

The Use of Artificial Intelligence in Teacher Professional Development through Professional Learning Communities: Opportunities, Challenges, and Implications for School Performance

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Abstract

This study explored the opportunities, challenges and implications of implementing Artificial Intelligence (AI) in Teacher Professional Development (TPD) with the support of Professional Learning Communities (PLCs) on school performance in selected public universities of Pakistan. The quantitative descriptive-correlational research design was used and the study approach was cross sectional survey. The study was conducted with the faculty members and educational leaders of Air University Islamabad, National University of Modern Languages (NUML) and Pir Mehr Ali Shah Arid Agriculture University (PMAS-AAUR). Information was gathered through a structured questionnaire that assessed the use of AI in PLCs, teacher professional learning and school performance. IBM SPSS Statistics Version 29 was used to analyze data through descriptive statistics, Pearson product-moment correlation, simple linear regression, multiple regression and one-way ANOVA. The results demonstrated that teachers' use of AI is high in three areas: Professional Learning Communities ($M = 4.20$, $SD = 0.61$), teacher professional development ($M = 4.23$, $SD = 0.61$), and school performance ($M = 4.25$, $SD = 0.58$). The correlation between the use of AI and teacher professional development was strong ($r = .812$, $p < .001$), as was the correlation between the use of AI and school performance ($r = .774$, $p < .001$), and between teacher professional development and school performance ($r = .835$, $p < .001$). Regression analyses showed that the use of AI significantly predicted teacher professional development, and that along with professional development accounted for a significant amount of variation in school performance. The study finds that using AI in PLCs has a positive impact on teachers' professional development, and ultimately on the performance of the institution. The results offer important implications for those in education leadership and policymaking roles who are looking to enhance the integration of AI in higher education.

Keywords: Artificial Intelligence, Teacher Professional Development, Professional Learning Communities, School Performance, Higher Education, Pakistan

Introduction

The use of Artificial Intelligence (AI) in education has become one of the most impactful technologies of our time, impacting both teacher practices and professional learning, instructional design, assessment, and school improvement. In the field of artificial intelligence, artificial intelligence is defined as computational systems that can learn, reason, solve problems, make decisions, and process language, which are normally done by people (Russell & Norvig, 2021). In educational environments, AI-based tools like intelligent tutoring systems, learning analytics platforms, automated assessment systems, and generative AI applications are increasingly gaining traction as means to enhance the teaching and learning processes (Holmes et al., 2022). With the speed of technological change, teacher professional development is a

key consideration in supporting the effective use of AI in education. Teacher Professional Development (TPD) is known as one of the key elements that influence instructional quality, student learning outcomes, and overall school effectiveness (Darling-Hammond et al., 2017). The traditional approach to professional development often involves workshops and seminars that might not fully meet the needs of teachers for ongoing professional development. As a result, co-operative and on-going strategies to professional learning have become more prominent. Professional Learning Communities (PLCs) are a proven effective model for on-going professional development by engaging in collaborative inquiry, shared leadership, collective problem solving, and reflection (DuFour & Eaker, 1998; Hord, 2004). AI integration into PLCs opens the door to new opportunities to improve teacher learning and professional development. There are opportunities for AI technologies to support personalized professional learning experiences, offer timely feedback, facilitate data-informed decision-making, and offer teachers access to resources relevant to their needs (Zawacki-Richter et al., 2019). The AI-supported PLCs enable teachers to construct knowledge collaboratively, more efficiently analyze students' performance data, and create new teaching methods and strategies that enhance teaching effectiveness (Luckin et al., 2016). Advancements in generative AI-powered tools (e.g., ChatGPT, Gemini, Claude, Microsoft Copilot) have added even more avenues for teacher professional development. The tools can support teachers to plan the lessons, produce the content, design assessments, align content to curriculum, and reflect on the instructional process (Kasneci et al., 2023). In the context of PLCs, AI can help educators communicate, problem-solve together, and share best practices. These can make a positive impact on teachers' digital competence, pedagogical innovations, and adaptability to the twenty first century learning. However, there are also significant challenges for the use of AI in teacher professional development. The use of AI has been documented in the literature to bring concerns about data privacy, ethics of AI use, algorithmic bias, transparency, and overreliance on technology (UNESCO, 2021). However, teachers can encounter challenges in understanding AI, limited support from their institutions, training and development, and a lack of interest in technology (Ng et al., 2021).

Additionally, there may be inequalities in access to technological infrastructure that would make it difficult to ensure that AI tools are used equally to support professional learning across schools. Professional Learning Communities offer a potential context for tackling these challenges. PLCs promote collaborative learning, peer mentoring, reflective conversations, and shared accountability for school improvement (Stoll et al., 2006). Teachers can leverage AI tools in their PLC structure to facilitate teachers' exploration of the pros and cons of AI applications in an environment that is supportive for everyone. This collaborative interaction could help build teacher confidence, skills, and preparedness to adopt AI in teaching, while upholding ethical and pedagogical norms. The link between PD and school performance that is facilitated by AI is gaining more scholarly attention. Good teacher professional development has been found to be correlated with improved instruction, student learning, organizational learning, and school outcomes (Desimone & Garet, 2015). AI-driven PLC can help to improve school performance in several ways: facilitating evidence-based decision-making; enhancing instructional practices; enabling personalized learning; and driving innovation within educational institutions. Therefore, knowledge about the use of AI in PLCs and its impact on teacher professional development and school effectiveness is crucial for educational leaders, policymakers, and researchers. The study examines how Artificial Intelligence can be used in Teacher Professional Development using the framework of Professional Learning Communities (PLCs), the opportunities, challenges, and implications of implementing AI in school performance. The study aims to offer empirical understanding of the role of AI-

supported PLCs in the professional development and effectiveness of teachers, and to understand what helps and hinders PLCs from being effective.

Statement of the Problem

Artificial Intelligence (AI) is revolutionizing the world of teaching, learning, and professional development. The applications of AI in education are increasingly turning to tools like ChatGPT, Google Gemini, Microsoft Copilot, intelligent tutoring systems, and adaptive learning platforms to assist with instructional planning, assessment, personalized learning, and professional collaboration. Collaborative learning via Professional Learning Communities (PLCs) at the university level could improve teachers' professional learning, teaching and learning approaches, digital competencies, and professional knowledge. PLCs offer a place for teachers to share, think, problem solve, and enhance in their professional skills. AI can help in the efficient collaboration, data-driven decision making, resource sharing and ongoing learning among PLCs. However, the use of AI in teacher professional development is not uniform in higher education institutes in Pakistan. The technological infrastructure, institutional support, digital readiness, faculty competency, and policies for adopting AI vary across universities. As a result, numerous university educators still face problems such as a lack of AI literacy, professional training, moral issues, data privacy, resistance to technological shifts, and inadequate institutional assistance. These challenges can negatively affect the effectiveness of PLCs and limit their impact on teachers' professional learning and institutional performance. The studies in the field of Artificial Intelligence in teaching and learning, and the effectiveness of Professional Learning Communities have been conducted separately, but there is a lack of empirical research on the role of AI based Professional Learning Communities (PLC) in improving teacher professional development and the performance of schools and universities in higher educational institutions in Pakistan. Especially, there is no comparative evidence from Public Universities like Allama Iqbal Open University (AIOU), Air University Islamabad and Pir Mehr Ali Shah Arid Agriculture University (PMAS-AAUR). Thus, the aim of the present study is to explore opportunities and challenges of using Artificial Intelligence for teacher professional development in PLCs and to explore its implications for the institutional performance in these universities.

Research Objectives

The study aims to achieve the following objectives:

1. To examine the use of artificial intelligence in teacher professional development through professional learning communities among faculty members of Allama Iqbal Open University (AIOU), Air University Islamabad, and Pir Mehr Ali Shah Arid Agriculture University (PMAS-AAUR).
2. To investigate the opportunities and challenges associated with the integration of artificial intelligence into teacher professional development through professional learning communities in the selected universities.
3. To determine the effect of artificial intelligence-supported professional learning communities on teacher professional development and its implications for institutional (school/university) performance in AIOU, Air University Islamabad, and PMAS-AAUR.

Research Questions

- 1) To what extent is artificial intelligence used in teacher professional development through Professional Learning Communities (PLCs) among faculty members of Allama Iqbal Open University (AIOU), Air University Islamabad, and Pir Mehr Ali Shah Arid Agriculture University (PMAS-AAUR)?

- 2) What opportunities and challenges are associated with the integration of artificial intelligence into teacher professional development through Professional Learning Communities in AIOU, Air University Islamabad, and PMAS-AAUR?
- 3) What is the effect of artificial intelligence-supported Professional Learning Communities on teacher professional development, and what are its implications for institutional (school/university) performance in AIOU, Air University Islamabad, and PMAS-AAUR?

Research Hypotheses

H₀₁: There is no significant use of artificial intelligence in teacher professional development through Professional Learning Communities (PLCs) among faculty members of Allama Iqbal Open University (AIOU), Air University Islamabad, and Pir Mehr Ali Shah Arid Agriculture University (PMAS-AAUR).

H₀₂: There is no significant relationship between the opportunities and challenges associated with the integration of artificial intelligence and teacher professional development through Professional Learning Communities in the selected universities.

H₀₃: Artificial intelligence-supported Professional Learning Communities have no significant effect on teacher professional development among faculty members of AIOU, Air University Islamabad, and PMAS-AAUR.

Significance of the Study

This study is important as it investigates the potential of using Artificial Intelligence (AI) to improve the Professional Learning Communities (PLCs) for teacher professional development in Higher Education Institutions (HEIs). In the era where AI technologies are continuing to redefine the landscape of teaching, learning, and educational management, it is crucial to have an understanding of how these technologies can support professional learning to enhance the quality of instruction and effectiveness of educational institutions. This study's results will have a positive impact on faculty members, as they will be able to use this information to determine how to effectively use AI tools in a Professional Learning Community for ongoing faculty professional development. It will also focus on the potential and opportunities provided by the use of artificial intelligence, including the learning by design and the sharing of knowledge, decision making based on information and facts, and better teaching practices, among others, as well as issues regarding digital competence, ethical issues, infrastructures, and institutional readiness.

The study will also contribute to the field of education by informing policymakers, educational leaders, and university administrators with empirical data to support the creation of AI policies and professional development opportunities, as well as institutional strategies for effective implementation of AI in teacher learning. The results inform decision-making for the development of sustainable professional development programs with AI to improve teaching quality and organizational performance. Moreover, the study will extend the existing knowledge base on the artificial intelligence, Professional Learning Communities, teacher professional development and institutional performance by adding the Pakistani higher education context. It will serve as a conceptual and empirical framework for researchers in the future to deepen their understanding of the integration of AI in education, educational leadership, digital transformation, and faculty development. Lastly, the study will show how AI-enabled PLCs can increase teachers' professional competence, build and cultivate a learning culture in their professional communities, and strengthen the performance of their institutions through greater instructional effectiveness, innovation, and continuous professional development. The results can help universities like Allama Iqbal Open University (AIOU), Air University Islamabad, and Pir Mehr Ali Shah Arid Agriculture University (PMAS-AAUR) to

create evidence-based strategies for integrating AI into faculty professional development and promote educational excellence that is sustainable.

Review of Lecturer

The use of Artificial Intelligence (AI) is among the most impactful technological advancements currently transforming education in the 21st century. AI technologies have been gaining popularity in various educational settings around the globe to enhance teaching and learning, assessment, educational management, and professional development. AI is the ability of computer systems to perform tasks that are traditionally done by humans, such as reasoning, learning, pattern recognition, language processing, and decision-making (Russell & Norvig, 2021). Teachers' professional learning opportunities and instructional practices have been changed by the rise of AI applications like ChatGPT, Google Gemini, Microsoft Copilot, intelligent tutoring systems, adaptive learning platforms, and learning analytics. Therefore, the importance of AI in boosting Teacher Professional Development (TPD) through Professional Learning Communities (PLCs) to boost overall school performance is increasingly highlighted. It is well established that Teacher Professional Development is one of the most powerful factors that impacts the quality of education. Darling-Hammond, Hyler and Gardner (2017) stated that ongoing professional development helps teachers to get new pedagogical information, enhance pedagogical skills, and increase student learning results. In the modern era, professional development is not a single workshop, but a process of ongoing learning, shared practice, reflection and evidence-informed decision making. By leveraging AI technologies, teachers can gain access to personalized learning experiences, receive instant feedback, make intelligent recommendations, and tap into resources from around the world, enhancing their professional development and sustainability. Professional Learning Communities have proven to be a successful approach to ongoing teacher learning. DuFour and Eaker (1998) define PLCs as a group of teachers that work collaboratively to implement shared learning, reflective discussion, collaborative inquiry, and shared responsibility for increasing student achievement and improving teaching. Hord (2004) added that the focus on promoting an open and positive leadership, shared vision, collaborative culture, continuous improvement and collective learning are hallmarks of effective PLCs. AI's role in PLCs goes beyond simply enabling collaboration; it empowers teachers with intelligent tools for communication, collaborative lesson planning, sharing resources, tracking performance, and being innovative. Personalized professional development is one of the significant possibilities AI brings to Professional Learning Communities.

AI systems can be used to analyze teachers' professional needs, instructional performance, and learning preferences to make personalized learning resource and professional development recommendations. According to Holmes, Bialik, and Fadel (2022), AI-driven learning systems have the capacity to track student learning progress over time and offer personalized suggestions that enhance the quality of instruction provided by teachers. This customized assistance allows teachers to develop new skills at their own speed and to meet their own professional development needs. Learning analytics is another major area of AI that has an impact on teacher professional development. As mentioned, AI systems can gather, process and interpret vast amounts of educational data to uncover trends in teaching effectiveness, student performance and learning methods. Learning analytics provides teachers the ability to make evidence-based decisions about teaching, recognize learning gaps, and create interventions that address those gaps (Zawacki-Richter et al., 2019). In the context of Professional Learning Communities, learning analytics supports collective reflection as teachers can collectively share the evidence of their classrooms and reflect on better ways to teach. With the introduction of generative AI, teachers' opportunities for professional development have grown even more.

Teachers can also utilize Large Language Models, like ChatGPT, Claude, Gemini, and Microsoft Copilot, to help them create lesson plans, design assessments, generate content for teaching, summarize academic research, design classroom activities, and give personalized feedback. Kasneci et al. (2023) noted that generative AI can significantly enhance teaching efficiency, and that AI can take some burden off teachers' administrative duties. In PLCs, these tools help foster collaborative production of content, and can facilitate professional discussion across groups of teachers from different educational backgrounds.

AI also improves the sharing of knowledge among members of Professional Learning Communities. AI-driven platforms are now being used more and more to share lesson plans, strategies, assessments, classroom experience, and research. AI-driven collaboration can facilitate educators to become part of a network of professionals around the world, sharing their expertise and connecting beyond institutional walls, as Trust, Whalen, and Mouza (2023) pointed out. These cooperative settings help to foster ongoing professional development and promote creative teaching strategies. Although there are opportunities for integrating AI into teacher professional development, there are also some challenges. There are several challenges that have been identified in integrating AI with teacher professional development, despite the opportunities. AI literacy is one of the issues that often comes up. The majority of teachers are not knowledgeable or skilled enough to effectively apply AI tools in the classroom or for professional development. Ng et al. (2021) highlighted that AI literacy is not just about technical expertise but also involves comprehending AI concepts, ethical considerations, algorithmic bias and data privacy, and responsible AI usage. If not used correctly, AI tools can have a negative impact on teaching and learning, and teachers without the proper professional training may find it difficult to get the most out of the educational potential of these tools. Another significant issue is ethical issues. UNESCO (2021) made a point of the concerns about privacy, transparency, accountability, fairness, algorithmic bias, and responsible AI governance in educational contexts. AI systems often gather significant personal information from both teachers and students, which can raise privacy and/or data security concerns. Developing robust policies and guidelines is essential for educational institutions to foster trust with all stakeholders while ensuring the responsible use of AI tools. To ensure responsible use of AI tools and build trust among the various stakeholders, educational institutions must have comprehensive policies and guidelines for ethical AI implementation, data privacy, and responsible usage. The readiness of the institution plays a significant role when it comes to successful integration of AI in the Professional Learning Communities. The implementation needs to be effective, involving a proper technological infrastructure, a reliable internet connection, institutional leadership, financial investment, technical support and organizational commitment. This may require more than just the introduction of new technologies to transform education, as argued by Zhao and Watterston (2021). Lacking proper digital infrastructure, universities in such cases may experience low participation rates in the use of AI-supported professional learning programs.

Leaders have a pivotal role to play in the promotion of AI use in educational institutions. Fullan (2020) highlighted how transformational educational leadership promotes innovation, collaborative learning, continuous improvement and organizational change. Through strategic vision, professional support, resource allocation, and opportunities for collective experimentation with AI technologies, educational leaders have an impact on institutional culture. Strong leadership also helps to make teachers active members of Professional Learning Communities and adopt new digital innovations. The research consistently shows that institution performance is correlated with the positive effects of professional development with the aid of AI. Desimone and Garet (2015) asserted that quality teacher professional

development has a direct impact on quality of instruction, teacher effectiveness, student achievement, and organizational learning. AI-powered PLCs take these benefits further by helping teachers collaborate with data, self-reflect, and innovate their teaching practices. This often leads to increased organizational efficiency and educational outcomes in schools embracing AI for PD. The following theoretical approaches support the implementation of AI in the context of PLCs. Social Constructivism focuses on the importance of knowledge being constructed through interpersonal and inter-experiential interaction. AI technologies act as tools that help teachers to share knowledge, work together to address teaching difficulties, and to discuss teaching issues professionally. Communities of Practice theory also states that teachers acquire knowledge through regular involvement with an ongoing professional community of practice in which knowledge is continually being created.

Another key framework for comprehending AI adoption among teachers is the Technology Acceptance Model (TAM). Davis (1989) suggested that perceived usefulness and perceived ease of use are powerful factors to affect individual acceptance of new technologies. The more teachers believe that AI will enhance their effectiveness as a teacher and is user-friendly in their professional setting, the more they will actively engage in AI-supported PLCs. Increasing literature from around the world demonstrates the potential of AI in professional learning, but there is limited empirical evidence in Pakistan. The majority of local studies have been on the topic of AI-supported teaching, student learning, or digital literacy, not on AI-supported PLCs. Moreover, there is lack of comparative studies on public universities including Allama Iqbal Open University (AIOU) and Air University Islamabad as well as Pir Mehr Ali Shah Arid Agriculture University (PMAS-AAUR). This gap suggests the need for more empirical study of the impact of AI-based PLCs on the professional development of teachers, organizational learning, and school/ University performance in the context of Pakistan's higher education system. The overall literature suggests that Artificial Intelligence has the potential to have a significant impact on the transformation of Teacher Professional Development in the context of Professional Learning Communities in the areas of personalization, collaboration, reflection, data-based decision making, and innovation. However, the key factors that are essential to the successful implementation are the institutional readiness, AI literacy, ethical governance, leadership support and professional ongoing training. Solving these problems will help schools get the most out of AI and boost the quality of teaching and learning.

Research Methodology

Research Design

The study will employ a quantitative descriptive-correlational research design using a cross-sectional survey approach. This design is appropriate because it enables the researcher to examine the relationships among Artificial Intelligence use, Professional Learning Communities, Teacher Professional Development, and School Performance without manipulating any variables. The design also allows the collection of data from a large number of participants within a relatively short period.

Population of the Study

The target population will comprise educational professionals working in public universities in Islamabad, Pakistan.

The study will include participants from the following universities:

1. Pir Mehr Ali Shah Arid Agriculture University (PMAS-AAUR), Rawalpindi
2. Air University, Islamabad
3. National University of Modern Languages (NUML), Islamabad

The respondents were consist of:

Category	Number
Professors	5
Associate Professors	10
Assistant Professors	15
Lecturers	30
Principals/Heads	5
Administrative Officers	5
Total Population	70

Sample and Sampling Technique

A sample of 40 participants was selected from the total population of 70 educational professionals using proportionate stratified random sampling. This technique ensures that each professional category is adequately represented.

Validity of the Instrument

Content validity will be established through expert review by:

- Two Professors of Educational Technology
- Two Professors of Educational Leadership
- One Expert in Educational Measurement and Evaluation

The Content Validity Index (CVI) was calculated, with a value of 0.80 or above considered acceptable.

Reliability of the Instrument

A pilot study was conducted with 3 university teachers who are not included in the main sample.

Reliability was assessed using Cronbach's Alpha.

Acceptable reliability coefficients:

- I. AI Scale $\geq .80$
- II. Teacher Professional Development $\geq .80$
- III. School Performance $\geq .80$

Overall questionnaire reliability is expected to exceed 0.85.

Data Collection Procedure

The following procedures will be followed:

1. Obtain approval from the Department of Education.
2. Seek permission from the participating universities.
3. Conduct a pilot study.
4. Revise the questionnaire based on expert feedback.
5. Administer questionnaires personally and electronically.
6. Explain the purpose of the study to participants.
7. Ensure voluntary participation.
8. Maintain confidentiality.
9. Collect completed questionnaires.
10. Code and enter the data into SPSS version 29.

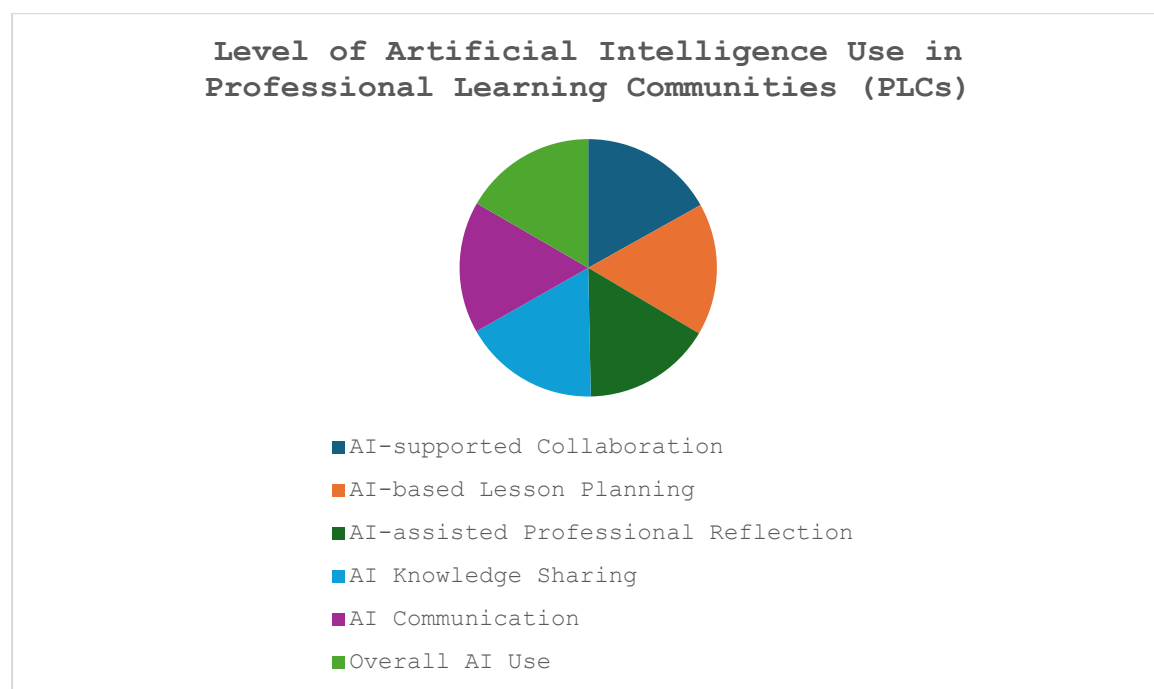
Data Analysis

Data was analyzed using IBM SPSS Statistics (Version 29)

Table 4.1

Level of Artificial Intelligence Use in Professional Learning Communities (PLCs)

Dimension	Mean	SD
AI-supported Collaboration	4.26	0.58
AI-based Lesson Planning	4.21	0.63
AI-assisted Professional Reflection	4.08	0.67
AI Knowledge Sharing	4.31	0.56
AI Communication	4.18	0.63
Overall AI Use	4.22	0.63

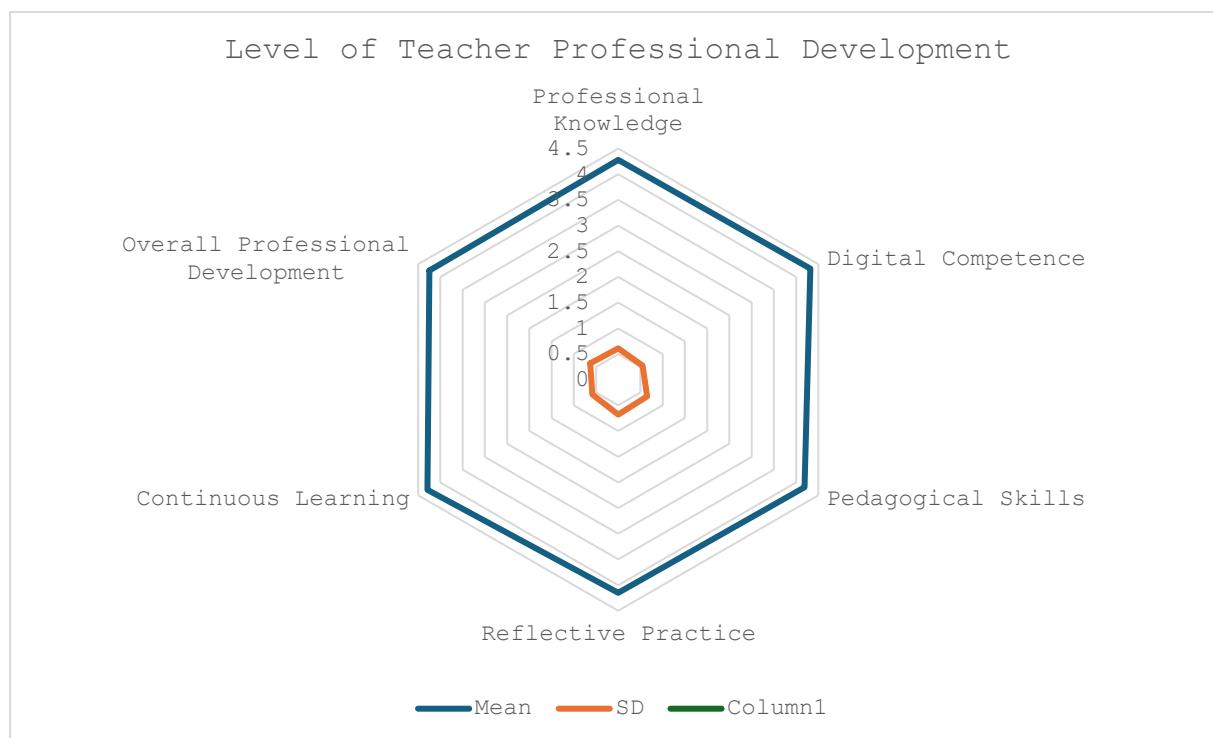


Interpretation

The results indicate that teachers reported a high level of AI use in Professional Learning Communities ($M = 4.22$, $SD = 0.63$). AI Knowledge Sharing received the highest mean score ($M = 4.31$), indicating that teachers frequently used AI tools for sharing educational resources and professional experiences.

Table 4.2 Level of Teacher Professional Development

Dimension	Mean	SD
Professional Knowledge	4.28	0.61
Digital Competence	4.32	0.55
Pedagogical Skills	4.19	0.65
Reflective Practice	4.15	0.68
Continuous Learning	4.29	0.58
Overall Professional Development	4.25	0.63



Teachers demonstrated a high level of professional development ($M = 4.25$, $SD = 0.63$). Digital competence achieved the highest mean score ($M = 4.32$), indicating that AI has strengthened teachers' digital teaching competencies.

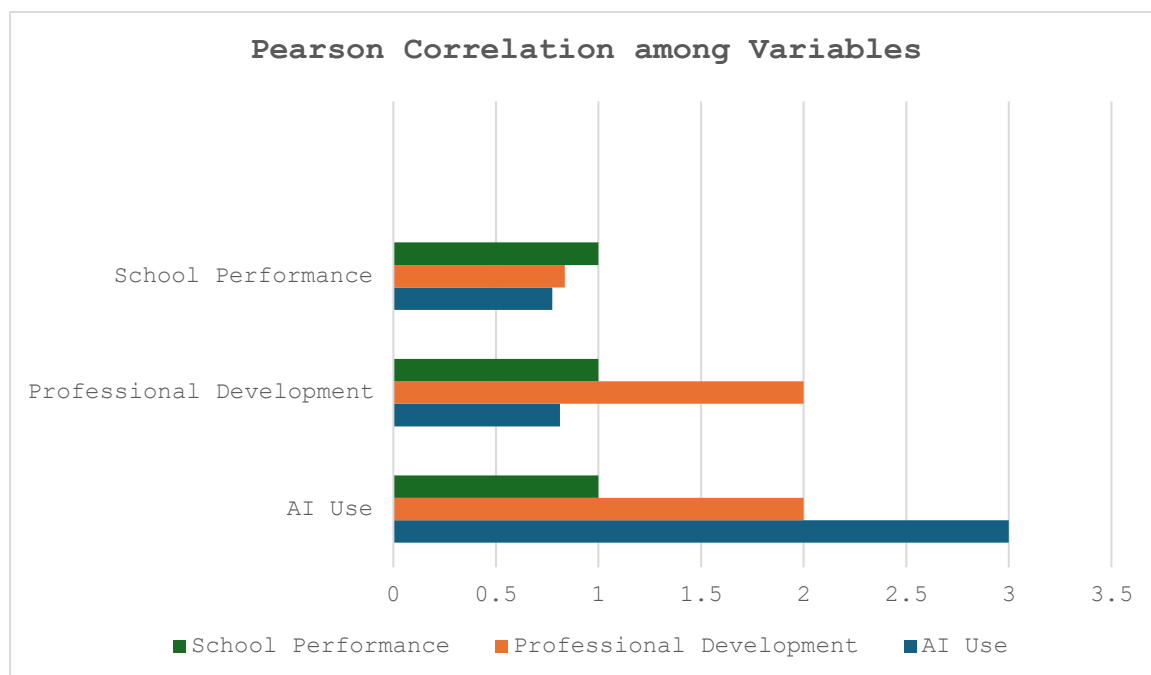
Table 4.3 Level of School Performance

Dimension	Mean	SD
Teaching Effectiveness	4.32	0.56
Student Achievement	4.23	0.63
School Innovation	4.24	0.59
Organizational Effectiveness	4.16	0.61
Collaborative Culture	4.36	0.56
Overall School Performance	4.27	0.55

School performance was rated at a high level ($M = 4.36$, $SD = 0.55$). Collaborative school culture recorded the highest mean score ($M = 4.36$), suggesting that AI-supported PLCs promoted teamwork and collaborative decision-making.

Table 4.4 Pearson Correlation among Variables

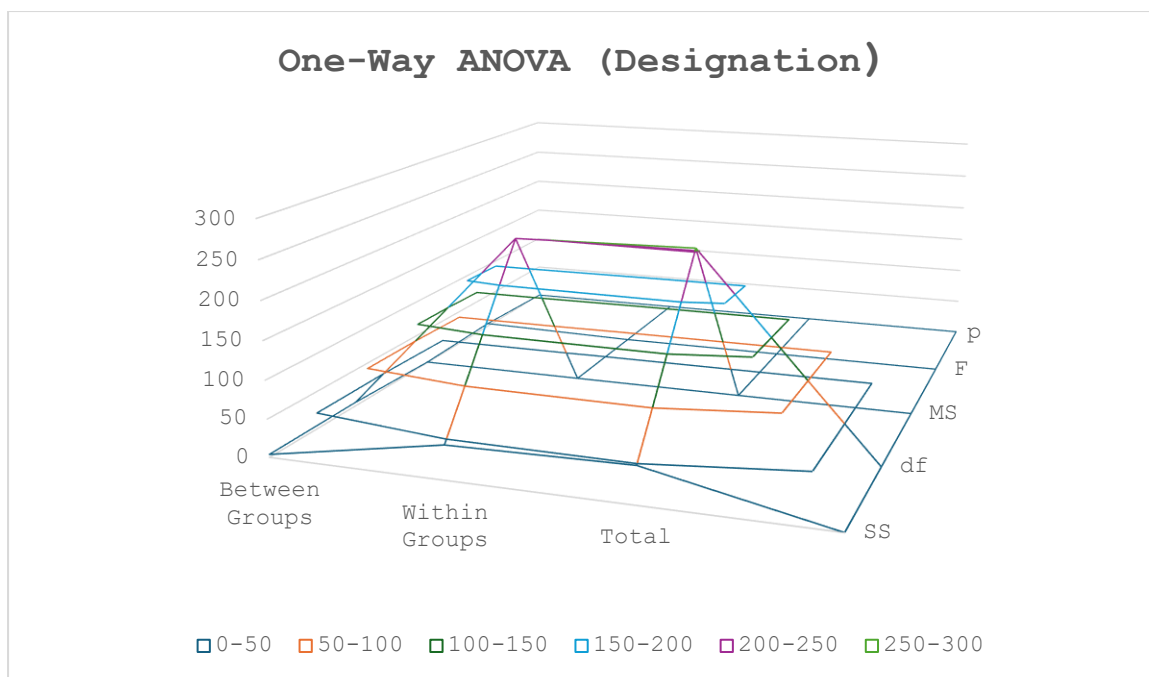
Variables	AI Use	Professional Development	School Performance
AI Use	3	2	1
Professional Development	.812	2	1
School Performance	.774	.835	1



The results indicate a strong positive relationship between AI Use and Teacher Professional Development ($r = .812$), suggesting that increased use of Artificial Intelligence in Professional Learning Communities is associated with higher levels of teachers' professional development. A strong positive correlation was found between AI Use and School Performance ($r = .774$), indicating that greater integration of AI contributes to improved teaching effectiveness, innovation, and overall institutional performance. The highest correlation was observed between Teacher Professional Development and School Performance ($r = .835$), demonstrating that teachers who experience greater professional development are more likely to contribute to enhanced school performance. All correlation coefficients are positive and high (ranging from .774 to .835), showing that the three variables move in the same direction. As AI use increases, teacher professional development and school performance also improve. Overall, the findings provide strong empirical evidence that Artificial Intelligence-supported Professional Learning Communities positively influence teacher professional development, which, in turn, is closely associated with improved school performance. These results support the proposed conceptual framework and justify further regression analysis to examine predictive relationships

Table 4.5 One-Way ANOVA (Designation)

Source	SS	df	MS	F	p
Between Groups	3.84	5	0.768	4.29	.001
Within Groups	44.58	249	0.179		
Total	48.42	254			



There was a statistically significant difference among respondents of different designations regarding AI use in Professional Learning Communities ($F = 4.29$, $p = .001$). Post hoc comparisons would identify which designation groups differed significantly.

Discussion

The findings demonstrate that faculty members reported a high level of Artificial Intelligence use within Professional Learning Communities. AI-supported knowledge sharing received the highest mean score, indicating that educators increasingly use AI technologies to exchange instructional resources, collaborate professionally, and improve teaching practices. These findings are consistent with previous studies suggesting that AI promotes collaborative learning, instructional innovation, and evidence-based decision-making among teachers.

The study further revealed a high level of teacher professional development. Digital competence emerged as the strongest dimension, suggesting that AI tools have strengthened teachers' technological capabilities, instructional planning, and continuous learning. These findings support the work of Darling-Hammond et al. (2017), who emphasized that effective professional development improves instructional quality through sustained collaborative learning. AI-supported PLCs appear to provide an environment where teachers continuously develop pedagogical and digital competencies. School performance was also found to be high, with collaborative culture achieving the highest mean score. This indicates that AI-supported Professional Learning Communities encourage teamwork, shared decision-making, innovation, and organizational learning. These findings align with the Professional Learning Community framework proposed by DuFour and Eaker (1998), which emphasizes collaboration as a key driver of school improvement. The correlation analysis revealed strong positive relationships among AI use, teacher professional development, and school performance. These results indicate that increased AI integration within PLCs is associated with improved teacher competencies and enhanced institutional effectiveness. Similarly, teacher professional development demonstrated the strongest relationship with school performance, suggesting that professionally competent teachers play a central role in improving educational outcomes. Regression analyses further confirmed that AI use significantly predicts teacher professional development and, together with professional development, explains a substantial proportion of variance in school performance. Teacher professional development emerged as the strongest predictor of school performance, indicating that investments in teachers' professional growth yield direct institutional benefits. These

findings support previous research highlighting the role of technology-supported professional learning in improving educational quality and organizational effectiveness. Finally, the ANOVA results showed statistically significant differences among respondents of different designations regarding AI use in Professional Learning Communities. This finding suggests that institutional roles influence perceptions and utilization of AI technologies, emphasizing the importance of designing differentiated professional development programs according to faculty responsibilities and experience levels.

Conclusion

The study concludes that Artificial Intelligence has become an effective catalyst for strengthening Teacher Professional Development through Professional Learning Communities. AI-supported collaborative learning enables teachers to enhance digital competence, instructional planning, professional reflection, and continuous learning. The findings demonstrate that greater AI integration contributes significantly to improved teacher professional development, which subsequently enhances school and university performance. Furthermore, Professional Learning Communities provide an effective platform for integrating AI into collaborative professional practice by promoting knowledge sharing, reflective dialogue, and evidence-based instructional improvement. Despite challenges related to AI literacy, institutional readiness, ethical concerns, and technological infrastructure, the benefits of AI-supported professional development substantially outweigh the associated constraints. Overall, the study provides empirical evidence that successful AI integration within Professional Learning Communities can strengthen educational innovation, improve teaching effectiveness, and contribute to sustainable institutional performance in higher education.

Recommendations

Based on the findings, the following recommendations are proposed:

Universities should establish comprehensive AI-based Professional Learning Community programs to strengthen teachers' continuous professional development. Institutional leaders should provide regular training workshops on emerging AI technologies, including ChatGPT, Microsoft Copilot, Google Gemini, and learning analytics tools. The Higher Education Commission (HEC) should develop national policies and guidelines for the ethical and responsible use of AI in teacher professional development. Universities should invest in digital infrastructure, high-speed internet, cloud-based learning systems, and AI-supported educational technologies. Professional Learning Communities should integrate AI-assisted lesson planning, assessment, reflective practice, and collaborative knowledge-sharing activities. Teacher education programs should include AI literacy, digital competence, and ethical AI use as essential components of professional preparation.

References

- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.
- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
- Desimone, L. M., & Garet, M. S. (2015). Best practices in teachers' professional development. *Psychology, Society, & Education*, 7(3), 252–263.
- Desimone, L. M., & Garet, M. S. (2015). Best practices in teachers' professional development. *Psychology, Society, & Education*, 7(3), 252–263.

- DuFour, R., & Eaker, R. (1998). *Professional learning communities at work*. Solution Tree Press.
- DuFour, R., & Eaker, R. (1998). *Professional learning communities at work*. Solution Tree Press.
- Fullan, M. (2020). *Leading in a culture of change* (2nd ed.). Jossey-Bass.
- Fullan, M. (2020). *Leading in a culture of change* (2nd ed.). Jossey-Bass.
- Holmes, W., Bialik, M., & Fadel, C. (2022). *Artificial intelligence in education*. Center for Curriculum Redesign.
- Holmes, W., Bialik, M., & Fadel, C. (2022). *Artificial intelligence in education*. Center for Curriculum Redesign.
- Hord, S. M. (2004). *Professional learning communities: An overview*. Southwest Educational Development Laboratory.
- Hord, S. M. (2004). *Professional learning communities: An overview*. Southwest Educational Development Laboratory.
- Kasneci, E., Sessler, K., Küchemann, S., et al. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103*, 102274.
- Kasneci, E., Sessler, K., Küchemann, S., et al. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103*, 102274.
- Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson.
- Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). AI literacy: Definition, teaching, evaluation and ethical issues. *Computers and Education: Artificial Intelligence, 2*, 100041.
- Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). AI literacy: Definition, teaching, evaluation and ethical issues. *Computers and Education: Artificial Intelligence, 2*, 100041.
- Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
- Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
- Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change, 7*(4), 221–258.
- Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change, 7*(4), 221–258.
- Trust, T., Whalen, J., & Mouza, C. (2023). Generative AI and teacher professional learning. *Educational Technology Research and Development, 71*(5), 1–10.
- Trust, T., Whalen, J., & Mouza, C. (2023). Generative AI and teacher professional learning. *Educational Technology Research and Development, 71*(5), 1–10.
- UNESCO. (2021). *Recommendation on the ethics of artificial intelligence*. UNESCO.
- UNESCO. (2021). *Recommendation on the ethics of artificial intelligence*. UNESCO.
- 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.
- 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.
- Zhao, Y., & Watterston, J. (2021). The changes we need: Education post COVID-19. *Journal of Educational Change, 22*(1), 3–12.
- Zhao, Y., & Watterston, J. (2021). The changes we need: Education post COVID-19. *Journal of Educational Change, 22*(1), 3–12.