging learning environment that goes beyond the conventional approaches used in the classroom, the mechanism improves both comprehension and non-comprehension. It is thus possible for teachers to intervene in a proactive manner, giving tailored help to improve the overall learning outcomes and the success of students. Chatbots powered by artificial intelligence may be used as a means of providing instant help (Nuangchalerm & Saregar, 2024).

The processes of artificial intelligence in the acquisition of knowledge by students highlight a dramatic change toward individualized and adaptable education (Maghsudi et al., 2021; Chiu et al., 2023). It can nurture an educational experience that is suited to the requirements of each student by leveraging the power of data analysis, adaptable platforms, intelligent tutoring systems, and immersive technology (George & Wooden, 2023). Understanding these mechanisms is becoming increasingly important for teachers, policymakers, and students alike as we navigate this era of technological integration in education. This understanding will pave the way for a future in which learning will not only be efficient but will also be uniquely tailored to the strengths and aspirations of each student.

3. AI Literacy and Adaptation of Pre-Service Teachers

With the rapidly changing learning environment, artificial intelligence has become an indispensable component of our day-to-day existence. The notion of artificial intelligence literacy in the contemporary classroom has arisen as an essential component of education (Long & Magerko, 2020; Ng et al., 2021; Gašević et al., 2023). AI literacy refers to the capacity to comprehend, engage with, and assess artificial intelligence technology critically. Furthermore, it requires a comprehensive grasp of the ethical, social, and economic ramifications of artificial intelligence. AI goes beyond simple technological skill and artificial intelligence literacy required for modern classroom. Pre-service teacher is key element to adapt AI into

classroom (Seufert et al., 2021). They must have AI literacy and allow AI into their classroom activities that are required to interact with AI technology in a responsible manner.

As we know, AI literacy fosters critical thinking by encouraging students to examine, analyze, and assess the ethical implications of the use of AI. The incorporation of AI literacy into educational programs encourages responsible digital citizenship (Ali et al., 2021). They gain awareness of concerns with privacy, prejudice, and justice and learn how to employ artificial intelligence technology in an ethical manner. AI literacy may be included in pre-existing programs that cover a wide range of disciplines (Lee, 2020). Students will acquire the necessary knowledge to become proficient in artificial intelligence (Hickman et al., 2021). Students can immediately interact with artificial intelligence technology via practical, hands-on projects.

Through activities like constructing and programming artificial intelligence models, playing with chatbots, or producing art pieces that include AI, students can gain a concrete knowledge of AI ideas. Students are given the opportunity to get exposure to real-world applications and views when they collaborate with industry professionals and specialists in artificial intelligence. However, discussions on ethical concerns, such as bias in algorithms, data privacy, and the influence of artificial intelligence on society. It should be included in the curriculum for artificial intelligence literacy and students' perspectives. Students are given the ability to advocate for ethical AI techniques and make judgments based on accurate information via these talks.

Educational institutions can provide students with the skills necessary to flourish in a society that is driven by technology by instilling in them a complete grasp of AI, its applications, and the ethical implications of AI (Safdar et al., 2020; Ashok et al., 2022). The cultivation of critical thinking, problem-solving skills, and responsible digital citizenship are all acquired via the incorporation of artificial intelligence literacy into the curriculum. Students will not only be able to utilize technology, but they will also be able to comprehend it, change it, and contribute meaningfully to the ever-changing digital world if we place a focus on artificial intelligence literacy as we go ahead.

4. Developing AI literacy in Teacher Education

Teacher education programs require pre-service teachers to prepare and adapt to a rapidly changing technology environment by incorporating AI into lessons. It is essential that teacher education programs

prioritize AI literacy development. It can include lessons on artificial intelligence in curricula, some lessons that go over the fundamentals of AI, and it may be used in the classroom. They must understand how to use AI-powered resources in pedagogical practices.

The ability to use AI technologies wisely in educational settings, strategically leveraging their capabilities, and mindfully integrating them into pedagogical methods to maximize and enhance the overall learning experience for students. This requires not just technical proficiency in navigating AI applications But is also a nuanced knowledge of how these technologies may be adapted to fit the different requirements of students, promoting engagement, customization, and efficiency in educational processes. Furthermore, it requires a keen awareness of ethical considerations, ensuring that the use of AI adheres to principles of fairness, transparency, and responsible data usage, allowing teachers to make informed decisions that positively impact their students' educational journeys. Developing AI literacy in teacher education is critical for preparing teachers for the changing technological world and providing them with the skills needed to incorporate AI into their teaching methods (Alam, 2021b).

Additionally, avoid pitfalls and risks associated with AI in the classroom, the educational environment including artificial intelligence. This includes a thorough grasp of the ethical, privacy, and security aspects of AI adoption, as well as a proactive strategy for addressing prejudice, data privacy, and algorithmic transparency. Teachers must have a keen eye for detecting and avoiding any unexpected repercussions, ensuring that the advantages of AI are maximized while protecting against any negative impacts on student learning experiences (Chen et al., 2023). Teachers may successfully navigate issues and design a responsible and productive AI-infused educational environment for their students by developing a culture of attentiveness and continual professional development (Akgun & Greenhow, 2022).

Developing curriculum and pedagogy around AI systems thoughtfully by creating curriculum and pedagogical techniques that carefully include and reflect the intricacies of AI systems. It needs guaranteeing a mindful connection with educational goals and students' developing requirements. This entails systematically integrating AI-related ideas, applications, and ethical issues into the curriculum. A holistic educational framework that enables students to understand, participate with, and critically assess AI technology. Pedagogical strategies should be carefully crafted to provide an environment that not only transmits technical expertise in AI (Lameras & Arnab, 2021). But it also cultivates fundamental abilities such as critical thinking, problem-solving, and ethical reasoning. By deliberately incorporating AI into the educational

fabric, teachers can provide students with the information and abilities required to navigate the increasingly AI-driven world, preparing them for future problems and opportunities with a well-rounded and informed viewpoint.

AI tools with accuracy, gaining a detailed grasp of their capabilities and limits in order to make educated choices about their integration and use. This requires undertaking in-depth studies of the technical functions, performance metrics, and possible ramifications of certain AI technologies. Teachers and stakeholders should examine accuracy, dependability, scalability, and applicability to a variety of educational environments. Simultaneously, a keen understanding of the inherent limits, such as possible biases, ethical problems, and contextual restrictions, is required. By using a thorough and balanced review method, education professionals may efficiently assess the applicability of AI technologies, guaranteeing alignment with educational objectives while eliminating any risks or downsides that may prevent their maximum usability in the learning environment.

Foster AI ethics and safety in students by developing a complete grasp of AI ethics and safety in students, creating a mentality that values ethical and careful use of artificial intelligence technology (Nguyen et al., 2023; Kong et al., 2023). This includes raising awareness of AI's ethical consequences, such as bias, transparency, and responsible data usage. Emphasizing the necessity of safety standards ensures that students not only understand the potential advantages of AI but also acquire an acute awareness of possible pitfalls and how to manage them wisely.

Promoting AI ethics in students also entails developing critical thinking and reflective behaviours, which will allow them to examine, evaluate, and make educated judgments on the ethical elements of AI applications (Miao et al., 2023). Furthermore, including real-world case studies and scenarios might give useful insights into the ethical issues that may occur in diverse AI environments. Teachers can provide students with the information and skills they need to navigate the ever-changing world of AI by instilling a sense of responsibility and ethical mindfulness in their interactions with AI devices.

5. Recommendations for Teacher Preparation Program

As technology plays a big role in education, it is necessary that teachers be literate in AI. They should be well-versed in the definition of AI and understand the difference between basic automation and real AI with the ability to learn and adapt. Furthermore, the privacy problems surrounding student data and being cognizant of the significance of data in artificial intelligence applications should be concerned.

Integrating AI ethics modules into curriculum design courses is a forward-thinking and responsible method that teaches future educators how to manage the ethical implications of developing technology. Teachers help students to discuss the issue of bias in artificial intelligence systems and how it may affect educational results. Professionals need to develop ways for recognizing and minimizing bias in educational AI systems.

Teachers examine the ethical issues surrounding the acquisition and use of student data. Moreover, they can allow students to investigate the roles and responsibilities of educators, administrators, and developers in promoting ethical AI usage in education. Discussion accountability procedures in the event of unforeseen effects or ethical violations is needed. AI generative models have intriguing potential, but tackling inherent biases and data privacy issues is critical. We can leverage the promise of generative AI for good by promoting responsible development, diversified data practices, and openness, ensuring that society benefits equally and ethically.

The current world is experiencing massive changes caused by breakthroughs in artificial intelligence. As we approach a future dominated by intelligent computers and automated systems, teachers play an increasingly essential role in shaping the next generation. Educators, as knowledge builders and character mentors, play critical roles in preparing students for the challenges and opportunities that an AI-powered world will provide. The introduction of AI technology causes a paradigm shift in the skills for success. Ethical concerns in AI development and use are another essential aspect of educators' responsibilities.

Teachers encourage students to engage across disciplines, fostering an environment in which varied perspectives lead to novel solutions. While AI excels in data processing and analysis, human skills like critical thinking, creativity, and emotional intelligence remain important. Teachers emphasize the importance of these soft skills, recognizing that these are unique human attributes that AI struggles to replicate. This focus cultivates a well-rounded skill set, presenting students as valuable contributors to a technologically advanced society.

Finally, teachers play a key role in educating students for an AI-driven future. Their numerous roles include teaching students' technical skills, instilling ethical concerns, fostering adaptability, promoting cooperation, and emphasizing the irreplaceable value of human qualities. Educators have the capacity to shape a generation that not only embraces the possibilities presented by AI but also steers it towards a more ethical, inclusive, and human-centered future.

6. Conclusion

This article highlights the need for fostering AI literacy among pre-service teachers. Integrating AI into teacher education program can develop their instructional skills. As AI continues to shape the educational landscape, it is essential for teaching and learning environments. It can ensure that future educators are equipped to guide students through a world increasingly influenced by AI. The pre-service teachers should also have an opportunity to shape more informed, responsible, and innovative classrooms through AI literacy and suitable implications.

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