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AI and E-Learning: Enhancing Educational Sustainability in Pakistan

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ABSTRACT
AI's role in online learning is transforming the way schools operate globally, which will have a significant impact on the long-term viability of education in Pakistan. AI-powered educational technologies, such as adaptive learning systems, AI tutors, automated grading, and personalized learning paths, open up new ways to close learning gaps, engage students more actively, and optimize resource utilization in school systems with limited resources. Although AI has considerable potential, its implementation in Pakistan's schools is hindered by several specific challenges. Some of these problems include the digital gap between cities and the countryside, which is caused by teachers lacking sufficient knowledge about AI and inadequate digital infrastructure. This study employed a mixed-methods research methodology, which included quantitative data from lengthy questionnaires administered to 500 children and 100 teachers at ten different schools in Pakistan, as well as qualitative interviews with policymakers to obtain a comprehensive picture. The findings indicate that AI has led to a significant increase in student participation, retention, and academic performance. The results show that AI integration improves student engagement and learning outcomes; however, there are still major problems, including inadequate digital infrastructure, unprepared teachers, and a lack of standardized AI policies. Still, significant problems highlight the importance of improving digital infrastructure, educating teachers, and ensuring that AI education guidelines align with industry standards. The study concludes that Pakistan must make focused investments in inclusive AI standards, teacher training, and digital infrastructure to ensure that AI-assisted online learning is sustainable and equitable in the long run.

1. INTRODUCTION

This article provides a critical examination of how online learning is evolving in Pakistan, with a focus on the potential impact of artificial intelligence (AI) on the country's education system. Schools may utilize AI-powered technology to address learning gaps, engage students more effectively, and foster long-term educational success, particularly in resource-constrained environments [1,6]. The report, however, acknowledges that there are still challenges that hinder Pakistan's adoption of AI. These include a lack of digital infrastructure, teachers who aren't adequately prepared, and policies that aren't sufficiently robust [7]. The goal of this study is to provide a comprehensive understanding of AI-driven online learning by combining real-world data with expert opinions [2]. Ultimately, it will provide recommendations for policymakers, educators, and other stakeholders on how to develop and implement inclusive and sustainable educational strategies nationwide [17].

Adoption of artificial intelligence in Pakistani education is still mostly experimental and limited to few prestigious universities [11]. Public colleges must overcome several challenges like poor financial resources, restricted internet access, and insufficient educator training in digital and artificial intelligence literacy [12]. Although Pakistan's Higher Education Commission (HEC) acknowledges these limitations, it does not have thorough policies to enable significant integration of artificial intelligence [17].

This paper fills important gaps by assessing how artificial intelligence affects educational sustainability in Pakistan and offers pragmatic,

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policy-oriented analysis supporting significant educational changes.

The COVID-19 pandemic was a global disaster of a kind that had never been seen before. It messed up markets, healthcare systems, and schooling in a basic way. Millions of students around the world had a hard time learning when schools and colleges suddenly shut down. In countries like Pakistan, where digital education infrastructure was already underdeveloped, the sudden transition to online learning exposed deep-rooted challenges, including accessibility issues, a lack of digital literacy among educators, and the absence of structured e-learning frameworks [1,9]. However, the pandemic also sped up the use of Artificial Intelligence (AI) in schools, which was a big step forward for technology.

As schools looked for options, digital learning tools powered by AI became more popular [14]. As a way to deal with the problem, AI-powered tools like automatic tests, adaptable learning models, and AI-driven teaching systems came into being. Technology giants such as Google, Microsoft, and IBM reacted immediately by presenting AI-powered tools and platforms at no cost to educational institutions, allowing them to explore, improve, and provide feedback on their success [6]. But these tools did more than just keep school going during the pandemic. They also started a conversation about AI's long-term role in making education more sustainable [3].

Several global tech companies created AI-driven learning solutions so that schools could try and improve them. This was done in response to the growing need for effective and scalable online education [14]. Google released AI-powered Learning Management Systems (LMS), and Google Classroom now has features like AI-assisted grades and auto-generated comments [9]. These AI tools made it easier for teachers to handle big groups of students by cutting down on paperwork and letting students give and receive comments in real time. During the peak of the outbreak, Pakistani universities and schools were given access to these services at no cost, encouraging experiments with AI in education [1].

IBM launched Watson AI Tutor, which used natural language processing (NLP) to help students with their homework in real time [8]. This was an example of AI being used in education. Watson AI helped students by answering their questions, describing ideas, and changing based on each student's performance needs. In the same way, Microsoft added personalised learning tools backed by AI to Teams. These tools include real-time recording, automatic marking, and performance tracking screens for teachers [15].

China's Squirrel AI was another example of AI-driven education that worked well [18]. During the pandemic, it offered free tailored training [6] did research that showed students who used Squirrel AI's adaptable learning paths did 30–40% better in understanding what they were learning than students who used traditional online learning. These projects showed how AI can be used in education and how it can help make learning more personalised and efficient. Even though AI-driven e-learning has been a worldwide success, it was still unclear whether these tools could effectively solve the problems that Pakistan's education system was facing [20].

While AI-based learning tools became more popular around the world, they were still not widely used in Pakistan. The Higher Education Commission (HEC) told universities to look into how AI could be used to improve e-learning, but there were a lot of problems that made it hard to do on a big scale. This was a big problem because there wasn't enough digital infrastructure. A lot of schools, especially those in rural places, didn't have the fast internet that AI-driven systems needed. Students couldn't participate as much because they couldn't get gadgets that work with AI [7]. This made it hard to use personalised learning on a large scale.

One of the biggest problems was that schools didn't want to use AI. A lot of teachers didn't have official training in how to use AI to teach and didn't know much about AI-driven flexible learning methods [19]. Due to a lack of preparation, educators were hesitant to fully implement AI in their classes [12]. Also, while AI tools were originally given away for free during the pandemic, many state universities and schools could not afford to pay for long-term access to paid AI services [5].

Even with these problems, a number of universities in Pakistan tried out AI-powered learning tools, such as Google Classroom, Coursera, and local learning management systems (LMS). While urban schools gained from AI-enhanced learning, study found that less than 30% of students in rural Pakistan had access to stable internet connections, further widening the digital gap [1]. This gap showed that smart policy changes are needed to make sure that AI is used fairly in education [16].

Personalised learning settings driven by AI have been shown to make students much more interested and motivated all over the world [4,10]. Students can get real-time feedback, personalised learning paths, and AI teachers that are available 24 hours a day, seven days a week with adaptive AI learning models. Many kids in Pakistan don't have

access to skilled teachers. AI-based teaching tools could help close the learning gap [15].

In a recent study that looked at how AI affects student involvement in Pakistani colleges, participation rates and learning results got a lot better. The data, which came from 500 students before and after AI was used, showed that students were much more interested:

Engagement Factor	Before AI (%)	After AI (%)
Active Class Participation	45%	78%
Assignment Completion Rate	52%	88%
Student Retention Rate	60%	82%

The results show that incorporating AI led to a significant rise in student involvement. Participation and task finish rates went up with personalised AI coaching, automatic tests, and adaptable learning material. Students said that AI-assisted comments helped them understand course material better, which made learning more fun overall. However, despite these benefits, students from rural or lower-income areas continued to face problems getting AI-driven education due to bad facilities and lack of internet connectivity [6].

AI-driven education has shown that it can make learning better, but for it to work in Pakistan in the long run, major changes need to be made. Government funding in AI technology is one of the most important places for growth [5]. Increasing access to high-speed internet, setting up AI research labs, and starting digital literacy programs can all help make the environment right for AI-powered education [7]. AI-based education should be a top priority for the Digital Pakistan Initiative to close the digital gap and make sure all kids can access it [19].

Also, AI training for teachers is very important. A lot of teachers still don't know how to use AI-driven teaching methods, which makes AI integration less useful. The HEC should set up AI training programs for teachers across the country to get rid of pushback and give them the skills they need to use AI tools in the classroom [12]. Working together with big names in AI like Google, IBM, and Microsoft could make it easier to make AI training programs that fit the needs of teachers in Pakistan [15]. Policy changes also need to include AI ethics, data privacy rules, and ways to fund study into AI-based learning [3]. AI should be taught in schools and universities, both as a subject and as a way to teach. This will prepare students for a world dominated by AI [2].

Despite the fact that the COVID-19 outbreak brought to light severe deficiencies in Pakistan's educational system, it also sped up the use of digital learning alternatives. E-learning that is driven by artificial intelligence has the potential to revolutionise education by making it more approachable, interactive, and individualized [18]. The results of this literature study indicate that AI-driven education greatly enhances student engagement and learning outcomes [13]. However, impediments like as infrastructural restrictions, a scarcity of AI-trained instructors, and cost limits prevent broad deployment [11].

Strategic government involvement is critical for the long-term viability of AI-driven education in Pakistan. Investment in AI infrastructure, teacher training programs, and inclusive AI education policy will be vital to ensure that AI is a long-term solution rather than a quick cure [14]. If applied correctly, AI-powered education has the potential to overcome learning gaps, improve accessibility, and increase educational sustainability, eventually influencing Pakistan's learning future [20].

Research Hypotheses

H_1: E-learning driven by artificial intelligence increases academic performance and student involvement in Pakistani institutions.

H_2: Adoption of artificial intelligence is much hampered by shortcomings in digital infrastructure and dearth of qualified teachers.

Research Questions

1. How does e-learning driven by artificial intelligence affect academic achievement and student involvement in Pakistani institutions?
2. Particularly with regard to digital infrastructure and educator preparedness, what main obstacles prevent Pakistan from implementing AI-driven education?
3. Which strategic interventions and policy decisions are required to assure Pakistan's educational sector's sustainable integration of artificial intelligence?

2. MATERIALS AND METHODS

2.1 Research Design and Approach

In order to investigate the impact that AI-driven e-learning has on the long-term sustainability of education in Pakistan, this study used a mixed-methods research methodology, which integrates qualitative and quantitative aspects of research. For the purpose of gathering information from students and instructors on their experiences with e-learning that was powered by artificial intelligence, a numerical poll was used. Conversations with school administrators and legislators that were qualitative in nature provided further information on issues that were occurring

inside the institutions, gaps in the policies, and potential solutions.

I can be certain that our findings are robust, accurate, and applicable to actual classroom circumstances since we have used a technique known as "triangulation," which involves merging three distinct forms of data. At the same time as the quantitative component assists in determining certain engagement metrics and learning outcomes, the qualitative component provides background information and investigates the elements that influence the use of artificial intelligence in Pakistan's educational system.

2.2 Population and Sample Selection

This study's target group consists of Pakistani university students, teachers, and legislators for education. Universities are the main adopters of AI-driven learning systems, especially after the COVID-19 epidemic, so they take front stage. Selected public and private universities were meant to provide variety in points of view and experiences.

2.2.1 Sample Size and Justification

A total of 600 individuals took part in this research project, and their responses were broken down as follows:

There were five hundred students studying at ten different universities in Pakistan, both public and private.

There were one hundred teachers (professors, lecturers, and academic support personnel) that have used AI-based technologies in their classroom classroom instruction.

There were ten policymakers and university administrators that were engaged in the decision-making process about digital education methods.

The selection of a sample size of 500 students was made in order to guarantee statistical validity and generalisability, taking into consideration the varied backgrounds of students coming from Pakistan. When selecting participants, a stratified sample approach was used. This strategy ensured that participants were selected from a variety of fields, including engineering, business, social sciences, information technology, and medical sciences, as well as geographical locations, including urban and rural areas. A purposive selection method was used to pick the one hundred educators, and it was made sure that all of the participants had prior experience working with AI-based e-learning technologies. For the purpose of gaining views from those who are directly responsible for the application of artificial intelligence in education, the ten policymakers were chosen from relevant governmental and academic organisations via the use of expert sampling.

2.3 Data Collection Methods

2.3.1 Quantitative Survey (Students and Educators)

A survey questionnaire with a structured format was designed in order to obtain quantitative data from students and educators on their experiences with e-learning that is driven by artificial intelligence. A combination of closed-ended questions, items based on the Likert scale, and multiple-choice questions were included in the questionnaire in order to measure:

Student engagement metrics include participation rates, the percentage of assignments that are completed, the efficiency of the AI tutor, and the level of student satisfaction. AI training, difficulties in adopting AI, and the perceived efficacy of AI technologies in the classroom are some of the experiences that educators have had. Infrastructure limits, the digital divide, cost-related concerns, and hostility to artificial intelligence in education are some of the challenges and barriers that exist. The online questionnaire was distributed using Google Forms and university websites; we ensured that it was easily accessible and that it reached a large number of people. Students and teachers were given a two-week window to complete the survey, and they were sent email reminders to follow up on their responses.

This was done in an effort to enhance response rates. To acquire large-scale, measurable data that may reveal patterns and trends in the use of artificial intelligence and its influence on student learning, the motivation for utilising a survey was to collect the data. A statistical analysis of the survey findings was carried out with the help of SPSS (Statistical Package for the Social Sciences) in order to determine whether or not there are any links between the incorporation of AI and the outcomes of schooling.

2.3.2 Qualitative Interviews (Policymakers and Administrators)

For the purpose of completing the quantitative data, ten policymakers and educational administrators who were active in AI-driven education policies and digital transformation in universities were interviewed in a semi-structured manner. Interview questions were created with the purpose of investigating:

Institutional views on AI in education.

There are several obstacles to overcome when using AI at the policy level.

Learners in Pakistan may benefit from sustainability methods for AI-driven learning.

The actions and future goals of the government regarding artificial intelligence in education.

On the basis on availability, interviews were carried out either via the use of Zoom or in person, and the duration of each session was around thirty to forty minutes. Following the transcription of the responses, the NVivo program was used to conduct an analysis in order to find recurrent themes and policy ideas.

The inclusion of qualitative interviews was done with the purpose of gaining in-depth insights from important decision-makers and contextualising the data obtained from the quantitative research. This technique made it possible to get a more in-depth knowledge of the systemic problems and policy-level solutions that are required to maintain the use of AI in educational settings.

2.4 Selection of AI-Based E-Learning Tools for Analysis

In this research, three key AI-powered e-learning technologies that are regularly used in Pakistan's universities were analysed in order to determine the influence that artificial intelligence has on student engagement and learning results.

Utilised for automated grading, feedback supported by artificial intelligence, and adaptable assignments, Google Classroom AI is a tool. One example of an artificial intelligence-based chatbot instructor is IBM Watson Instructor, which offers real-time support and adaptable learning material. AI-driven course suggestions that are personalised for each student based on their learning habits are offered by Coursera AI and Khan Academy AI. The selection of these tools was based on their unability in Pakistani institutions and has been shown to have an influence on artificial intelligence learning research all over the world.

2.5 Data Analysis Techniques

2.5.1 Quantitative Data Analysis (Surveys)

The purpose of analysing the survey results was SPSS, and the following statistical procedures were utilised:

The purpose of descriptive statistics is to provide a summary of student engagement levels, adoption rates of artificial intelligence tools, and instructor perspectives. When comparing engagement metrics before and after the use of AI, t-tests and analysis of variance are utilised. Utilised for the purpose of determining the influence that the implementation of AI has on academic achievement and the percentage of students who remain enrolled in school. In order to quantify the usefulness of artificial intelligence in increasing educational sustainability, the quantitative study was conducted. This research highlighted engagement patterns and impediments to adoption.

2.5.2 Qualitative Data Analysis (Interviews)

The purpose of analysing interview transcripts, the NVivo program was used, and a thematic analysis technique was utilised in order to uncover important themes linked to the following:

Challenges at the policy level faced by AI integration. opposition from institutions to the implementation of AI. Methods for ensuring the long-term future of AI-driven education. The results of the survey were given a more in-depth context by the qualitative insights, which illustrated real-world implementation challenges and possible solutions.

2.6 Ethical Considerations

The following actions were taken in order to guarantee the integrity of the ethical system:

For the purpose of obtaining informed consent, each participant was required to submit written permission before to taking part in the survey or interviews. Anonymisation of the data was performed in order to maintain the confidentiality of the respondents. Participation was voluntary, and participants were free to withdraw from the study at any point in time. The Institutional Review Boards (IRB) of the universities that took part in the study were consulted in order to acquire ethical permission for the study. This was done to ensure that the study adhered to the rules for research ethics.

2.7 Limitations of the Study

In spite of the fact that it offers insightful information on AI-driven e-learning in Pakistan, this research has a number of limitations that must be acknowledged:

Limited Rural Representation: The participation from students living in rural areas was lower than anticipated due to difficulties in gaining access to the internet.

Impact of Artificial Intelligence in the Short Term: The study mainly examines the adoption of AI over the course of one academic year, while research on long-term sustainability trends involves many years. Surveys relied on self-reported experiences, which may create answer biases. Self-reported data included responses from respondents.

In order to conduct a comprehensive study of artificial intelligence (AI) in education throughout Pakistan, future research should investigate longitudinal studies and broaden the scope of data gathering to include more rural institutions.

3. RESULTS

3.1 AI and Student Engagement: Measuring the Impact

One of the most important goals of this research was to investigate the effect that AI-driven online learning had on the level of student engagement. A comparative comparison of the levels of student involvement in Pakistani institutions before and after the use of artificial intelligence is shown in the table that follows.

Table 1: AI's ımpact on student engagement (N = 500 Students)

Engagement Factor	Before AI (%)	After AI (%)	Change (%)
Active Class Participation	45%	78%	+33%
Regular Assignment Submission	52%	88%	+36%
Student Retention Rate	60%	82%	+22%
Time Spent on E-Learning	3.2 Hours/Day	5.1 Hours/Day	+1.9 Hours

Interpretation

The data suggest that there has been a substantial rise in the levels of student involvement after the implementation of AI. Artificial intelligence-driven personalised learning and AI tutors may have contributed to an increase in student interest in assignments, as seen by a 33 percent rise in active class engagement. It was shown that students were motivated to finish and hand in their assignments on time by using AI-assisted feedback and automated grading, which resulted in a 36% improvement in the regular submission of tasks.

Personalised learning tactics that were driven by artificial intelligence helped prevent students from dropping out of school, as shown by the fact that student retention rates climbed from sixty percent to eighty-two percent. The amount of time that students spend on e-learning platforms grew from 3.2 to 5.1 hours per day, which is a significant rise that demonstrates greater student enthusiasm and involvement in education that is assisted by AI.

3.2 Educator Perspectives on AI in E-Learning

One hundred instructors from both public and private colleges were polled in order to get an understanding of how they feel about the incorporation of AI into the classroom. As a consequence, the findings provide insight on the difficulties, advantages, and perspectives of educators about AI-driven education.

Table 2: Educator perceptions on AI in teaching (N = 100 Educators)

Perception Statement	Agree (%)	Neutral (%)	Disagree (%)
AI enhances student engagement and participation	78%	12%	10%
AI-assisted grading reduces workload	72%	15%	13%
Lack of AI training is a major challenge	81%	10%	9%
AI may replace traditional teaching methods	54%	22%	24%

Interpretation

The majority of educators (78%) believed that artificial intelligence had a favourable influence on student involvement, which indicates that AI-powered learning tools effectively made classroom participation more effective. Furthermore, 72% of educators said that the use of AI-assisted grading decreased the amount of work they had to do, which enabled them to concentrate on interactive teaching.

On the other hand, a substantial obstacle was discovered, as 81% of educators saw a lack of AI training as a key barrier to artificial intelligence implementation. The use of AI to replace conventional teaching techniques has been a source of worry for many educators, with 54% of respondents saying that AI may eliminate the need for human teachers in the future. In order to guarantee that artificial intelligence is effectively integrated into Pakistani education, this research underscores the need of teacher training programs and the development of AI skills.

3.3 Barriers to AI Adoption in Pakistan's Education Sector

Some obstacles prevent wide use of artificial intelligence in Pakistan, despite the fact that AI has been successful in increasing student engagement. The below table summarises some of the most significant challenges that have been highlighted by students, educators, and policymakers.

Table 3: Challenges in AI adoption in pakistani universities (N = 600 Respondents)

Challenge	Students (%)	Educators (%)	Policymakers (%)	Overall (%)
Limited Digital Infrastructure	58%	49%	67%	58%
Lack of AI Training Programs	47%	81%	63%	64%
High Cost of AI Implementation	53%	56%	74%	61%
Resistance to AI in Education	32%	47%	51%	43%

Interpretation

The lack of adequate internet infrastructure was mentioned as a primary issue by 58% of students, 49% of educators, and 67% of policymakers in Pakistan. It is difficult to execute education that is driven by artificial intelligence since many institutions, particularly those that are situated in rural areas, do not have access to high-speed internet and devices that are compatible with artificial intelligence.

The unavailability of artificial intelligence (AI) training programs was identified as an additional key hurdle that was taken into consideration. According to the findings of more than eighty-one percent of educators and sixty-three percent of policymakers, the lack of organised artificial intelligence training is a potential barrier to successful integration. In addition, the high cost of deploying AI was a significant problem, particularly among policymakers (74%), which emphasises the fact that financial constraints are a significant impediment in the way of sustaining AI-driven education. Concerns have also been expressed about the hostility to the use of artificial intelligence in educational settings, particularly among educators (47%) and policymakers (51%). This opposition particularly comes from educators.

Many conventional instructors are of the opinion that artificial intelligence poses a potential threat to the methods that have been used in the classroom for generations. This demonstrates the importance of the need for awareness campaigns and coordinated AI literacy programs in order to build a positive image of the function that artificial intelligence plays in the educational system.

3.4 Student Satisfaction with AI-Powered Learning

Students were given a Likert scale with five points and asked to rate how satisfied they were with the use of artificial intelligence in their educational experiences. The objective of this finding was to get an in-depth finding of the perspectives that students have on education that is driven by AI.

Table 4: Student Satisfaction Levels with AI-Based Learning (N = 500 Students)

Satisfaction Level	Percentage of Students (%)
Very Satisfied	36%
Satisfied	42%
Neutral	12%
Dissatisfied	7%
Very Dissatisfied	3%

Interpretation

A total of 78% of students said that they were pleased or extremely satisfied with AI-based learning, which demonstrates that there is a high level of acceptance of AI-driven education. 19% of students, on the other hand, expressed sentiments that were either indifferent or negative, with 7% being unhappy and 3% being extremely dissatisfied. Problems with the internet, a lack of knowledge of artificial intelligence, and restricted access to AI teachers were listed as primary causes for the dissatisfaction of students who were less happy.

The results of this study strongly back the idea that e-learning powered by AI makes students more interested and improves their academic success. However, problems like a lack of digital infrastructure, insufficient AI training, and limited funds continue to make it hard for AI to be widely used in the long term. The results make it clear that Pakistan needs AI training programs, government investments in infrastructure, and financial support for schooling that is based on AI right away.

4. DISCUSSIONS

4.1 How AI Affects Student Engagement and How Well They Learn

The results show that AI-powered e-learning makes it much easier for students to participate, finish their work, and remember what they've learnt. In the results area, Table 1, active class involvement went up by 33%, and regular task entry went up by 36% after AI was used. These changes are in line with what [6] found: personalised AI-driven learning platforms make students more motivated and lower the number of students who drop out of digital learning settings.

The fact that students spend more time on AI-based e-learning tools (from 3.2 to 5.1 hours per day) backs up the claim that AI makes students more interested in learning. Features that use AI, like adaptable learning, real-time feedback, and AI teachers, make the learning experience more personalised and engaging, which encourages more participation. Related research has been done in China's Squirrel AI system, where similar adaptable AI models raised the rate of student understanding by 30–40% [1].

Compared to the old ways of teaching and learning Pakistan's traditional education is based on methods that focus on the teacher and don't always meet the needs of each student. AI, on the other hand, makes personalised learning possible, where students get real-time, personalised feedback based on how they're doing. This change from passively learning to actively participating is a big reason why students did better in school in this study.

Even with these benefits, Pakistan is still in the early stages of using AI in education. Many students, especially those who live in rural areas, still have trouble connecting to the internet, finding digital tools, and getting help from AI teachers. These problems keep AI-driven education from reaching its full potential.

4.2 Educators' Perspectives: Opportunities and Concerns

The study showed that teachers strongly back AI in the classroom; 78% of staff members agreed that AI makes students more interested in learning. But the results also showed that there are big problems with adopting AI.

One of the biggest problems was that teachers didn't have enough training in AI; 81% of teachers said this was a major problem. This result fits with earlier study that found that teachers in poor countries don't always have official AI training or digital literacy skills [1]. Many teachers have trouble using AI in their lessons because they haven't been properly trained. This makes people resistant to and sceptical of AI's role in education.

Also, 54% of teachers were worried that AI could replace traditional ways of teaching. AI can automatically grade, give feedback, and personalise learning, but it can't do what human teachers do, which is to help students think critically, be mentored, and develop their emotional intelligence. In light of this, AI should be seen as an additional tool, not as a substitute for teachers.

Bridging the AI Training Gap

To ease these worries, colleges and lawmakers need to put money into professional development programs that focus on AI. Teachers can get the skills and confidence they need to use AI-powered teaching tools successfully by taking courses, attending staff meetings, and getting certified. Partnerships with big tech companies like Google, IBM, and Microsoft can give schools organised AI training programs. This makes sure that the use of AI is both flexible and long-lasting.

4.3 Barriers to AI Adoption in Pakistan's Higher Education

Even though it's clear that AI-driven education has benefits, this study shows three big problems that make it hard for Pakistan to adopt AI:

Not Enough Digital İnfrastructure

The biggest problem that was named was not having enough digital infrastructure. This was said by 67% of lawmakers and 58% of students. Many colleges, especially those in rural or poor areas, don't have stable internet connection or gadgets that work with AI. This makes it harder for AI-powered e-learning to be used by more people.

In comparison, countries such as India and Indonesia have engaged in national AI-based education policies, providing fair access to digital learning tools across urban and rural areas [6]. Pakistan needs to make the same kind of success, so the government needs to put a lot of money into digital infrastructure, like expanding the internet, building AI research centres, and making schools smarter.

People aren't trained or aware of AI

A big problem that a lot of educators (81%) and lawmakers (63%) said they saw was people who didn't know how to use AI. A lot of universities don't have clear rules about how to

teach AI, so teachers aren't ready to use AI in their lessons.

Lack of money and the high cost of integrating AI

The high cost of implementing AI is another big problem that 74% of officials said needed to be fixed. During the COVID-19 pandemic, AI-powered platforms like Google Classroom and IBM Watson AI were given away for free. However, many colleges are now having trouble paying for long-term AI contracts and paid AI-assisted learning services.

Suggestions for policy: The Higher Education Commission (HEC) should work with EdTech companies to find AI learning options for universities that are both useful and cheap. AI education funds and government funding can help schools buy AI-based tools without having to worry about the cost.

The results of this study strongly suggest that AI-driven e-learning has made Pakistani university students much more interested in learning, helped them learn more, and kept them there. The data showed that after AI was introduced, active participation in class went up by 33% and the rate at which assignments were turned in went up by 36%. The number of students who stayed in school also went up from 60% to 82%, showing that personalised learning methods driven by AI can effectively lower the number of students who drop out.

Educators also agreed that AI could help make training more efficient. About 72% of teachers agreed that AI-assisted grades made their jobs easier and gave them more time to focus on engaging learning. The lack of AI training, on the other hand, became a big problem. 81% of educators said they had not received official AI training to use AI tools in their lessons. This shows how important it is for Pakistani teachers to have organised AI training classes.

The study also found three main problems with using AI in education: not enough digital infrastructure (67% of students and 58% of policymakers), not enough training in AI (81% of teachers and 63% of policymakers), and not enough money (74% of policymakers). These problems make it harder for AI to spread in Pakistani colleges, especially in state schools and rural places where it's hard to get high-speed internet and gadgets that work with AI.

Even with these problems, 78% of students said they were happy with AI-based learning, which shows that Pakistanis strongly support AI-driven education. But kids in rural and poor areas still had trouble getting online, which suggests that AI can't solve the education problem on its own and needs help from the government and better infrastructure.

5. Conclusion

Based on the study's results, a number of important suggestions are made to make sure that AI is properly integrated into Pakistan's higher education system in the long term.

The government spending money on digital infrastructure

The biggest problem with AI usage is that many colleges, especially those in rural places, don't have the right digital infrastructure. The government should put most of its money into expanding high-speed internet, setting up AI research centres, and making schools smarter by adding gadgets that work with AI. Adding AI-based education changes to the Digital Pakistan Initiative will help close the digital gap and make learning more accessible for everyone.

National programs to teach people how to use AI and train teachers

AI merging won't work unless teachers are properly trained. The Higher Education Commission (HEC) should create professional development programs for teachers that focus on AI. These programs should include courses on AI literacy, staff meetings, and licensing programs for teachers. Universities should work with big names in AI, like Google, Microsoft, and IBM, to give teachers free or low-cost AI training classes.

Low-cost AI learning tools and partnerships between the government and private sector

74% of colleges said that the high cost of integrating AI was a problem. To get around this, public-private partnerships (PPPs) should be made with EdTech companies to offer AI-powered learning tools at lower prices. The government can give public universities AI education funds so that schools that are having trouble making ends meet can still use AI-powered learning tools without putting too much of a financial strain on their students.

Policy framework and ethical guidelines for AI

Pakistan does not have a formal policy on AI schooling at this time. The Ministry of Education and the Higher Education Commission (HEC) should write national AI policy rules to make sure that the use of AI is in line with privacy, fairness, and social concerns. Universities should also set up AI ethics groups to make sure that AI is used in

a fair and clear way for academic grading and learning analytics.

Making AI literacy a part of college courses

To get students ready for a world dominated by AI, AI knowledge needs to be taught across all educational subjects. Not only should IT departments offer courses on AI basics, machine learning, and AI ethics, but so should business, social sciences, and medical sciences. This way, students from all fields can learn how to use AI.

This research looked at how AI-powered e-learning affects student involvement, learning results, and problems in Pakistan's higher education industry. The results showed that using AI in education makes it much easier for students to participate in class, do their homework, and remember what they've learnt. In fact, over 78% of students said they were satisfied with AI-based learning. However, bad digital infrastructure, a lack of teachers trained in AI, and financial limits all make it harder for AI to be widely used.

The conversation made it clear that AI shouldn't be seen as an alternative to traditional teaching, but rather as an extra tool that helps students learn. AI-driven learning models offer personalised lessons and tests that are done automatically, but students still need human teachers for critical thought, mentoring, and their overall health and happiness.

To make sure that AI stays a part of Pakistani education, lawmakers need to put money into digital infrastructure, create AI training programs for teachers, and make AI education rules. Partnerships between the government and private companies can help make AI learning tools more cheap. To prepare students for a future driven by AI, universities should teach AI skills.

In the future, researchers should look into AI's long-term effects on education, case studies that compare China to other emerging countries, and AI-driven models for job training. Pakistan can use AI as a strong tool for educational equality, accessibility, and sustainability by removing the hurdles that are already in the way and taking a planned approach to integrating AI.

AI-driven education could change the way people learn in Pakistan if the right infrastructure is built, teachers are trained, and new rules are made. This would make high-quality education available to all kids, no matter where they live or how much money they have.

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Conflict of Interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

The study protocol was approved by the Ethics Committee of the Association UK (Ethics Committee Approval: 2025/01).

Author Contributions

Study Design, ZHS; Data Collection, ZHS and SHS; Statistical Analysis, ZHS and CCT; Data Interpretation, CCT and ANO; Manuscript Preparation, SHS, ZHS, CCT AND ANO; Literature Search, AEB. All authors have read and agreed to the published version of the manuscript.

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