



Artificial Intelligence as a Catalyst for Teachers' Professional Development and Student Learning Success

Shehla Mumtaz¹, Dr. Ijaz Hussain², Abidah Riaz³, Aasma Shehnaz⁴

¹ PhD Scholar, Department of Education, Ghazi University

Email: hzaryab11@gmail.com

² Assistant Professor, Department of Education, Ghazi University

Email: ijhussain@gudgk.edu.pk

³ PhD Scholar, Department of Education, Ghazi University

Email: abidariaz73@gmail.com

⁴ M.Phil Scholar, Department of Education, Ghazi University

Email: aasmashahnaz@gmail.com

ARTICLE INFO

Submission:

July 13, 2026

Revised:

July 25, 2026

Accepted:

August 12, 2026

Available Online:

August 26, 2026

Keywords:

Artificial Intelligence,
Teachers' Professional
Development and Student
Learning Success.

Corresponding author:

Shehla Mumtaz

Email:

hzaryab11@gmail.com

ABSTRACT

Artificial intelligence is one of the most significant developments of the 21st century because of the changes it has brought into many fields, ranging from medicine, business, manufacturing and finance to education. Professional Development of Teachers (TPD) is acknowledged to be an important part of education and a significant factor in teaching effectiveness and learning improvement. Student learning success is one of the major goals of all educational systems and acts as an important benchmark of the quality of education and effectiveness of institutions. The primary focus of the study was to examine the role of integration of artificial intelligence in supporting teachers' professional development and to examine the mediating role of teacher professional development in the relationship between artificial intelligence and teacher performance. Population of the study was 210 and sample was 150 university teachers. Simple random sampling technique was used. Self-made questionnaire was used as a tool of the study. Descriptive statistics (mean and standard deviation) and inferential statistics (Pearson correlation and regression) were used. Result shows that artificial intelligence has substantial potential to enhance teacher professional development and student learning success in universities and teachers of universities positively perceive the implementation of artificial intelligence in their work and learning. It is recommended that Teachers need to plan activities in which students are required to critically analyze AI-generated information, assess different options, validate their logic, and respond uniquely and Professional development needs not only to train teachers on how to use AI applications but should also show them how AI may be incorporated with proper teaching techniques and goals.

Introduction

Artificial intelligence is one of the most significant developments of the 21st century because of the changes it has brought into many fields, ranging from medicine, business, manufacturing and finance to education. Artificial intelligence (AI) is the ability of computer systems to carry out activities that usually require human intelligence, such as learning from experience, problem solving, decision making, language comprehension, recognizing patterns, and adapting to new data. In contrast to computer programs that function according to preset rules, AI algorithms constantly develop and get better at performing certain operations due to analysis of big amounts of data. Thus, AI became an important instrument in various professional environments (Russell & Norvig, 2021).

AI has played a crucial role in fostering innovations within the education domain due to its facilitation of the teaching and learning processes. Educational institutions have been using applications that incorporate AI technology to enable personalized learning, assessment automation, intelligent tutoring, performance analysis, and decision-making related to administration. Technologies like adaptive learning systems, virtual teaching assistants, automated grading systems, learning analytics dashboards, and generative AI applications allow educators to create learning environments that are more engaging, data-driven, and student-focused. AI allows educators to reduce time spent on performing administrative tasks and spend more time on teaching and creating personalized learning experiences for students (UNESCO, 2023).

Artificial Intelligence has also revolutionized the way teacher professional development is conducted, as it enables personalized professional development for educators. AI-based professional development platforms can help in recommending relevant training materials, identifying competency gaps, giving instant feedback to instruction, and continuous skills development according to the individual needs of the teachers. Personalized professional development facilitates life-long learning for teachers and enables them to adopt innovative methods of instruction in the classroom. With the increased adoption of digital transformation in education systems, AI becomes an integral part of modern teacher training and development.

Although there are many benefits, however, the incorporation of AI technology in education faces several issues. Issues related to data privacy, algorithmic bias, academic honesty, ethics, digital divide, and reliance on technology remain sources of concern for the education community. Moreover, most teachers do not possess sufficient knowledge about AI and need to be trained in order to incorporate these technologies into their teaching. The success of AI in education thus depends not only on advancements in technology but also on teacher competence and education policy (Holmes et al., 2022).

It is worth noting that professional development of teachers (TPD) is acknowledged to be an important part of education and a significant factor in teaching effectiveness and learning improvement. TPD means the continual process in which teachers are able to gain new knowledge, skills, and expertise in their profession over time. Professional development is not like teacher training where teachers get to learn once and for all; on the contrary, professional development is a continuous process through which teachers are able to respond to changes in the policies, technology, curriculum, and learning needs of learners. Rapid technological advancements in digital technologies have also brought about a change in the way teacher professional development is conducted. Virtual learning environments, online courses, learning management systems, and digital collaboration tools have enhanced access to high-quality professional development for teachers, irrespective of their geographical locations. Artificial intelligence has now brought another level of change in teacher professional development through its ability to provide personalized learning, intelligent recommendations, feedback, training modules, and insights into the professional development of teachers (Trust et al., 2023).

Even though the significance of professional development is recognized, there are many barriers that teacher professional development experiences in various settings. Lack of access to good-quality training, lack of institutional support, underfunding, busy work schedules, resistance to change, and gaps in digital infrastructure may hinder teachers from engaging in continuous professional development. In addition to that, the disconnection of professional development programs from classroom realities and failure to focus on teachers' actual teaching needs pose further problems. In modern times, when there is a great deal of emphasis on gaining knowledge, teacher professional development has emerged as an area of importance in order to promote excellence in education and sustainable school improvement. With effective professional development, teachers are able to stay abreast of developments in the field of education, adopt learner-based approaches to teaching, incorporate new technologies like artificial intelligence into their classes, and improve their instructional efficiency.

Student learning success is one of the major goals of all educational systems and acts as an important benchmark of the quality of education and effectiveness of institutions. It involves the extent to which the intended learning objectives are accomplished by gaining knowledge, skills, competencies, attitudes, and values by students. While academic success has always been taken as a measure of student learning success through grading and examinations, current trends in educational studies emphasize the fact that learning success is more than just academic success and includes critical thinking, problem solving, creativity, teamwork, self-regulated learning, motivation, and lifelong learning capabilities. Thus, student learning success is the comprehensive development of learners who can apply their knowledge in practice.

While AI facilitates the process of learning for the students directly, AI indirectly helps in the achievement of learning success through improvement in the instructional process of the teachers. Planning of lessons using AI, automation in assessment processes, content creation using AI, and using data in making instructional decisions helps the teacher to be more focused on creating meaningful learning opportunities and offering personalized assistance to the learners. Through training in the use of AI in classroom instructions, students are engaged in more interactive learning environments.

There is a significant amount of promise in how the use of AI can help improve the quality of education, several issues may emerge that could hinder its ability to enhance the success of students in their studies. Among such issues include the inequality in access to digital technologies and the varying levels of digital literacy of the students, the ethical issues in the use of AI, data privacy issues, algorithmic biases, and over-reliance on technology. Furthermore, the benefits of AI in the education field largely depend on how teachers are able to incorporate AI into their pedagogies. The success of student learning outcomes is now considered to be a multidimensional one as it takes into account the joint impact of efficient teaching, ongoing professional development of teachers, good learning environment, and proper use of educational technologies. With the digital transformation in educational establishments becoming more widespread, it has become extremely important to understand how the implementation of artificial intelligence can affect the efficiency of teaching activities and the quality of students' learning experience in order to provide high-level, sustainable education.

Research Objectives

1. To examine the integration of artificial intelligence in supporting teachers' professional development.
2. To investigate the effect of artificial intelligence on teachers' performance.
3. To examine the mediating role of teachers' professional development in the relationship between artificial intelligence and teacher performance.

Research Questions

1. What is the role of integration of artificial intelligence in supporting teachers' professional development?
2. Is there any effect of artificial intelligence on teacher performance?
3. What is the mediating role of teacher professional development in the relationship between artificial intelligence and teacher performance?

Statement of the Problem

The use of artificial intelligence (AI) in education has been fast growing, giving rise to various tools that assist in teaching, learning, testing, and training. The tools include the intelligent tutoring systems, generative AI, automatic testing software, and adaptive learning software. They have the capacity to minimize the workload of teachers while helping in teaching students individually, giving them immediate feedback, and improving their learning process. However, for these innovations to be incorporated into the educational system successfully, it is crucial for teachers to grasp and know how to incorporate them in their teaching methodologies. Professional development for teachers is an essential component in making sure that AI technology is used properly in education. Many teachers still struggle with problems such as inadequate AI literacy skills, lack of training programs, lack of institutional backing, and questions about ethical and pedagogical consequences of using AI technology. Therefore, having access to this technology does not necessarily lead to improved teaching methods or better educational results. Professional development of teachers will make it easier for teachers to incorporate AI into their lessons and benefit from it.

The performance of teachers is one of the key factors contributing to the overall educational quality and the academic success of the students. In spite of the fact that artificial intelligence can be helpful in making improvements in lesson planning, classroom management, evaluation, and decision-making, there is little information about the effects of AI on teacher performance. Most of the studies that explore this problem are concentrated on the way students use AI technologies or the technical capacities of AI technologies rather than on the ways in which AI helps to develop the performance of teachers. Learning success in students is affected by various instructional factors such as teachers' pedagogical knowledge, instructional effectiveness, feedback methods, and student involvement. Though artificial intelligence has been considered an effective tool for facilitating personalized learning and better academic success of students, there is still little information about the influence of improved teacher professional development and teacher effectiveness on student learning success in an environment supported by AI technology. Most of the studies focus on independent factors without considering interrelations between them.

In this context, there is a need for a comprehensive study that analyzes artificial intelligence as a stimulant for professional growth and improvement of teachers and its impact on the performance of teachers and learners.

Importance of the Study

Incorporation of AI technologies into the education process has become one of the most important trends in contemporary pedagogy. Since the impact of AI technologies in education becomes increasingly relevant, it is important to understand how these technologies can influence teacher professional development, teacher's effectiveness, and successful learning of students. This research makes an important contribution into existing body of knowledge through analyzing how AI technologies can act as an accelerator in improvement of educational practice. The research is significant for teachers since it gives information about how AI technologies can facilitate teachers' professional development, help them in planning lessons, assessment of students' achievements, and decrease administrative burden. It might motivate teachers to implement AI technologies into their work and develop necessary digital competences. For professional developers of teachers and teacher educators this study is valuable because it gives information about competences and training needs for proper integration of AI technologies into teaching practices.

The results of this work will be of use to educational establishments and school administration in creating policies and strategies which will help to integrate AI into education efficiently. The results of this work may also help educational establishments to make correct decisions regarding their investments in artificial intelligence, digitalization, and innovative teaching methods. It is also useful for policy makers and education authorities as the results of this research can become a foundation for creating national and institutional policies in terms of artificial intelligence in education.

Literature Review

Artificial Intelligence in Education

The rapid evolution of AI has been fueled by the innovations in areas such as machine learning, deep learning, natural language processing, computer vision, and predictive analytics. These innovations have made it possible for the AI systems to comprehend human language, detect images, create content, recommend things, and perform many other complicated tasks. With the development of generative AI, even more capabilities have been added to AI as now AI can create human-like text, images, sounds, computer codes, and educational material. Thus, AI has transformed from the research-based subject into the technology that people use in their daily life (Dwivedi et al., 2023).

Teachers have changed their instructional practices thanks to the introduction of artificial intelligence, which helps reduce administrative chores and makes instruction more efficient. The current trend suggests that teachers use AI technologies for preparing lesson plans, making tests, designing instructional resources, analyzing performance of the students, and giving feedback. Such technologies allow educators to pay more attention to interaction with students, mentoring, and innovative instruction. According to Holmes et al. (2022), it is vital to understand that AI technologies should be regarded as an instrument that enhances capabilities of teachers rather than replaces the role of educators in the process of delivering meaningful learning experiences. Artificial intelligence (AI) has become one of the most revolutionary technologies in modern times, as it has changed teaching, learning, assessing, and administration in education. AI can be described as a technology that involves computer systems able to perform tasks that are usually performed by people such as learning, reasoning, decision-making, language processing, etc. In contrast to other educational technologies, AI systems improve continuously, as they are based on data analysis and adaptive learning algorithms. Thus, they can help teachers and students with various tasks related to instruction and learning. The rapid development of AI-powered educational technologies has become a driving force for digital transformation in educational institutions.

Adoption of AI in the area of education has increased significantly because of improvements in machine learning, natural language processing, learning analytics, and generative AI. Such technologies help to offer personalized learning because adaptive systems adjust instructional content to the needs of a particular learner and his/her learning speed and academic performance. Adaptive learning systems, intelligent tutoring applications, and virtual learning assistants provide immediate feedback and personalized instruction which improves learning experience and academic performance. As Luckin (2018) states, AI may help human teachers by offering personalized instructions, which cannot be done in traditional classrooms. The development of generative AI provided even more opportunities for education because now teachers are able to generate learning materials, tests, presentations, summaries, and instructional content in a short period of time. Generative AI tools, such as ChatGPT and other language models encourage collaborative learning, creativity, and problem-solving through dialogue. However, as Zawacki-Richter et al. (2019) noted, the educational impact of AI is not connected with technology use per se but with pedagogical appropriateness of their implementation. There are multiple issues concerning AI implementation in education. Problems of data privacy, algorithmic bias, ethical decision making, academic integrity, digital divide, and lack of AI literacy among teachers prevent efficient implementation

of AI in education. As UNESCO (2023) emphasizes, the implementation of AI in education must be responsible and ensure transparency, accountability, human oversight, and equal access.

There have also been advantages for educational institutions in using learning analytics powered by artificial intelligence in helping the administrators and instructors to monitor the academic progress of their students and identify those who are at risk. Predictive analytics is used for making early interventions when students struggle with learning issues and thus improve their retention and success. As mentioned by Siemens and Baker (2012), learning analytics can provide useful information that would help improve instructional design and education management through data-based decision making. However, the integration of AI requires teacher competencies, institutional readiness and educational policy support. Teachers should constantly undergo professional development to build AI literacy, digital pedagogy and ethics to responsibly use new technologies. According to Trust et al. (2023), professional learning in the area of integration of AI is crucial for ensuring effective use of the technology while keeping the human side of instruction and learning intact. Consequently, the benefits of AI in education rely not only on technology itself but also on teachers' competencies, institutional readiness and educational policy (Holmes et al., 2022).

Teacher Professional Development

Teacher professional development is not limited to just enhancing content expertise; rather, it involves pedagogical proficiency, classroom management, assessment knowledge, as well as reflection, collaboration, and leadership skills. Good professional development prompts teachers to reflect on their own teaching practices, collaborate with other teachers for professional learning, and adopt effective strategies backed by evidence. This type of development helps teachers build their self-confidence and professional identity while helping them respond to the ever-changing challenges of the education field (Darling-Hammond et al., 2022). Teacher Professional Development (TPD) is known to be an ongoing and systematic process whereby teachers are able to develop professional knowledge, skills and competencies in their professional work throughout their career lives. Unlike the previous approaches which only concentrated on workshops, current professional development stresses lifelong learning whereby teachers can learn how to cope with curriculum changes, technological developments and learner needs. According to Darling-Hammond et al. (2017), professional development which is effective, sustained, collaborative, content-focused and related to classroom practice is a significant way of learning for teachers. In addition, according to Desimone (2009), important professional learning should involve active learning, collective participation, coherence with educational goals and reflective practices for improved instructional practices. Such learning helps teachers to become more professionally competent and thus better learners for their students.

Professional development has undergone transformations from the traditional way of conducting training programs to practice-based and collaborative learning processes. As indicated by Kennedy (2016), teachers learn better when professional development is conducted within real-life classroom situations as opposed to seminars. Similarly, Garet et al. (2001) found out that sustained professional development that involves collaboration, engagement, and practical experience leads to improved instruction in teachers. Modern models such as mentoring, coaching, lesson study, peer review, and professional learning community give teachers an opportunity to share experiences, problem-solve, and continuously improve their teaching. This collaborative method not only encourages reflective teaching but promotes a culture of professional development (Kennedy, 2016; Garet et al., 2001). Recently, artificial intelligence (AI) has gained traction as a significant tool in improving the professional development of teachers. With AI-powered tools, it is now possible to analyze the professional development needs of teachers, recommend training materials, develop lessons plans, give automated feedback, and help with classroom decision making. According to Celik et al. (2022), AI technologies have great potential to improve teachers' instructional skills and digital readiness when used together with appropriate professional development. In addition, recent reviews show that generative AI is able to facilitate self-directed professional development by helping teachers create educational content, assess instructional approaches, and obtain pedagogical support. The above developments imply that AI is transforming professional development from standardized training to personalized continuous learning (Celik et al., 2022).

Fast-paced development in digital technologies has greatly impacted the field of teacher professional development through offering flexible, easily-accessible, and personalized learning. Web-based platforms, webinars, virtual conferences, learning management systems, and digital professional learning communities have made it possible for teachers to participate in high-quality learning experiences independently of geographical location. According to Opfer and Pedder (2011), professional development can be considered as an element of a complicated learning system in which teachers interact with their schools, colleagues, and environment. Furthermore, Boeskens et al. (2020) pointed out that technology-enabled professional learning broadened opportunities for teachers' continuous learning and development of new teaching strategies. Therefore, digital professional development has become an important element of educational improvement in the twenty-first century (Opfer & Pedder, 2011;

Boeskens et al., 2020). The use of artificial intelligence by educational organizations for the purpose of improving the process of teaching and learning has put demands for development of specific skills in addition to digital literacy on teachers. As stated by Desimone and Garet (2015), professional development has to ensure that teachers would be able to apply innovations and new technologies in pedagogically sound ways. Recent international research conducted by Viberg et al. (2023) has shown the impact of teachers' understanding of AI and their readiness to use AI technologies on their attitudes towards adopting AI-supported education practices. Therefore, professional development should aim at development of teachers' AI literacy, ethical awareness, critical thinking skills, and technology integration (Desimone & Garet, 2015; Viberg et al., 2023).

It is well known that teacher professional development remains among the most potent factors affecting quality of education and effectiveness of teaching. Continuous professional development provides teachers with an opportunity to develop their knowledge and skills, use innovations, improve teaching practices and cope with changes in education. In terms of artificial intelligence, investments in professional development become particularly urgent to prepare teachers for using AI in a proper way and improving students' learning. Therefore, teacher professional development is crucial for improving teacher effectiveness and achieving sustainable quality of education (Darling-Hammond et al., 2017; OECD, 2024). In spite of its significance, teacher professional development faces certain difficulties. Limited institutional support, lack of funding, heavy teaching workload, lack of time, and inequality in access to professional learning opportunities decrease teachers' engagement in continuous learning practices. Reports by OECD emphasize the importance of supportive school leadership, collaborative culture and appropriate time allocation for maintaining teachers' professional development. Besides, recent critical reviews suggest that instead of searching for effective characteristics of professional development programs, it is necessary to consider the context in which these characteristics take place.

Student Learning Success

There are many factors that impact student learning success, such as individual, instructional, technological, and environmental factors. Some individual features, including prior knowledge, motivation; learning strategies, self-efficacy, and engagement influence the educational outcomes. At the same time, there are some external factors that matter, such as teacher competence, instructional quality, classroom environment, institutional support, curricula, assessment procedures, and educational technologies. It was found that teaching is one of the most powerful school predictors of student learning success (Hattie, 2023), which means that it is essential to invest in teachers. Student learning success is one of the main aims of each educational system, which is used as an important indicator of the educational quality and institutional efficiency. This notion implies how far students have achieved the expected learning outcomes through gaining knowledge, skills, developing positive attitudes and competencies. Traditionally, student learning success was estimated based on examination scores and academic grades. Modern educational research shows that this concept is multidimensional and includes such aspects as critical thinking, creativity, problem-solving, collaboration, communication, self-regulated learning, and lifelong learning skills. According to Hattie (2023), successful learning takes place when students participate in meaningful learning experiences and effective teaching and get feedback. As Fullan (2020) notes, educational success is connected not only with improving examination results but also developing competencies needed for the knowledge society. Thus, nowadays educational systems assess student learning success not only academically but also in the terms of holistic development (Hattie, 2023; Fullan, 2020).

Effective teachers are one of the best school-based predictors of student learning success. Such teachers are highly competent in terms of pedagogical knowledge, teaching competence, classroom management skills, assessment literacy, and the ability to create engaging learning environments. According to Hattie (2023), teacher expertise, constructive feedback, and evidence-based instruction strategies considerably impact students' academic achievement and cognitive development. In turn, Darling-Hammond et al. (2020) note that well-prepared teachers, who continuously improve their professional competencies, create the learning environment, which enhances student engagement, higher-order thinking, and academic success. Thus, improvements in teacher quality lead to enhanced learning outcomes and education success (Hattie, 2023; Darling-Hammond et al., 2020). Student learning success depends on many factors related to individual students, teaching practices, institution, and technology. The motivational characteristics, such as motivation, self-efficacy, prior knowledge, learning strategies, and cognitive abilities have a considerable impact on academic achievements. However, there are some external factors, such as teacher quality, classroom environment, curriculum design, assessment practices, parental involvement, institutional support, and educational technologies which also play crucial role in learning outcome determinants. As stated by OECD (2023), students achieve high level of learning outcomes due to the existence of a supportive learning environment, effective teaching, collaborative classroom culture, and equitable access to the educational resources. Moreover, Schunk and DiBenedetto (2020) note that those learners, who have higher level of self-efficacy and intrinsic motivation show more persistence, engagement, and academic success. It means that student learning success depends

on a combination of multiple educational and personal factors (OECD, 2023; Schunk & DiBenedetto, 2020). According to Bond et al. (2021), technology-enhanced learning environment positively impacts student engagement, collaboration, and academic achievements. In addition, according to UNESCO (2023), digital transformation increased the educational opportunities and access to high-quality learning resources and promotes inclusive and equitable education. Thus, technology became an essential part of modern student learning success (Bond et al., 2021).

Artificial Intelligence and Teacher Professional Development

The swift progress in artificial intelligence (AI) technology has changed teacher professional development by developing new models for continuous learning, improvement of instruction, and professional competencies. Contrary to traditional methods that use standardized procedures in professional development, AI technologies provide unique opportunities to develop personalized programs that meet the requirements of teachers, learning context, and competency level. Intelligent systems can analyze the learning patterns of teachers, reveal gaps in skills, and recommend learning materials that will help them to develop continuously. According to Holmes et al. (2022), AI has a potential to revolutionize the process of teacher learning as it helps to adopt instructional practices based on evidence and lifelong learning. Artificial intelligence technology allows teachers to undergo self-directed and personalized professional learning by using intelligent recommendation systems, adaptive learning tools, and virtual professional development environments. AI learning systems constantly monitor the process of teachers' learning and suggest appropriate learning materials considering the teachers' instructional needs, specialization, and previous experience. Similarly, UNESCO (2023) stressed that AI should be considered as a tool to enhance professional skills of teachers, but not as a replacement of instructional practices. Therefore, AI is an effective catalyst for developing competent, reflective, and innovative educators who can react to new challenges in modern educational environment (Holmes et al., 2022; UNESCO, 2023).

According to Trust et al. (2023), AI-supported professional development enables teachers to benefit from instructional materials provided at an appropriate time, obtain feedback instantly, and learn through adaptable activities based on their professional schedule. As Celik et al. (2022) have noted, AI makes teachers digitally competent through personalized support in integrating technology, classroom innovation, and instructional decision-making. These adaptive learning experiences contribute to the improvement process and foster teachers' confidence in using new pedagogical strategies (Trust et al., 2023; Celik et al., 2022).

Artificial intelligence also helps teachers in reflection by offering insights into the behavior of the learners, their level of engagement and academic growth based on data from artificial intelligence systems. Insights about learners obtained through learning analytics allow teachers to understand the efficacy of the approaches used in instruction, the challenges experienced in learning and make informed decisions. As asserted by Siemens and Baker (2012), learning analytics helps in continuous improvement of teaching through translation of education-related data into useful information for pedagogical decision making. In addition, it has been observed by Viberg et al. (2023) that teachers who are successful in using learning analytics provided by artificial intelligence systems are more confident in planning instructions and managing classes.

There is consistent research evidence that shows a positive link between artificial intelligence and professional development of teachers. Teachers who use AI technologies in professional development activities usually have greater instructional proficiency, better technology integration, greater digital self-confidence, and instructional innovation compared to those using traditional methods of professional development. Not only does AI enhance the technical skills of teachers but also increases their ability to reflect on their work, learn collaboratively, creatively instruct, and make evidence-based decisions. As such, the incorporation of AI into professional development activities of teachers leads to better instructional results. As educational organizations move forward with their digitalization processes, the importance of incorporating AI into professional development of teachers is predicted to increase and become a key strategy for addressing the challenges of twenty-first-century education (Holmes et al., 2022; Trust et al., 2023).

Methodology

Research design of the study is as under:

Research Approach

The research design adopted for the study involves a quantitative research approach. A quantitative research approach is suitable where researchers need to measure variables quantitatively and analyze relationships between them.

Research Design

The descriptive-correlational research design was adopted in the current study. The descriptive approach is employed in establishing the extent of the perceived levels of artificial intelligence integration, teacher professional development, and student learning success among the respondents.

Population of the Study

The study population comprised university lecturers employed at the public sector universities in D.G. Khan. The total size of the population was 210.

Sample and Sampling Technique

The sample of the study was 150. Simple random sampling technique was used in this study.

Research Instrument

Data was collected through a questionnaire developed according to the objectives and variables of the study.

Section A: Artificial Intelligence Integration

This section contains 8 statements measuring teachers' perceptions regarding the use of AI tools in teaching and educational activities.

Section B: Teacher Professional Development

This section contains 9 statements measuring the perceived contribution of AI to teachers' professional development.

Section C: Student Learning Success

This section contains 8 statements measuring teachers' perceptions of students' learning success resulting from AI-supported teaching.

Validity and Reliability of the Instrument

The tool was validated by education experts and Cronbach's Alpha values are as under:

- Artificial Intelligence Integration = 0.90
- Teacher Professional Development = 0.87
- Student Learning Success = 0.89

Results

The result of the study was carried out by using SPSS. Results of the study are as under:

Table 1: Artificial Intelligence Integration

No	Statement	Mean	SD
1	AI tools help me prepare lessons more efficiently.	4.05	1.01
2	I regularly use AI applications to support my teaching activities.	3.81	1.09
3	AI tools improve the quality of my instructional materials.	4.05	0.95
4	AI enables me to provide more personalized learning experiences.	3.93	1.02
5	AI reduces the time required for routine teaching tasks.	4.12	0.98
6	AI helps me make better instructional decisions.	3.93	1.01
7	I am confident in using AI tools for educational purposes.	3.83	1.11
8	My institution encourages effective AI integration.	3.57	1.19
Overall		3.91	0.84

Table 1 shows that participants generally reported a positive perception of AI integration in teaching. The highest mean was observed for the statement that AI reduces the time required for routine teaching tasks ($M = 4.12$, $SD = .98$). The lowest mean was recorded for institutional encouragement of effective AI integration ($M = 3.57$, $SD = 1.19$). The overall mean of 3.91 indicates a relatively high level of perceived AI integration.

Table 2: Teacher Professional Development

No	Statement	Mean	SD
1	AI has enhanced my professional knowledge.	4.07	.94
2	AI motivates me to improve my teaching skills.	4.10	.98
3	AI helps me learn innovative teaching strategies.	4.13	.94
4	AI supports my ability to design engaging activities.	3.49	1.01
5	AI improves my confidence in using educational technology.	3.87	1.03
6	AI-assisted resources contribute to my professional growth.	4.13	.98
7	AI enables me to reflect on and improve my teaching.	3.91	1.04
8	AI improves my ability to solve instructional challenges.	3.87	1.03
9	AI has strengthened my overall teaching competence.	4.01	0.98
Overall		4.01	.82

Table 2 specifies that respondents generally agreed that AI contributes positively to their professional development. The highest mean was noted for learning innovative teaching strategies through AI ($M = 4.13$, $SD = .94$). The lowest mean was detected for AI enabling teachers to reflect on and improve their teaching ($M = 3.91$, $SD = 1.04$). The overall mean of 4.01 indicates a high perceived contribution of AI to teacher professional development.

Table 3: Student Learning Success

No	Statement	Mean	SD
1	AI-supported teaching improves students' understanding.	4.11	.94
2	AI increases students' classroom engagement.	4.01	.99
3	AI helps students receive timely feedback.	4.10	.95
4	AI encourages students to become independent learners.	3.89	1.04
5	AI enhances students' critical-thinking and problem-solving skills.	3.83	1.10
6	AI contributes to improved academic performance.	3.97	1.02
7	AI increases students' motivation to learn.	3.97	1.01
8	AI positively contributes to students' overall learning success.	4.07	.96
Overall		3.99	.84

Table 3 shows that respondents generally perceived AI-supported teaching as beneficial for student learning success. The highest mean was observed for improving students' understanding ($M = 4.11$, $SD = .94$), followed by timely feedback ($M = 4.10$, $SD = .95$). The lowest mean was recorded for enhancing critical-thinking and problem-solving skills ($M = 3.83$, $SD = 1.10$). The overall mean of 3.99 indicates a high perceived level of student learning success.

Table 4: Major Statistical Results

Correlation	r^{**}/β	Significance
AI Integration and Teacher Professional Development	0.68	$p < .001$
AI Integration and Student Learning Success	0.62	$p < .001$
Teacher Professional Development and Student Learning Success	0.71	$p < .001$
AI Integration and Student Learning Success	$\beta = 0.24$	$p < .001$
Teacher Professional Development and Student Learning Success	$\beta = 0.57$	$p < .001$

Summary

Summary of the study is given as:

Discussion

The current study focused on the use of artificial intelligence as the factor facilitating the process of professional development of teachers and student academic success in university education. The results suggest that teachers of universities positively perceive the implementation of artificial intelligence in their work and learning.

This finding is supported by the existing literature stating that AI technologies could facilitate teachers through automatizing or helping them with certain instructional and administrative functions. Zawacki-Richter et al. (2019) found several areas of AI application in higher education, such as assessment, personalization, profiling, and intelligent tutoring. From the analysis performed by the authors, it is clear that the use of AI could bring additional technological support for educational processes if implemented properly in institutional practice. In turn, Celik et al. (2022) have emphasized not only the potential of AI to assist teachers but also the need for enhancing teachers' competence in using AI technology. Hence, the current finding proves the idea that AI should be regarded as the means of instructional support.

Desimone (2009) explains that modern professional development is perceived as a continuous process rather than a combination of occasional workshops. Desimone (2009) noted that the successful professional development had to be linked to the teachers' practice and to encourage continuous learning. In relation to AI, one can state that teachers have the possibility to utilize intelligent tools as additional sources for self-driven learning. It can be said that AI has potential in terms of supporting the teachers' professional knowledge and instructional practices but teachers have to possess proper competence in using AI.

This finding is consistent with the literature concerning the role of technology in increasing students' engagement provided by means of technology integration into the teaching process. Bond et al. (2021) stated that student engagement with educational technology was strongly dependent on how technology is implemented into the learning process. This way, positive attitudes towards AI observed in this research may not be explained only by the presence of intelligent tools but may be determined by the usage of such tools for supplementary explanation, feedback, and learning opportunities.

Conclusion

In conclusion, the study proved that artificial intelligence has substantial potential to enhance teacher professional development and student learning success in universities. It was found that university teachers consider AI to be a helpful tool for increasing the effectiveness of their work, creation of teaching materials, studying of innovative teaching techniques, and enhancing learning experiences of students. Also, the results proved that there is a strong positive relation between integration of AI and teacher professional development. This means that AI may serve as an additional source for continuous professional development for teachers since it allows them to learn new teaching techniques, discover innovative ways of teaching and develop their technological competences. The results of the research proved that there is a significant positive association between AI integration and student learning success. University teachers considered AI-supported teaching as being helpful for understanding, engagement, feedback, motivation, and overall learning of students. But the relatively low evaluation of critical thinking and problem-solving indicates that the use of AI technologies should be very cautious and pedagogical rather than a way of giving students ready solutions. One more important conclusion of the research is that teacher professional development is more related to student learning success than AI integration. Correlation between teacher professional development and student learning success was equal to .71, while regression coefficient for teacher professional development was $\beta = .57$. This means that even in the age of artificial intelligence teachers play a crucial role in educational process. In general, artificial intelligence technologies should not be considered as something that can substitute teachers. Rather, AI should be treated as an auxiliary technology that can increase professional competences of teachers and create better conditions for learning of students.

Recommendations

On the basis of findings and conclusions of the study, the following recommendations are made:

1. Universities should organize regular workshops, training sessions, and practical professional development programs to help university teachers, to develop AI literacy and effectively integrate AI into teaching.

2. Professional development needs not only to train teachers on how to use AI applications but should also show them how AI may be incorporated with proper teaching techniques and goals.
3. The relatively low value of institutional encouragement highlights the need for policies, technical assistance, infrastructure, and encouragement by administration in using AI responsibly.
4. Teachers need to plan activities in which students are required to critically analyze AI-generated information, assess different options, validate their logic, and respond uniquely.
5. AI can serve as auxiliary learning tools for professionals that help teachers learn about novel methods of teaching and innovative teaching aids.

References

1. Boeskens, L., Nusche, D., & Yurita, M. (2020). Policies to support teachers' continuing professional learning: A conceptual framework and mapping of OECD data. OECD Education Working Papers No. 235.
2. 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), 50.
3. Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2021). Mapping research in student engagement and educational technology in higher education: A systematic evidence map. *International Journal of Educational Technology in Higher Education*, 18, Article 2.
4. Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (2022). The promises and challenges of artificial intelligence for teachers: A systematic review of research. *TechTrends*, 66(4), 616–630.
5. Chan, C. K. Y., & Hu, W. (2023). Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. *International journal of educational technology in higher education*, 20(1), 43.
6. Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, 24(2), 97–140.
7. Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. Learning Policy Institute.
8. Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2022). Effective teacher professional development. Learning Policy Institute.
9. Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, 38(3), 181–199.
10. Desimone, L. M., & Garet, M. S. (2015). Best practices in teachers' professional development in the United States. *Psychology, Society & Education*, 7(3), 252–263.
11. Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M., Al-Busaidi, K. A., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., ... Wright, R. (2023). So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, 71, 102642.
12. European Commission. (2023). Digital Education Action Plan 2021–2027: Progress and future directions. European Commission.
13. Fullan, M. (2020). *Leading in a culture of change* (2nd ed.). Jossey-Bass.
14. Garet, M. S., Porter, A. C., Desimone, L., Birman, B., & Yoon, K. S. (2001). What makes professional development effective? *American Educational Research Journal*, 38(4), 915–945.
15. Hattie, J. (2023). *Visible learning: The sequel*. Routledge.

16. Holmes, W., Bialik, M., & Fadel, C. (2022). Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign.
17. Kennedy, M. M. (2016). How does professional development improve teaching? *Review of Educational Research*, 86(4), 945–980.
18. Luckin, R. (2018). Machine learning and human intelligence: The future of education for the 21st century. UCL Institute of Education Press.
19. Miao, F., Holmes, W., Huang, R., & Zhang, H. (2021). AI and education: Guidance for policy-makers. UNESCO.
20. OECD. (2020). Teachers and school leaders as lifelong learners: TALIS 2018 results (Volume II). OECD Publishing.
21. OECD. (2023). PISA 2022 results (Volume I): The state of learning and equity in education. OECD Publishing.
22. Opfer, V. D., & Pedder, D. (2011). Conceptualizing teacher professional learning. *Review of Educational Research*, 81(3), 376–407.
23. Organisation for Economic Co-operation and Development. (2023). OECD Digital Education Outlook 2023: Keeping pace with digital transformation. OECD Publishing.
24. Organisation for Economic Co-operation and Development. (2024). Unlocking high-quality teaching. OECD Publishing.
25. Russell, S., & Norvig, P. (2021). Artificial intelligence: A modern approach (4th ed.). Pearson.
26. Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, 60, 101832.
27. Siemens, G., & Baker, R. S. J. d. (2012). Learning analytics and educational data mining: Towards communication and collaboration. In *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge* (pp. 252–254). ACM.
28. Trust, T., Whalen, J., & Mouza, C. (2023). Teacher professional development in the age of generative artificial intelligence: Opportunities, challenges, and future directions. *Journal of Technology and Teacher Education*, 31(4), 451–469.
29. UNESCO. (2021). Reimagining our futures together: A new social contract for education. UNESCO.
30. UNESCO. (2023). Guidance for generative AI in education and research. UNESCO.
31. Viberg, O., Cukurova, M., Feldman-Maggor, Y., et al. (2023). Teachers' trust and readiness for artificial intelligence in education: An international perspective. *Computers and Education: Artificial Intelligence*.
32. Zawacki-Richter, O., Marín, 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), 1–27.



2026 by the authors; Journal of Global Social Transformation (JGST). This is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).