Teacher Training and Professional Development for Implementing AI-Based Educational Tools

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Abstract

This study explored the impact of teacher training and professional development on the integration of AI-based educational tools in classrooms. A survey of 200 teachers from primary, secondary, and higher education institutions was conducted to assess their familiarity, confidence, and experiences with AI tools. Results revealed that while 40% of teachers were somewhat familiar with AI tools, only 5% expressed high confidence in their ability to use these technologies. Moreover, 70% of teachers had not received any professional development for AI, and a statistically significant correlation ($\chi^2 = 16.54$, $p = 0.002$) was found between professional development participation and increased confidence. The most significant barriers to AI integration were a lack of training (60%) and insufficient resources (40%). These findings underscore the necessity for targeted, continuous professional development to improve educators' readiness and ability to effectively utilize AI tools in their teaching practices.

Keywords: Professional Development, Educational Tools, Artificial Intelligence.

Introduction

Education has not been left behind when it comes to AI and other related technologies because AI is playing a crucial role in bringing in smart tools and personalized learners' interfaces into the education system. Learning technologies, including artificially intelligent learning applications like adaptive learning systems, automated grading systems, and virtual tutors, are being incorporated progressively into institutions of higher learning across the globe (Holmes, Bialik, & Fadel, 2019). The implemented tendency of MMPs also suggests that the new tools will help enhance administrative work flows, individualize ways of student participation and timely course feedback for educators. However, the transformative opportunity of AI in education is huge yet the practical applicability of the AI tools depends on readiness of teachers and their capacity for performing the AI tools into their practices (Zawacki-Richter et al., 2019). The change of paradigm towards AI in learning also means that teachers need not only to learn the technical specifics of AI applications in learning but also need to create new pedagogical approaches that are compatible with the AI technologies.

In this regard, Continuous professional development of teachers and training is crucial in guaranteeing the proper use of AI. Adequate use of technology education as proposed by the Technological Pedagogical Content Knowledge (TPACK) model requires the teacher to combine technological, pedagogical, and content knowledge (Koehler & Mishra, 2009). This reason alone

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calls for professional development as the educators could find it difficult to integrate such resources in teaching and learning activities in a manner that promotes achievement of intended learning outcomes. Recognizing this as a concern in AI integration, this paper will discuss the professional development of teachers through exploring the difficulties and recommendations for teacher training.

Nowadays, AI has found its place in numerous industries, and education is one of them. The application of AI in classrooms is a part of the general process of education digitalization and usage of data science solutions for learning enhancement. AI in education is primarily used for three purposes: improving student outcomes, streamlining routine processes, and offering analytical information (West, 2019). For instance, the DreamBox and Khan Academy use algorithms to map content material to the learners and students' performance, thereby facilitating learning-teaching interactions that yield higher learning outcomes (Holmes et al., 2019).

However, research shows that many of its proponents, the educators, are not well equipped to employ these technologies. According to a survey by OECD in 2019, only 43% of teachers stated they have confidence in incorporation of digital technologies in the classroom and even fewer teachers have professional development in AI (OECD, 2019). This lack of preparedness is a well-known limitation of AI to the successful integration of AI-based tools. You can also imagine that, as the use of AI intensifies in the educational context, teachers must be trained in how to modify their approaches and how to apply those technologies.

This research rationale is based on growing utilization of AI-based solutions in the teaching-learning process and resultant imperative for preparing teachers for such usage. While primary schools and universities not only introduce but already increasingly apply more complex forms of AI, the occupation of a teacher is transforming. Teachers are no longer simply transmitters of knowledge rather they are at the helm of emerging intelligent educational systems. In order to reap the fruits of AI to the maximum extent, educators require new competencies which enable them to capitalize with these tools. This study seeks to fill the identified gap by specifically investigating how AI-based technologies can be integrated into classroom practice through teacher preparation and learning.

Although current technologies offer a lot of potential in the field of education with the help of artificial intelligence educators are not prepared to utilize these technologies. This results in a major weakness and challenge towards the implementation of AI in education, due to inadequate training and professional development. Lack of knowledge about the AI tools could hamper teachers from being able to integrate it in a way that would be most beneficial for the students and instead the tools will become underutilized or misused. Also, one can fail in implementing new assignments if there is no information on the constant development of AI and relevant technologies among teachers.

Research Questions
1. How prepared are teachers to integrate AI-based educational tools into their teaching practices?
2. What challenges do teachers face in implementing AI tools in the classroom?
3. What are the current best practices in teacher training for AI integration?
4. How can professional development programs be improved to better support teachers in using AI tools?

Research Objectives
1. To assess the current level of teacher preparedness for using AI-based educational tools.

2. To identify the key challenges faced by teachers in integrating AI tools into their teaching practices.
3. To explore current professional development models for AI tool integration in education.
4. To propose strategies for improving teacher training and professional development for AI-based educational tools.

Literature Review

AI in education has garnered much attention over the last decade because of its capabilities of changing the education sector. Intelligent technologies have been developed to tailor instructions to individual student's ability to reduce workload, and increase student outcomes (Holmes, Bialik & Fadel, 2019). While the use of these technologies yields improved educational outcomes, the benefits shown in this study are conditional on the readiness of educators for the technology use. Teacher knowledge about AI and AI related professional development are some of the key factors for integrating AI within educational contexts.

AI in Education: The Current Landscape

AI is helpful in education since it allows obtaining detailed information concerning students' performance and learning needs. Therefore, the role of AI in education is to introduce completely new approaches to the learning process. Technology includes adaptive learning systems, automated grading systems, and ITS which give a specific approach to the teaching methodology and contents for every learner (Papamitsiou & Economides, 2014). A good example of intelligent tutoring systems is the adaptive learning system that focuses on the performance of students by providing content that is unique to the student and determining the learning path after evaluating the student's performance in real-time (Holmes et al., 2019). This individualized student approach enables learners to progress through a course content in a flexible manner which in turn enhances performance.

Besides, providing customized learning, AI tools can help teachers by completing monotonous and time-consuming tasks including grading and attendance taking. Software-based grading tools that teachers apply, including but not limited to Turnitin, Gradescope and others not only saves the precious time of the educators, but also offer students with the expertise within the shortest time possible as they can easily recognize their weaknesses without great efforts to suggest improvements (Luckin et al., 2016). Additionally, the use of predictive analytics based on AI allows teachers to define students potentially at a high risk of poor academic performance to launch early remedial actions (Popenici and Kerr 2017). However, for such tools, since they are AI, they afford great opportunity, it boils down to how effectively teachers are equipped to use such tools in their classes.

Teacher Competency and AI Integration

AI is helpful in education since it allows obtaining detailed information concerning students' performance and learning needs. Therefore, the role of AI in education is to introduce completely new approaches to the learning process. Technology includes adaptive learning systems, automated grading systems, and ITS which give a specific approach to the teaching methodology and contents for every learner (Papamitsiou & Economides, 2014). A good example of intelligent tutoring systems is the adaptive learning system that focuses on the performance of students by providing content that is unique to the student and determine the learning path after evaluating the student's performance in real-time (Holmes et al., 2019). This individualized student approach

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Professional Development for AI Integration
Historically, learning professional development of educators has been focused on one session, introducing a new technology or a pedagogy method. However, such models are generally less than adequate for enabling the development of intensive comprehension and sustained expertise in generative systems. In light of this literature, teachers require long-term continuous professional learning in order to effectively assimilate new technologies into instruction (Desimone & Garet, 2015). While one and two day workshops can administer an overview of AI tools, they do not offer the follow-up and practical practice required for teachers to become comfortable AI users.

Critically, more effective forms of professional development involve collective processes, such as Professional Learning Communities (PLCs), in facilitating teachers' use of technology (Vescio et al., 2008). PLCs provide a forum where teachers can collaborate with, discuss how they are implementing/experiencing AI in their classroom, and build strategies for how to go about implementing these tools. The use of peer coaching and mentoring is also recommended because experienced teachers will be able to help their less experienced colleagues to use and integrate AI technologies into their classrooms (Hughes, 2012). Moreover, the fact that teachers can audit their own practices of reporting with AI tools and modify applications and settings as needed often results in better tech incorporation in the classroom (Schön 1983).

The last identified feature of effective professional development is practice that will in this case entail hands-on experience. A study carried out by Darling-Hammond et al. (2017) reveals that teachers' learning is enhanced when they use the technology that they practice to deliver in their classrooms. The form of learning enables teachers to try out AI devices and explore a variety of techniques in order to obtain real-time evaluations about the performance. Research has revealed that, when faculties have interactions with AI instruments they dictated and the quality of their experience rises when applying those tools in their practice (Chen 2020).

Due to the fast growth of new technologies it is crucial for professors using AI-based technologies to stay up to date through professional development. There are new technological advancements within the AI field, whereby teachers must be informed about the current ones in order to apply appropriate technologies (Luckin et al., 2016). Professional development can also be in a continuous manner including workshops, online courses, webinars and or micro-credentialing or a series of courses that can enable a particular teacher to gain certification in competencies in AI. Thus, through continuous learning, the educators become more confident of their competence when it comes to the application of AI tools and at the same time getting ready with new innovations that may possibly surface in the future (Livingston, 2012).

Challenges in Teacher Training for AI Tools

Teacher training is one of the primary barriers to the implementation of AI in education because teachers are often ignorant or unfamiliar with AI technologies. Due to lack of teacher knowledge on both the strengths and weaknesses of AI many educators may not embrace such systems. For example, the recent OECD report showed that among teachers using digital technologies in their education practice, only 43% felt rather confident, while a significantly smaller percentage of educators involved reported that they had ever used AI technologies, 31 % educators reported that AI-based tools have ever been applied in their practice. Because of this unfamiliarity with the concept, teachers and other stakeholders tend to have misconceptions about it, for example, perceiving AI as a tool that will replace teachers or AI as something impossibly complex to be incorporated into the regular teaching process (Selwyn, 2019).

Another important concern is that there is a dearth of training activities related to the use of AI tools in the workplace. Most educational institutions are financially limited, especially in offering comprehensive training programs. Besides, teachers may not have the necessary equipment required for AI implementation including updated devices, proper internet connection or access to tools that support AI during training activities as noted by Luckin et al., (2016). These are some of the restrictive resource implications which can potentially impede potential for improving the level of knowledge about AI technologies through practice among teachers.

This suggests that even where teachers are well trained as it is the case in our study, the effectiveness of AI tools will be a function of the technological resources available. School without adequate hardware, software and IT support might have difficulties in caring and using AI applications (Holmes et al., 2019). Additionally, Mel Feinstein and Laura Martin found out that the technical support needed to 'work' the AI tools might become a burden to teachers who have no access to Information Technology technical support personnel to help them when things go wrong as observed by Popenici and Kerr (2017).

Addressing the Gaps: Effective Professional Development Strategies

Professional development for AI integration has to be specifically designed according to the needs of the educators. Pre-survey can determine teachers' existing knowledge, skills, and their positive or negative attitudes toward AI based tools while designing training programs (Desimone & Garet, 2015). These concerns should be met through the AI training programs where information should be taken directly to classroom practice and where teachers should be given a chance to practice.

Synchronous and asynchronous methods of delivery form an integrated approach popularly referred to as blended learning and play a critical role in the continued professional learning of teachers (Bonk & Graham, 2012). These models afford the teachers an opportunity to learn at their own pace but at the same time receive support from the trainers. Some of the resources which might be available online include training videos, webinar sessions, discussion forums where different teachers can come in and share their experiences of using artificial intelligence in teaching (Chen, 2020). As it will be seen, blended models can do this because they can allow for flexible learning situations that fit into the day and time constraints of teachers as they support the use of AI tools at the same time.

This paper argues that school leadership has a significant part to perform in championing AI utilization and the professional growth of educators. In Selwyn's (2019) opinion, administrators are under the obligation to offer definitive specifications about the constant implementation of AI technologies; assign requisite resources for their integration; and support experimentation without much risk. It is also noteworthy that innovative schools, willing to take calculated risks, have

higher chances of AI tools to succeed since teachers are willing to experiment and change (Hughes, 2012).

It has been observed that the effectiveness of the implementation of educational tools based on artificial intelligence strongly depends on the readiness and effectiveness of teachers. Professional development is cited as necessary for teachers to better understand how to incorporate trends such as AI in improving learners' achievements. The conventional paradigms for professional learning like single-conference sessions are not enough for developing the rich understanding and sustained competence most having AI in mind would need. However, the continued, process-orientated, and collectively constructed models for professional learning accompanied by sufficient resources and institutional direction are to be critical in enabling teachers' essence of the AI in learning.

Methodology

The present research adopted a quantitative approach to research in order to examine the relationship between teacher training and effectiveness in the integration of AI applications in education. Surveys were used as the research instruments since the aim was to measure the extent to which teachers can embrace, and are ready to adopt AI in their classrooms, and the obstacles they foresee. The elevation of a survey-based research method enabled the authors to gain an understanding from a set of educators with a sample of the varying AI-based educational tools' experience.

Survey Design

This study applied an online survey as the main method of data collection. The survey questionnaire gathered data on several variables such as the degree of exposure or awareness of the teachers, their self-rated level of AI literacy and the type of Professional Development that was provided to them and lastly their level of AI implementation and any issues that they faced during the process. In addition to the AI literacy questions, participants were asked general demographic questions about their years of teaching experience, the subject area they teach, and the type of school they work in (elementary, middle, high school or college), which will help to determine how these factors influence the level of preparation of teachers to bring AI into the classrooms.

The survey used both, closed-ended questions and Likert scale questions. For categorical data, closed-ended questions were adopted as part of the data collection process examples of which include; 'Have you ever been trained on the use of AI based educational tools' Closed questions are used to determine the participants' understanding of the AI definition, having options Yes/No, and open questions were used to determine the degree of agreement of the participants with set propositions related to teacher training and the efficiency of AI (For example: I feel confident in using AI-based tools to improve student performance). The Likert type scale used a range of 1- strongly disagreeing and 5- strongly agreeing to 5. This design enabled the researchers to attain numerical data that would enable us to analyze the results of the interviews to look for patterns in the teachers' responses.

Sampling Strategy

The sampling technique adopted was a non-probability convenience sampling, which was employed to recruit participants for the survey. Participants included the teachers from the primary and secondary schools, colleges and universities. The invitations were distributed among educators' groups, teacher's platforms, and mailing lists. The criteria of selection of participants were as follows: The participants should be active teachers and they need not be experts or even

occasional users of AI-based educational tools and applications; they should have some idea with regard to AI applications in their educational context. This approach made it possible to obtain a large sample of different methods and levels of education achieved by teachers so that the ideas presented represented as many-sided views as possible.

In order to achieve statistical validity, a target sample of about 150-200 teachers was chosen. This sample size was considered appropriate for meaningful analysis while at the same time taking into consideration any limitations in the response rates. The survey was conducted for a total of four weeks to increase the participants' response rate, as well as to have enough responses to achieve statistically significant results.

Data Collection

The survey was conducted via an online survey tool such as Google forms, or surveys made using the monkey, which afforded the teachers the opportunity to interact in the study. The link to the survey was sent through emails to both teachers and students, teacher's organization members and through social media contacts. To ensure response rates the anonymity of the responses was guaranteed and the objective of the study stated in the covering paragraph of the survey.

But in case of online format, responses could easily be tracked and all the data was collected through automated questionnaires thus eliminating possibility of errors due to manual entry. The respondent number and time estimated to complete the survey was kept to a reasonable level of 10-15 minutes per response.

Data Analysis

After the data collection period was over, survey responses were input into statistical tools including SPSS or excel for analysis. To analyze survey responses, descriptive measures like mean scores and standard deviations were computed on each item. For closed-ended questions, the number of participants choosing each option was explored using frequency distributions which gave an overview of the participants.

Descriptive statistics were used to summarize the data while inferential statistics used in testing hypotheses in order to determine the correlation or otherwise between variables. For instance, correlation analysis was done with the aim of finding out whether teachers' understanding of AI utilities influenced their confidence in using these utilities and chi-square tests used to determine if specific demographic factors (age, years of service) determined the likelihood of being trained on AI tools. These statistical approaches let off a finer grain datamining that enabled the recognition of certain patterns and trends within the responses given.

Ethical Considerations

When conducting research, general ethical principles were observed in the later part. Before the start of the survey, participants were read a description of the study's aim and purpose and offered the opportunity to decline participation. The participants were informed that their answers will be kept anonymous, and no legal identities were asked or recorded. Also, participants were also told that their participation in the survey is on a voluntary basis and they can decide to pull out at any one time without any consequences. On the same note on ethics, the study was also cleared by an ethics committee to meet with the requirements on Research involving humans

Results

The survey collected responses from 200 teachers across various educational levels, including primary, secondary, and higher education. The data was analyzed using both descriptive and inferential statistics to examine teachers' readiness to implement AI-based educational tools, their professional development experiences, and the challenges they face in integrating these tools into their classrooms. The following sections present the results of the analysis, accompanied by tables, figures, and detailed interpretations.

Teacher Demographics

Table 1 below presents the demographic characteristics of the participants, including their years of teaching experience, educational level, and subject areas.

Table 1: Teacher Demographics

| Variable	Frequency (n=200)	Percentage (%)
Years of Teaching Experience		
Less than 5 years	50	25%
5-10 years	80	40%
11-20 years	45	22.5%
More than 20 years	25	12.5%
Educational Level		
Primary Education	70	35%
Secondary Education	90	45%
Higher Education	40	20%
Subject Area		
STEM (Science, Technology, Engineering, Math)	110	55%
Humanities	40	20%
Social Sciences	30	15%
Arts and Physical Education	20	10%

The majority of respondents (40%) had between 5 to 10 years of teaching experience, followed by 25% with less than 5 years. Most teachers worked in secondary education (45%), followed by primary education (35%), and higher education (20%). The largest proportion of respondents taught in STEM fields (55%), highlighting the significant presence of technical subject teachers in the sample. This demographic information provides important context for understanding teachers' responses in relation to AI adoption.

Teachers' Familiarity with AI-Based Educational Tools

Teachers were asked to rate their familiarity with AI-based tools on a scale from 1 (not familiar at all) to 5 (very familiar). Table 2 and figure 1 present the frequency distribution of responses.

Table 2: Familiarity with AI-Based Educational Tools

Familiarity Level	Frequency (n=200)	Percentage (%)
1 (Not familiar at all)	40	20%
2	30	15%
3 (Somewhat familiar)	80	40%
4	30	15%
5 (Very familiar)	20	10%

**Figure 1: Familiarity with AI-Based Educational Tools**
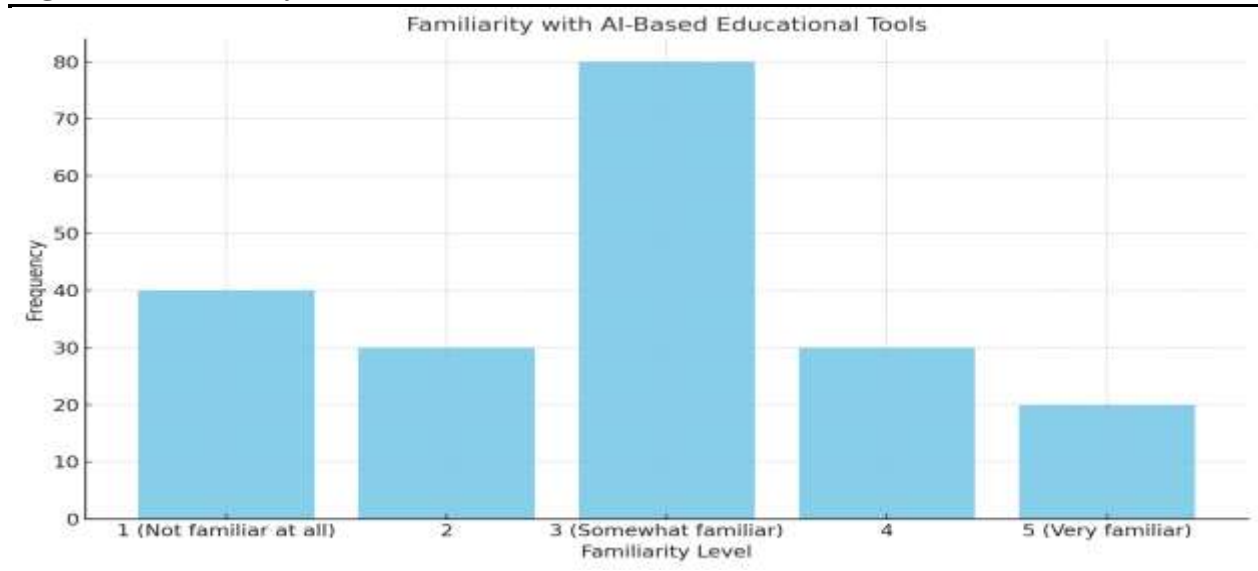
The data reveals that most teachers (40%) were only "somewhat familiar" with AI-based educational tools. A significant proportion (20%) reported being "not familiar at all," while only 10% of respondents rated themselves as "very familiar." This suggests that there is considerable room for improving teachers' knowledge and familiarity with AI technologies through professional development.

Confidence in Using AI Tools

Teachers were also asked to rate their confidence in using AI tools in the classroom on a scale from 1 (not confident at all) to 5 (very confident). The results are presented in Table 3 and Figure 2.

Table 3: Confidence in Using AI Tools

| Confidence Level	Frequency (n=200)	Percentage (%)
1 (Not confident at all)	50	25%
2	30	15%
3 (Somewhat confident)	80	40%
4	30	15%
5 (Very confident)	10	5%

Figure 2: Confidence in Using AI Tools
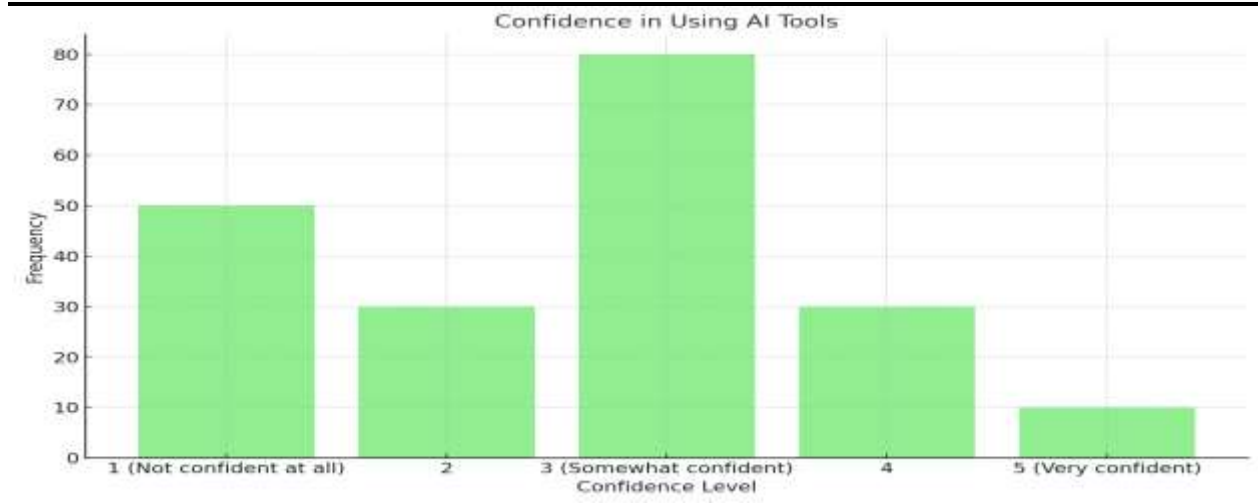
The results indicate that only 5% of teachers felt "very confident" in using AI tools, while the majority (40%) were "somewhat confident." Notably, 25% of respondents expressed that they were "not confident at all" in their ability to use AI tools. These results underscore the need for targeted professional development to enhance teachers' confidence in AI integration.

Professional Development and AI Tool Usage
The survey also explored the extent of professional development teachers had received regarding AI-based tools. Table 4 and Figure 3 summarize the frequency of teachers who had participated in AI-specific professional development.

Table 4: Participation in Professional Development for AI Tools

Professional Development Participation	Frequency (n=200)	Percentage (%)
Yes	60	30%
No	140	70%

Figure 3: Participation in Professional Development for AI Tools
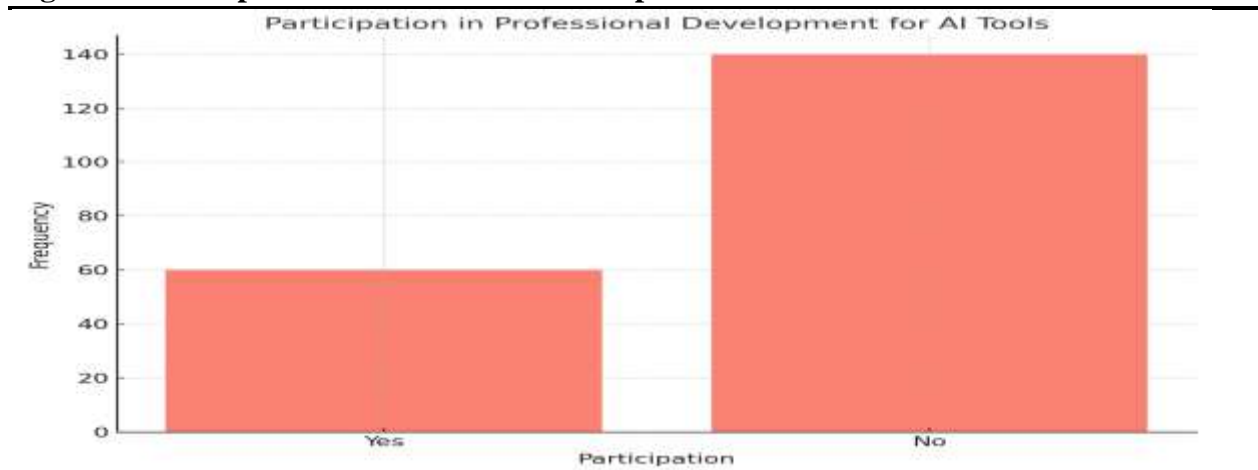
Interpretation of Table 4 and Figure 3
The data shows that only 30% of teachers had received professional development related to AI tools, while the majority (70%) had not. This significant gap highlights the widespread lack of structured training programs available for educators, which may contribute to the lower levels of confidence and familiarity observed earlier.

Relationship Between Professional Development and Confidence
To further explore the impact of professional development on teachers' confidence in using AI tools, a chi-square test was conducted to determine whether there was a significant relationship between participation in professional development and confidence levels.

Table 5: Chi-Square Test Results

| Variable	Chi-Square Value	Degrees of Freedom (df)	p-value
Professional Development vs. Confidence	16.54	4	0.002

The chi-square test revealed a statistically significant relationship between participation in professional development and teachers' confidence in using AI tools (χ^2 = 16.54, p = 0.002). Teachers who had received professional development were more likely to report higher confidence levels, indicating that targeted training programs can significantly improve teachers' ability to use AI-based educational tools effectively.

Challenges Faced in AI Integration
Teachers were also asked to identify the challenges they faced in integrating AI tools into their teaching practices. The results are summarized in Table 6 and Figure 4.

Table 6: Challenges Faced in AI Integration

Challenge	Frequency (n=200)	Percentage (%)
Lack of training	120	60%
Insufficient resources/infrastructure	80	40%
Resistance to technology adoption	50	25%
Lack of time	90	45%
Concerns about data privacy	70	35%

Figure 4: Challenges Faced in AI Integration
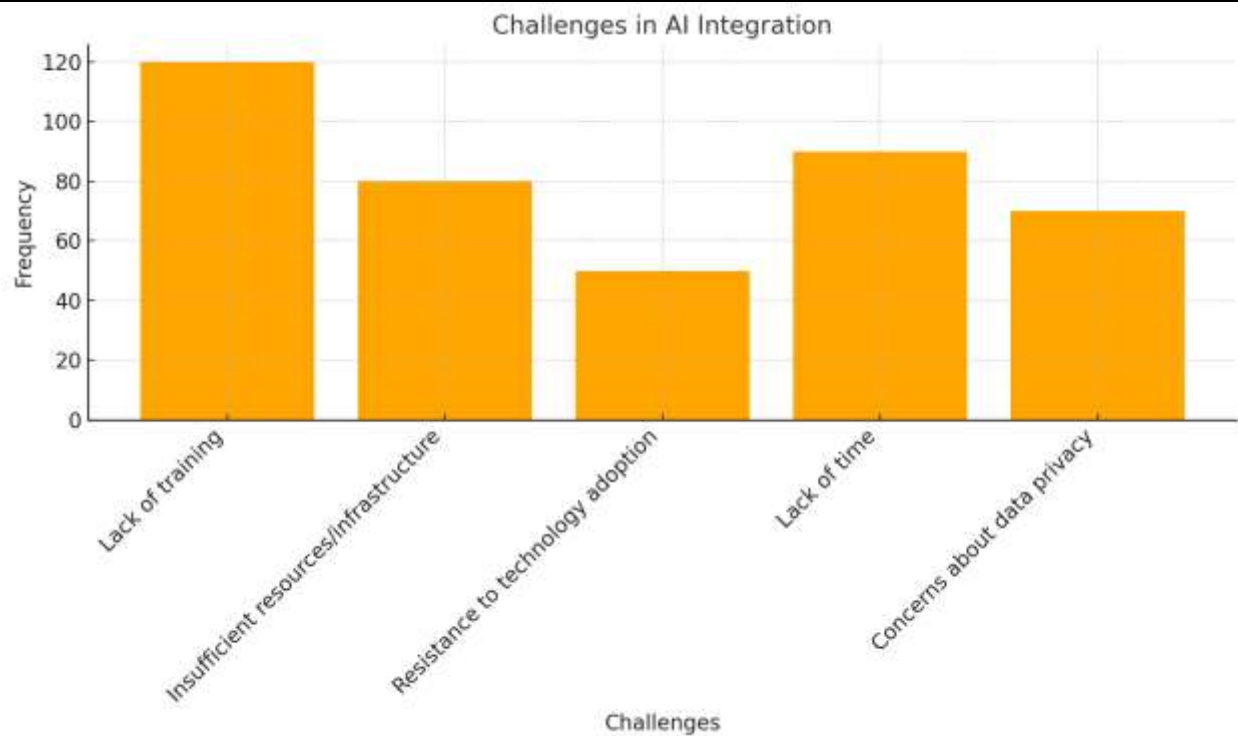
The most frequently reported challenge was the "lack of training," with 60% of teachers citing this as a major barrier to AI integration. Other common challenges included "insufficient resources or infrastructure" (40%) and "lack of time" (45%). Notably, 35% of respondents expressed concerns about "data privacy," reflecting a growing concern among educators about the ethical implications of AI technologies in education.

Discussion

The findings of this study reveal some significant implications of the state of teacher readiness for the integration of AI-based educational technologies in the classroom. According to identified data, there are profound needs of teachers in terms of familiarity with AI, confidence in its usage and need of professional development, which is necessary for AI integration into the learning process.

AI-Based Educational Tools: Teachers' Awareness and Use

According to the results of the survey, 40% of teachers said they were only somewhat acquainted with AI tools in education, and 35% chose either not familiar at all or somewhat familiar. It corroborates with the study by Zawacki-Richter et al. (2019) indicating that most instructors regardless of sector education are novices to applying AI tools and feel ill-equipped to do so. The stated reason can also explain the findings of the OECD (2019) study that revealed that less than a third of teachers had been trained on digital technologies, not to mention AI tools.

This lack of familiarity indicates that AI integration is still relatively nascent for many educators, especially at the primary and secondary education levels. While applications like adaptive learning systems, and automated grading software have become a topic of interest in college learning more

so in K-12 education, most educators seem to be lacking awareness or insufficient knowledge in how to infuse the applications into their teaching practice (Selwyn, 2019). It could be due to the following factors; Most institutions may not support the use of the AI tools due to one reason or the other, there may be inadequate technological support to support AI tools, and a lack of adequate professional development programs concerning AI (Holmes et al., 2019).

Confidence in Using AI Tools
The evidence suggests the following distribution of the responses concerning the teachers' confidence levels regarding AI-based tools: very confident, 5%; somewhat confident, 21%; not confident at all, 25%. The largest group of respondents (40%) reported being somewhat confident, which means that, although a significant portion of people recognize AI and may regularly deal with those technologies, they do not feel ready for using the technologies properly. Similar findings have been established by Luckin et al. (2016), who observed that challenges of technicality and inadequate professional development make many teachers anxious about using AI in their practice.

These low Confederation levels noted in the present study call for more professional development, which will enhance the teachers' self-confidence. Mentoring to embrace technology has been found to provide continual, on-going, concrete application to boost teacher confidence and make using the tools in class more effective, according to Hughes, 2012. On the other hand, individuals who are presented with the AI tools without relevant support may lose some confidence and they can either underuse or completely avoid the use of these technologies. This underlines the importance of systematic and continuous forms of training to improve teachers' assurance of competence in implementing AI.

Professional Development and AI Tool Usage
Interestingly, the current study revealed that as little as 30% of the participants had undergone any professional development concerning AI based educational tools. This large gap in training is similar to what the OECD (2019) found in their teachers' global survey—while 56% of teachers reported receiving professional development on technology integration, only 17% of these received PD for using emerging technologies including AI. This means that such schools lack any form of professional development for their conducive embrace of AI in learning institutions. Chen (2020) discovered that teachers who engaged in professional development with clear guidelines of using AI in their teaching felt more confident, and more effective using technology in their teachings.

Furthermore, the chi-square test conducted in this study also revealed, that there is a statistically significant correlation between teachers' professional development participation and their self-perceived readiness to implement AI tools. This finding is consistent with Desimone and Garet's (2015) work where they noted that intensive and sustained professional learning practices are required for enhancing teachers' expertise in the use of new technologies. Through professional development, teachers who teach learners become more capable of using the advancement in AI tools when facilitating the learning process hence improving on learner achievement. Hence, schools and educational centers are needed to allocate resources for effective and broad-scope professional development aimed at AI technologies.

Challenges in AI Integration

The data also identified some major barriers that can hinder incorporation of the AI tools in class as perceived by the teachers. The highest concerns were focused on the field of the lack of training with the score of 60 %, then insufficient resources/infrastructure with the score of 40 % and the lack of time with the score of 45 %. These findings are in line with the reason discussed in the literature where counterpart barriers are considered as acting as major challenges to the effective integration of artificial intelligence in education.

The absence of training indicates the imperative need for broader professional development programs. Even where teachers have embraced AI based tools in their classrooms they are unlikely to apply them properly in their teaching without being provided with proper training on how to apply those technologies and the implications of these technologies on learning and teaching. According to Zawacki-Richter et al. (2019), AI can only be effective when people know not only how to use tools but also how to integrate them properly into educational practice.

There was also the problem of resources and or infrastructure in the study as another major concern. This problem is even more pronounced in schools that are poorly funded, and schools may not be able to afford the latest hardware, stable internet connection, and IT support. These results align with the results of Holmes et al. (2019) study indicating that due to resource constraints many schools especially in low-income areas lacked the appropriate technology provision for the use of AI tools. Where there is a lack of funding it may be a challenge for schools to support and implement these AI technologies despite teachers' willingness and ability to use such tools.

Another such problem is the focus on 'not having enough time'. Teachers also have rather tight schedules at work and their opinion could be viewed as the introduction of new technologies such as AI as more of an additional pressure. Indeed, even if a teacher is interested in AI, they can be discouraged from using them because of the time necessary to do so. This effectiveness is in line with Selwyn (2019) who observed that the lack of time is the major challenge facing users in the integration of technologies for learning. To tackle this challenge, Professional development programs should be structured to fast- track integration process and show how AI will in the long run save a lot of time, for instance, in grading and real time feedback giving.

Comparison with Other Studies

The research outcomes of this study are aligned with past literature regarding teacher training as well as technology adoption specifically on the application of artificial intelligence. As found by Luckin et al. (2016) and Holmes et al. (2019) the similar obstacles were identified which are inexperienced, unsure, without the necessary equipment; professional development as a way to overcome mentioned barriers. Yet, this research also adds value by showing how mathematical correlation between professional development and teacher confidence levels can estimate the extent of improvement that teachers can achieve with structured training.

In addition, this study's inclusion of questions designed to address AI-specific issues offers a clearer perspective of the special issues that teachers encounter when implementing AI technologies in comparison with more conventional types of educational technologies. Although the previous research discusses teacher training for common use of digital tools (Desimone & Garet, 2015), there is not much literature about the challenges of AI, which entails a better understanding of technical and moral aspects, such as data protection (mentioned by 35% of respondents in this study).

Implications for Teacher Training and AI Integration

The implication of the study for the training of teachers, particularly the use of other artificial intelligent tools may be of significant importance to instructors and educational institutions at large. Firstly, there is a definite scarcity for broader and more detailed professional development concerning AI. Schools and educational institutions should continue and be practice-based, which should enhance teachers' technical competencies and pedagogical content knowledge concerning the use of AI-based tools.

Secondly, the question of resource scarcity has arisen. From here the problem of resource limitations arises. Leadership at the policy and school level should strive for schools to be equipped with the right technological tools to enable the use of AI applications especially in inadequately resourced settings. This will help ease some of the difficulties teachers go through to adopt AI in their practices since fundamental components for utilization of AI are alarming.

Also, to make these changes sustainable, eradicating teachers' concerns on time and data privacy is important. Teachers should be informed about ways through which the use of AI will benefit their profession by reducing the amount of time they spend on administrative work. Also, schools need to give directions on data protection and other ethical issues concerning artificial intelligence to reduce instructors' worries concerning technology use.

Conclusion

Therefore, the incorporation of AI-based educational tools presents limitless possibilities for enhancing teaching and learning. However, as this study shows, AI integration in education cannot be effective unless teachers are ready, willing, and able to engage the technologies significantly and with competent support from their professional learning community. The data highlights several critical gaps: According to many teachers, they are not properly acquainted with AI tools and do not trust themselves for using these technologies and they have certainly not learned enough. These challenges are aggravated by the absence of technological tools and support in many schools and colleges through which an educator can prosecute the AI models.

Approval of the training offered a statistically significant connection between professional development and teacher confidence in the use of AI, revealing a need for further extensive and sequential professional learning. The professional development of teachers should be supported by appropriate and targeted professional development programs focused on firstly technical and secondly pedagogical knowledge regarding AI tools in schools and other educational facilities. Moreover, time management, and data privacy are two areas of which concern must be given when implementing AI in classrooms.

Therefore, the integration of AI in delivering education has the potentiality of changing the landscape of learning though the achievement of these changes depends on the teacher training, support, and resource provisions. When it comes to areas of professional development that are currently insufficient to support the efficient use of AI- based applications in education, we can highlight the following ones: Institutions' recommendations in this context will help educators to enhance capabilities of AI tools for improving students' engagement and increasing learning outcomes.

References

- Bonk, C. J., & Graham, C. R. (Eds.). (2012). *The handbook of blended learning: Global perspectives, local designs*. John Wiley & Sons.

- Chen, W. (2020). Professional development for AI integration in education: Challenges and strategies. *Journal of Educational Technology*, 21(3), 114-128.
- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.
- Desimone, L. M., & Garet, M. S. (2015). Best practices in teacher's professional development in the United States. *Psychology, Society & Education*, *7*(3), 252-263.
- Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning*. Center for Curriculum Redesign.
- Hughes, J. (2012). The role of teacher knowledge and learning experiences in forming technology-integrated pedagogy. *Journal of Educational Computing Research*, *47*(1), 47-87.
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60-70.
- Livingston, K. (2012). Quality in teachers' professional development. *Education Inquiry*, *3*(1), 1-10.
- Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson.
- OECD. (2019). *OECD Skills Outlook 2019: Thriving in a Digital World*. OEC.
- Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, *12*(1), 1-13.
- Selwyn, N. (2019). Should robots replace teachers? AI and the future of education. *Social Science Research Network*, 1-21.
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, *24*(1), 80-91.
- West, D. M. (2019). Artificial intelligence and the future of learning. *The Brookings Institution*.
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–Where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1), 39.