

Artificial Intelligence and Professional Development of School Teachers: Opportunities, Challenges and Future Directions

PRABHJEET SINGH¹, DR. MANPREET KAUR²

¹Department of School Education, GMS Bhojemajra, Rupnagar, Punjab, India

²Department of School Education, GSSS Makrauna Kalan, Rupnagar, Punjab, India

Abstract- Artificial intelligence (AI) is set to revolutionize the educational sector by introducing new ways of teaching, learning and assessing knowledge to achieve positive learning outcomes. School teachers have turned to AI applications to help them with lesson planning, classroom instruction and management, human skills development, and assessments. This paper aims to analyze the role of artificial intelligence in professional development by examining opportunities and challenges associated with the use of AI in education. The paper will highlight opportunities provided by AI such as personalized professional learning, administrative automation, content personalization, and development of new pedagogical practices. In addition, the paper will also discuss challenges posed by the use of AI such as ethical issues, data privacy and security, algorithmic bias, digital divide, reliance on technology, and need for teachers to acquire new skills among other issues that may affect professional learning among school teachers. The paper will also suggest future directions of AI in professional development. The paper will conclude by asserting that AI should be treated as an assistant, not a replacement for professional development, to enhance school teachers' professional development and improve school education.

I. INTRODUCTION

The rapid development of digital technologies has penetrated almost all spheres of human activity. Such a powerful phenomenon as Artificial Intelligence (AI) is destined to have a significant impact on the development and improvement of education at all levels. AI is generally understood as a set of technologies that allow computers to simulate human intellectual activity: learning, thinking, perceiving, reasoning, understanding, problem-solving, etc. The emergence of AI software and applications has opened up new opportunities for education, both for teachers and for school administration.

Professional development is a vital aspect of education as it allows teachers to accumulate and update their knowledge and qualifications constantly. However, traditional models of professional development are often associated with various shortcomings and challenges. AI has a tremendous potential to address existing shortcomings by providing innovative, individualized, and continuous learning opportunities for teachers.

Modern AI-based applications such as ChatGPT, Microsoft Copilot, Gemini from Google, tutoring systems, smart learning platforms, automated grading systems, and many others are being used by educators to support and improve their teaching practices. AI enables teachers to create lesson plans, prepare presentations, engage in teaching-learning processes, provide feedback to students, assess their performance, and access relevant educational resources. Thus, with the help of AI, teachers can save time on less critical but necessary tasks and focus on more significant things, such as the quality of education and students' learning experiences.

However, the use of AI in education, in general, and in professional development, in particular, raises several ethical, social, and technical challenges. The issues of privacy, bias, ethics, digital security, misinformation, inequality, and digital competence are of great importance and must be considered when implementing AI-based solutions in educational institutions. In addition, it should be noted that teachers need to have the necessary digital skills to use AI-based software to its maximum.

The Government of India also recognizes the importance of integrating AI into the education

system to improve the quality of teaching, learning, and professional development. According to the National Education Policy (NEP) 2020, the use of emerging technologies, including AI, is encouraged to promote holistic learning, continuous professional development, and innovation in education. UNESCO and other governmental and non-governmental organizations are also working to ensure that AI is used in education in an ethical and responsible manner.

Therefore, given the relevance of the topic, the purpose of this study is to explore how AI can be used to support and improve the professional development of school teachers. The research will be conducted by analyzing the available scientific literature, identifying the main opportunities and challenges, and providing recommendations for future research and practical implementation. The findings of the study will be of interest to various stakeholders, including education researchers, policy-makers, and teacher training institutions.

II. REVIEW OF LITERATURE

Research on the application of Artificial Intelligence (AI) in education has been a topic of great interest to researchers, policymakers, and practitioners in the past decade. Most of the reviewed articles discuss the effect of AI on enhancing professional development, teaching, promoting professional growth, and sustaining professional learning of teachers.

In particular, UNESCO (2021) argued that Artificial Intelligence can transform teacher education through personalized learning, instructional support, and professional development. However, the report recommended that AI should only supplement teachers' roles and ensure ethical considerations and readiness. Luckin and Holmes (2022) took note that educational AI can support teachers' instructional planning, analyze teachers' behaviors, and propose professional developments. They concluded that AI could help educators create time for more creative activities instead of wasting time on monotonous tasks.

Zawacki-Richter et al. (2021) undertook a systematic literature review on the impact of artificial intelligence on higher education and school education. The researchers found that AI is mostly applied in assessments, tutoring, and learning analytics but not in professional development. Similarly, Kasneci et al. (2023) evaluated generative AI's implications for education, including ChatGPT, and found that it could be used for planning, developing, and assessing learners' progress. However, the researchers argued that teachers and students might struggle with AI-generated hallucinations and other ethical concerns.

Celik (2023) investigated teachers' readiness to apply AI in education and found that most respondents were positive about adopting the technology but lacked adequate knowledge and professional skills to implement it. OECD (2023) revealed that AI-powered professional learning systems can recommend what teachers want to learn depending on their qualifications, needs, and aspirations. Additionally, such developments aim to provide personalized learning experiences that transform educators' professional practice continually and strategically. In contrast to the earlier researchers, Chen, Chen, and Lin (2022) discovered that AI-powered learning could enhance educators' digital competence, innovation, and confidence. They recommended continued professional development to keep teachers updated on new technologies. Bozkurt et al. (2023) suggested that generative AI has great potential in education but requires institutional, policy, and teacher readiness support for effective implementation.

Mhlenga (2023) argued that AI is disrupting education by transforming curriculum design, class management, assessment, and teacher development. However, the researcher found that teachers need to develop AI literacy skills before total adoption. Holmes et al. (2022) discussed the ethical implications of adopting AI in teacher education and professional development. They argued that education professionals must consider privacy, fairness, transparency, accountability, and human oversight when designing ethical AI.

In summary, most researchers agree that Artificial Intelligence can be a game-changer in teacher education and professional development due to its ability to provide personalized experiences, support, and automate several functions. However, some researchers emphasize ethical considerations about personal data, transparency, and accountability, as well as infrastructural and equity challenges that may

hinder widespread adoption. In addition, most of the reviewed articles do not discuss the role of AI in professional development, and only a few have explored how technology can help enhance school teachers' continuous professional learning, which requires more research.

Table 1. Selected studies on artificial intelligence and teacher professional development.

Author(s)	Year	Topic Research	Main Conclusion/Finding
UNESCO	2021	AI & Education	AI's role in education: AI supports teacher development but needs ethical frameworks.
Zawacki-Richter et al.	2021	Systematic review	AI in education: AI can transform assessments, tutoring and learning analytics.
Holmes et al.	2022	Ethics of AI	Ethics of AI Ensures transparency and human oversight in AI
Luckin & Holmes	2022	Support for teachers	Teacher support: AI supports instructional planning and professional development
Chen et al.	2022	Digital competence	Digital competence: AI enhances educators' technology skills, innovation and confidence.
Kasneci et al.	2023	Generative AI	Generative AI's implications: ChatGPT can be used for planning, developing and assessing learners.
Celik	2023	Teacher readiness	Teacher readiness: Teachers need AI literacy and professional development.
Bozkurt et al.	2023	Educational AI	Educational implications: Need for institutional infrastructure, policies and ethical frameworks.
OECD	2023	Professional learning	Professional development: AI can provide personalized teacher professional development.
Mhlanga	2023	AI in education	AI's impact on education: AI disrupts education but needs teacher literacy for effective implementation.

Summary of Literature

The reviewed studies consistently reveal that Artificial Intelligence has become a critical phenomenon in teacher professional development. The majority of the authors stress that AI integration into the educational process facilitates higher quality of instruction, personalized learning, and teacher productivity. At the same time, they underline the necessity of teacher professional development, ethical concerns, policy implications, digital infrastructure development, and availability of resources. Indeed, a large amount of literature addresses different aspects of applying artificial intelligence in education and teaching. Nevertheless, most of them concentrate on short-term outcomes and

do not adequately address the issue of continuous professional development of teachers and school administrators. Thus, there is a need for further elaboration of this phenomenon from a conceptual perspective.

III. STATEMENT OF THE PROBLEM

Artificial Intelligence (AI) is transforming education by introducing tools and models that facilitate teaching, learning, assessment, and other pedagogical functions. AI-enabled tutors, tools, apps, and models offer unprecedented opportunities for professional learning and improvement of competencies by teachers. However, the adoption of professional

development solutions is not uniform due to differences in institutional capacity, infrastructure, and teachers' digital proficiency.

Most school teachers lack a coherent understanding of how to effectively and ethically adopt AI technologies to improve their professional capabilities. Several concerns about data privacy, biases, dependence on AI, and ethical issues have hindered widespread adoption and use of these tools. In addition, previous literature emphasizes the application of AI in student learning, teaching, and assessments but not on professional development of teachers. Given the rising interest in leveraging AI to improve teaching and learning, this paper focuses on conceptual understanding of opportunities, challenges, and future directions of using Artificial Intelligence to advance continuous professional development of school teachers.

IV. OBJECTIVES OF THE STUDY

This paper aims to achieve the following objectives:

1. To discuss the role of Artificial Intelligence in professional development of school teachers.
2. To highlight opportunities for using Artificial Intelligence to advance professional skills of teachers.
3. To identify ethical challenges associated with using Artificial Intelligence for professional development of school teachers.
4. To explore future directions of using Artificial Intelligence to improve continuous professional development of school teachers.
5. To make recommendations to relevant stakeholders on how to use Artificial Intelligence to improve professional development of school teachers.

V. RESEARCH METHODOLOGY

5.1 Research Design

This study will follow a conceptual and descriptive research design. The study will seek to understand the role of Artificial Intelligence in promoting professional development of school teachers. Instead of generating primary data, the researcher will rely on

secondary data to generate findings and propose recommendations.

5.2 Sources of Data

The study will use secondary sources of data. The following sources of information will be used:

Articles, Books, UNESCO reports, OECD reports, Policy documents, National Education Policy (NEP 2020), Scopus, Web of Science, ERIC, Google Scholar, Research Gate and other databases.

5.3 Inclusion Criteria

The following inclusion criteria will be used:

- Studies focused on Artificial Intelligence education
- Research papers focusing on teacher learning and professional development
- Articles published in the last 6 years (2020-2026) because the topic is dynamic and emerging.
- Articles published in English language
- Review papers and research articles

5.4 Exclusion Criteria

The following exclusion criteria will be used:

- Articles focusing on aspects of education irrelevant to the research question.
- Research papers focusing only on students to the exclusion of teachers.
- Articles published in non-academic internet forums, newspapers and magazines.
- Duplicate articles.

5.5 Method of Analysis

The study will follow a thematic analysis approach to analyze the collected data and develop responses to the research objectives and questions. Thematic analysis will help extract salient aspects of Artificial Intelligence, education, teacher learning, professional development, and related issues. Themes such as teacher professional learning and training, ethical considerations, and AI-enabled teaching and learning will be used to organize and discuss the findings to address the research objectives and questions.

VI. OPPORTUNITIES OF ARTIFICIAL INTELLIGENCE FOR PROFESSIONAL DEVELOPMENT OF SCHOOL TEACHERS

Artificial intelligence has many opportunities that can be leveraged to enhance professional competence and teaching efficacy of school teachers. These include:

7.1 Personalized Professional Learning

AI analyzes teacher's learning needs and recommends appropriate professional development plans to enable them enhance their skills and knowledge at their own pace.

7.2 Intelligent Lesson Planning

AI can help teachers come up with lesson plans, learning objectives, classroom activities, worksheets, presentations, and other learning materials in a short time thus improving teaching efficacy.

7.3 Automated Assessments and Feedback

Using AI, teachers can develop quizzes, assessments, tests question papers, mark assignments and give feedback to learners thereby saving time and increasing efficiency.

7.4 Content Development

Using generative AI applications, teachers can develop notes, presentations, case scenarios, worksheets, rubrics, project ideas, and other materials for use in teaching and learning.

7.5 Professional Collaboration

AI can enable teachers collaborate with each other online thus sharing innovative ideas and practices through discussion forums, online meetings, webinars, and other digital platforms.

7.6 Learning Analytics

Analytics can help teachers track and monitor progress and performance of their students and improve practice based on evidence.

7.7 Continuing Prof. Studies

AI can recommend online courses, journals, and articles, conferences, workshops, and other resources for professional development to keep teachers updated.

7.8 Inclusive Classrooms

AI can be used to create inclusive learning environments by providing speech to text recognition applications, interpreters, and other assistive technologies to support persons with different special needs.

VII. CHALLENGES AND ETHICAL CONCERNS

Although Artificial Intelligence (AI) presents great opportunities for improving the professional development of school teachers, there are several challenges and ethical concerns associated with its use. Some issues related to AI and professional learning require immediate attention.

8.1 Lack of AI Literacy Knowledge

Most teachers lack skills and knowledge to apply artificial intelligence in the classroom. Although AI technologies offer various benefits to education, they require continuous training so that teachers can acquire new skills and know-how to embrace and utilize them for professional development appropriately.

8.2 Data Privacy and Security

Various AI educational applications collect and analyze vast amounts of data from users. Therefore, there is a need to ensure data privacy and security by developing ethical and legal policies on the collection, processing, usage, and storage of information, especially for teachers and students.

8.3 Algorithmic Prejudices

AI applications rely on previous data to learn and develop new skills. As a result, they can sometimes display various algorithmic prejudices based on their data sets, such as gender, ethnicity, language, or culture. Thus, educational institutions must ensure that AI technologies offer equal opportunities to all students and staff.

8.4 Overreliance on Artificial Intelligence

Most people believe that teachers will become increasingly dependent on artificial intelligence to generate lesson plans, mark assignments, and create tests. Although AI is vital in professional learning,

teachers should not rely on it because it may cause a lack of creativity, judgment, or critical thinking during activities and assignments.

8.5 Digital Divide

The availability of internet access and other related technologies is uneven, particularly in rural and urban areas. Thus, there is a potential risk that some schools may not benefit from adopting AI, particularly if they do not have the infrastructure.

8.6 Ethical Use of AI

Most generative AI technologies can create various educational materials to support professional development. However, these applications can sometimes generate irrelevant or false information occasionally. Therefore, teachers should carefully review the material generated by artificial intelligence to avoid using it in their classes.

8.7 Infrastructure and Cost

Most schools, especially those in developing countries, might face several challenges implementing AI due to the high costs of maintaining and developing the required infrastructure and technologies in different learning institutions.

8.8 Policy

Most countries currently lack relevant policies on AI professional development, and this gap can negatively impact the growth of teachers in the future. Therefore, it is essential to develop ethical and legal policies that guide AI use in education.

VIII. FUTURE DIRECTIONS

Artificial intelligence will significantly impact teacher professional development in the future. Future directions of AI should focus on how it can contribute to and support teacher growth while considering the human factors involved.

Schools that offer teacher training programs should integrate artificial intelligence into their strategies and curricula to ensure that education professionals acquire the necessary skills to use AI appropriately. Teachers should also attend workshops and seminars on AI professional development to obtain knowledge

on such technologies and effectively apply them in their institutions. Moreover, it is vital for the government to develop policies on the use of artificial intelligence in education to promote transparency and accountability in its use among teachers and students.

Future directions of using AI for professional development should involve the creation of reliable, cost-effective, and efficient technologies that can offer personalized learning and professional growth opportunities to teachers. The future applications should be developed in various languages and support multiple contexts to meet the diverse needs of students worldwide. Collaboration between the government, universities, and private entities can help education professionals acquire the skills to utilize such technologies.

IX. RECOMMENDATIONS

Based on the research conducted for this paper, the following recommendations are proposed:

- School administrators should make AI literacy a requirement for teacher education and professional development and provide training and workshops that improve their knowledge and skills in using various technologies.
- Administrators should also develop ethical policies on the use of artificial intelligence within educational institutions.
- The government should invest in the development of digital infrastructure to guarantee internet access in all schools and ensure AI literacy among education professionals.
- Teachers should critically evaluate materials generated by AI before using them in their classes.
- Artificial intelligence should be used to support and supplement teachers' professional growth rather than replace their expertise, experience, and judgment.
- There is a need to encourage collaboration between policymakers, teachers, universities, and other relevant organizations in promoting AI ethics awareness among education professionals.

X. CONCLUSION

Artificial intelligence is a new and innovative technology that has the potential to disrupt and transform school teachers' professional development. Using AI in education can help teachers achieve their professional goals, such as personalized learning, lesson planning, test generation, data analysis, and collaboration, among others. Additionally, it can also support them in doing their daily tasks more efficiently and effectively, giving them more time to focus on teaching. However, it is vital to consider various factors when integrating such technologies into education, such as data privacy and security policies, ethical concerns, access and affordability, and teacher training and development. Therefore, AI is not a solution to all problems in teacher professional development, but rather a collaborator in achieving the most appropriate educational goals.

Although AI can support most aspects of professional learning, it is essential for education professionals to ensure that the use of such technologies is ethical, legal, and accountable. Therefore, it is crucial to develop policies and strategies that guide the ethical use of artificial intelligence in education while encouraging continuous teacher development and learning.

REFERENCES

- [1] Bozkurt, A., Karadeniz, A., Baneres, D., Guerrero-Roldón, A. E., & Rodríguez, M. E. (2023). Artificial intelligence and the future of teaching and learning: A systematic review. *Education and Information Technologies*, 28 (11), 14521–14545.
- [2] Celik, I. (2023). Towards intelligent-TPACK: An empirical study on teachers' professional knowledge to ethically integrate artificial intelligence into education. *Computers in Human Behavior*, 138, 107468.
- [3] Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, 8, 75264–75278.
- [4] Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.
- [5] Holmes, W., Miao, F., & Tuomi, I. (2022). Ethical and human-centred artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 3, 100071. (Open access) (PDF)
- [6] Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 102274.
- [7] Luckin, R., & Holmes, W. (2022). *Intelligence unleashed: Artificial intelligence and the future of teaching and learning*. London: Pearson Education. (Open access) (PDF)
- [8] Mhlanga, D. (2023). Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning. *Education and Information Technologies*, 28 (9), 11211–11234.
- [9] OECD. (2024). *Education Policy Outlook 2024: Reshaping teaching into a thriving profession from ABCs to AI*. OECD Publishing. (Open access) (PDF)
- [10] Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4 th ed.). Pearson. (Open access) (PDF)
- [11] Selwyn, N. (2019). *Should robots replace teachers? AI and the future of education*. Polity Press.
- [12] UNESCO. (2021). *AI and education: Guidance for policy-makers*. UNESCO Publishing. (Open access) (PDF)
- [13] UNESCO. (2023). *Guidance for generative AI in education and research*. UNESCO Publishing. (Open access) (PDF)
- [14] Zawacki-Richter, O., Marin, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education*, 16 (39). (Open access) (PDF)

- [15] Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in teacher education. *Educational Technology Research and Development* , 70 (5), 2147–2168.
- [16] Bearman, M., Ryan, J., & Ajjawi, R. (2023). Discourses of artificial intelligence in higher education: Implications for teachers. *Teaching in Higher Education*, 28 (8), 1658–1675.
- [17] Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2021). Emergency remote teaching in higher education: Mapping the first global online semester. *International Journal of Educational Technology in Higher Education*, 18 (1), 1–24.
- [18] Crompton, H., & Burke, D. (2023). Artificial intelligence in K–12 education: A systematic literature review. *Computers and Education: Artificial Intelligence*, 4 , 100120.
- [19] Dwivedi, Y. K., Hughes, L., Baabdullah, A. M., Ribeiro-Navarrete, S., Giannakis, M., Al-Debei, M. M., ... Sankaranarayanan, M. (2023). So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities, challenges, and implications of generative conversational AI. *International Journal of Information Management*, 71 , 102642.
- [20] Floridi, L., & Chiriatti, M. (2020). GPT-3: Its nature, scope, limits, and consequences. *Minds and Machines*, 30 (4), 681–694.
- [21] Gillani, N., Eynon, R., Osborne, M., & Hjorth, I. (2023). Artificial intelligence and teacher professional learning: Emerging perspectives. *Educational Review*, 75 (6), 1038–1056.
- [22] Hwang, G. J., Xie, H., Wah, B. W., & Gašević, D. (2020). Vision, challenges, roles and research issues of artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 1 , 100001.
- [23] Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2023). AI literacy: Definition, teaching, evaluation and ethical issues. *Computers and Education: Artificial Intelligence*, 4 , 100125.