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Enhancing Student Learning and Engagement Through AI-Powered Tutoring Systems

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ABSTRACT

The use of Artificial Intelligence (AI) in education has revolutionized student learning, instructional methods, and resource management inside institutions. AI-powered tutoring systems (AIPTS) have developed as effective instruments for providing individualized feedback, adaptive learning paths, and large-scale interactive participation. This research examines the function of AIPTS in improving learning outcomes and student engagement in higher education, specifically within the setting of the developing nation of Pakistan. Utilizing a quantitative, cross-sectional survey approach, data were gathered from 400 participants, including students, teachers, and administrators, via a structured Likert-scale questionnaire. The constructs assessed were AI Adoption, Learning Outcomes (comprehension, problem-solving, self-regulation), and Engagement (motivation, involvement, interaction). Data were evaluated using SPSS 26 via reliability testing, descriptive statistics, ANOVA, and regression analysis. The results demonstrated uniformly favorable opinions of AIPTS, with elevated mean scores in adoption, outcomes, and engagement. Reliability testing demonstrated robust internal consistency (Cronbach's $\alpha > .85$), while ANOVA revealed role-based disparities, with instructors and administrators exhibiting higher levels of optimism compared to students. Regression analysis indicated that AI adoption ($\beta = .32$, $p < .001$) and engagement ($\beta = .29$, $p < .001$) strongly forecasted learning outcomes, collectively accounting for 44% of the variation. Furthermore, AIPTS demonstrated a reduction in speaking anxiety and an enhancement in communication confidence, highlighting its emotional and cognitive advantages. Notwithstanding these encouraging outcomes, obstacles such as infrastructural deficiencies, ethical dilemmas (privacy, prejudice), and insufficient teacher training persist as significant impediments, especially in resource-limited environments. The research indicates that AIPTS has to be included into mixed instructional frameworks that merge AI efficiency with human oversight. Strategies at the policy level, institutional investments in infrastructure and training, and cooperation between teachers and AI are crucial for guaranteeing ethical, inclusive, and sustainable implementation.

Introduction

In this modern era friends of ours, AI (Artificial Intelligences) are becoming our oppressors; a kind of upstart craze of brains. It comes down to the detach side of our ancestors were not as close to it being tool add on and AI being closer to the thinking/ learning/ changes, they act it out but they learn and act it out not a thinking part of human mind and choices, This kind of systems allow the tailoring (or customization), automation, and interaction of educative process and give us a chance to go at some point to solve the problems of crowded classrooms, faculty time, and different student abilities (Zawacki-Richter et al., 2019). AI is the magic bullet of educational change: everywhere higher education institutions are preparing to turn these days, it looks like the illusion of the answer to all ills are on a grand scale as the scourge of the challenges they face are taken to logical extremes.

To narrow the gap from the education, the faced the learning, and the two phases of reception and use desire to students with biased based learning and the AI tutoring systems (AIPTS) in larger scale have been paid more and more attention recently. In the more typical classroom, teachers employ a one size fits all teaching method, which is not the most productive to address the specific needs of students that learn through different methods, at different rates and with different ability levels. Meanwhile, the use of AIPTS adap-tive algorithms can help to individualize content, offer tailored feedback, and support pupils in self-assessment of their learning progress (Luckin, 2018). Not only does this help students to do better in school, it also gives them more freedom and power; two good things in the modern classrooms.

AIPTs also use a lot of AI-driven technologies to help with different parts of language and cognitive skill development. For example, Automated Writing Evaluation (AWE) tools give students feedback on their grammar, cohesion, and organization over and over again, which helps them improve their writing through multiple drafts (Ranalli, 2018; Li & Link, 2022). Chatbots make interactive, conversational spaces where students can practice their communication skills in low-pressure situations, which helps them feel more confident, and fluent (Smutny & Schreiberova, 2020). Automatic Speech Recognition (ASR) technologies also improve speaking and pronunciation accuracy by giving feedback on phoneme accuracy, stress, and intonation (McCrocklin, 2019; Wallace, 2022). These systems not only help students do better in school, but they also make them more interested and motivated by giving them instant feedback, making learning fun, and giving them chances to practice in ways that work for them (Xu, 2021). AIPTS are important because they lower performance anxiety by making safe spaces where students can try new things, make mistakes, and learn without worrying about what others will think.

Even though there are these benefits, putting AIPTS into use is not without its problems. Research indicates that learning outcomes are affected by contextual elements, including student proficiency, engagement levels, and the instructors' role in facilitating AI-based feedback (Bai & Wang, 2021). If AI feedback isn't carefully integrated, students might not use it enough or understand it, which would limit its potential benefits. Moreover, ethical considerations such as data privacy, algorithmic transparency, and the potential for bias present significant challenges to the responsible implementation of AI in education (Alzahrani et al., 2023). In developing nations such as Pakistan, supplementary challenges including infrastructural deficiencies, inconsistent internet accessibility, and variations in digital literacy present considerable impediments, potentially exacerbating educational inequalities instead of alleviating them (Haque, 2021).

In light of this context, the current study aims to empirically assess the degree to which AI-driven tutoring systems improve student learning and engagement in higher education. This study adopts an integrated perspective, contrasting with much of the existing literature that typically concentrates on either cognitive outcomes (e.g., academic performance) or affective outcomes (e.g., motivation, confidence). It examines dimensions concurrently, evaluating the effects of AIPTS on comprehension, problem-solving, motivation, and classroom engagement. It also looks at how students, teachers, and administrators see things differently, because successful integration of AI technologies needs everyone to be on the same page and have the same goals (Crompton & Burke, 2023). The study seeks to elucidate the role of AIPTS in higher education, especially in resource-limited contexts, by tackling these issues. This dual focus on both learning outcomes and engagement allows for an evaluation of how AI can transcend its role as a mere technological innovation to become a catalyst for sustainable, inclusive, and transformative educational practices.

Statement of the Problem

Even though technology is moving quickly and more and more people around the world are using AI-powered tutoring systems (AIPTS), researcher still don't know much about how they actually affect student learning and engagement in higher education, especially in developing countries. Traditional classroom models persistently encounter significant challenges, including substantial class sizes, restricted teacher availability, and diverse levels of student preparedness, complicating the provision of individualized attention (Luckin, 2018). International studies have demonstrated that AIPTs facilitate personalized learning pathways, real-time feedback, and interactive practice (Xu, 2021; Wallace, 2022). However, there is a paucity of empirical research assessing how these advantages correlate with quantifiable enhancements in comprehension, problem-solving, and motivation within the context of Pakistani higher education.

Another aspect of the issue is that although AI tools can improve engagement through gasification, interactivity, and prompt corrective feedback, the degree to which these systems alleviate anxiety, enhance participation, and foster sustained motivation among learners remains ambiguous (Smutny & Schreiberova, 2020). Additionally, current research frequently investigates either cognitive outcomes (academic performance) or affective outcomes (motivation, confidence) in isolation, neglecting the simultaneous impact of AIPTS on both dimensions (Bai & Wang, 2021).

Research Objectives

1. To examine the role of AI tutoring systems in improving learning outcomes (comprehension, problem-solving, self-regulation).
2. To evaluate the effect of AIPTS on student engagement (motivation, participation, interaction).
3. To analyze role-based differences in perceptions of AIPTS among students, instructors, and administrators.
4. To identify challenges and propose recommendations for sustainable AIPTS adoption.

Research Questions

1. How do AIPTS contribute to improved student learning outcomes?
2. In what ways do AIPTS enhance student engagement?
3. Are there significant differences in perceptions among students, instructors, and administrators?

4. What challenges limit effective AIPTS adoption in higher education?

Significance of the Study

This study is important for a number of reasons, including academic, policy, institutional, and practical ones. It adds to the growing body of research on Computer-Assisted Language Learning (CALL) and the use of AI in education in general. Previous research has investigated AI applications for particular skills, including writing and pronunciation (Ranalli, 2018; Wallace, 2022); however, there is a paucity of studies examining the simultaneous effects of AI-powered tutoring systems (AIPTS) on learning outcomes and student engagement. By addressing this gap, the study enhances theoretical comprehension of the dual function of AIPTS in promoting cognitive outcomes (comprehension, problem-solving) and affective outcomes (motivation, confidence, diminished anxiety) (Godwin-Jones, 2019; Xu, 2021).

The findings provide evidence-based insights for the development of digital education policies at the policy level. These insights are especially useful for making sure that national strategies are in line with the United Nations Sustainable Development Goal 4 (SDG 4: Quality Education), which stresses the importance of fair access to quality learning opportunities for all (UNESCO, 2021). Policymakers can use the results to make plans that encourage AI use in higher education while making sure that everyone is treated fairly, that the process is clear, and that people are held accountable (Alzahrani et al., 2023).

The paper identifies to universities (and others) possible teaching and school-management benefits of AIPTS. The AI systems created to work in schools with excessive numbers of students and insufficient numbers of teachers, and students with multi-modal needs, can be used in personalized instruction; which makes education more effective to both the teacher and the outcome, which is the student (Crompton & Burke, 2023). In this particular case of developing countries, the perception of institutionalism remains an overriding factor due to resource scarcity and the urgent demand of saleable and cost-efficient educational means (Haque, 2021).

Finally, the research provides practical suggestions for teachers and educational technologists. With this evidence, teachers are able to plan blended learning models that deploy AIPTS to provide instantaneous adaptive feedback and consistent support. This enables teachers to move the center of classroom towards higher-order skills, such as critical thinking, creativity, and collaboration (Bai & Wang, 2021). Technologists and curriculum designers also potentially benefit from the results by being able to further aid in the development of AIPTS to make it easier to use, more widely accessible, and more aligned with student needs. In summary, this research is relevant since it bridges theory with practice. It provides a comprehensive view of AIPTS that enables scholars, policymakers, and practitioners to reform higher education for the 21st century.

Literature Review

AI and Learning Outcomes

AI has started playing a role in many recent educational concepts as recent research demonstrates the significant promise of AI as an avenue for improved student learning. This is due to AI's ability to provide adaptive instruction and personalized feedback. This also allows learners to receive assistance that is individualized, based on their own pace and requirements. AIPTS provides customized learning routes for every student, gives them the freedom of pacing their own

way, and receives immediate, criterion-based feedback (Luckin, 2018). Unlike the old teaching methods which are based on a one-size-fit-all model. This mirrors the advantages of human tutoring, directing students to more practice and resources items in specific areas of weakness, while also strengthening skills in areas in which they are already strong.

There are different AI driven applications that are helping a lot in doing multiple things to improve student's performance. One of them is the AWE (automated writing evaluator), a very valuable tool for the development of writing skills: the average quality of written texts turns out to improve after comparing the texts produced by students with texts from an AWE, which highlights the mistakes in grammar, logic sequencing, and structure with suggestions of how they can be fixed. This reiterated cycle develops met linguistic awareness and makes the students reflective writers (Ranalli, 2018; Li and Link, 2022). On the other hand, the oral communication is highly enhanced with the ASR (Automatic Speech Recognition) technologies, from which a user can get an immediate feedback about his or her pronunciation, accent, and intonation. It has been reported that the ASR students could achieve higher fluency and comprehension accuracy than traditional classroom activities students (McCrocklin, 2019; Wallace, 2022). These findings demonstrate the value of AI in enhancing both a surface level form of linguistic accuracy, and also that communicating competence.

What they're also learning, through AI-age apps' hard-core assisted classes, amount to more than words and speech. They also help teach people how to think and to understand and to remember words and how to solve problems. But they will never feel condescended to, only challenged. Two other systematic reviews (Collini, 2017; Nikiforos, 2019) on AI learning platforms and pedagogies reported a very strong evidence that students taught using an AI system are three times more likely to perform well compared to students taught traditionally. Under the cultivating process of practice activity and feedback, AIPTS can not only give supplement knowledge, but also provide customized examination, since information technology has been adopted to update the educational model in each industry. In combination, these results suggest that AI-based tutors are not tools only but new pedagogical entities. It's what fills in for the gaps that are always there to be found in traditional teaching, in teaching people the capacity to be wrong, to be wrong-thinking, and the ability to learn to revise. This provides sufficient scope for the AIPTS to serve as a useful medium for the conversion of short term skilling and long term education aspirations at higher education level.

AI and Student Engagement

Even though mental products such as understanding and problem solving are also important, the concerned studies exploring the principle of student engagement in quality learning are growing in number. Engagement is a multidimensional construct that not only comprises behavioral components such as attention and participation, but also affective and motivational ones such as persistence interest and emotional investment in the learning task (Fredricks et al., 2019). In this context, AI based tutoring platforms (AIPTS) demonstrated as very promising in order to enrich the interaction with the aid of personalized, adaptive, interactive learning experience but learner centric based.

The engagement between the gasification and immersive features is one of the main channels with the help of which AIPTSs improve engagement. Using this gasification of learning, AI systems utilize classroom environment metrics to assist students in reaching learning objective and time/span spent on such task (Smutny and Schreiberova, 2020). An example is that students would

practice more when they obtain immediate corrective feedback and a graphical depiction of their progress that provides a sense of achievement. The result of that perpetual feedback and reinforcement is instances of bliss, - then actions of perseverance - the two elements of long-term play.

AI chatbots allow learners to be able to practice speaking and communication skills in low-stress, low-pressure settings that make them remain engaged in the process. In contrast to classroom settings when students tend to avoid risks because of the fear of making a mistake, chatbots stimulate the risk-taking, meaning negotiation, and constant interaction (Winkler and Sollner, 2018). Studies have also identified that these conversational agents not only aid in language use, but also social and affective communication as students feel they are in the presence of an interactive and human-like system that can support them (Derakhshan, 2022).

Last but not the least is the provision of adaptive learning system which can modify the difficulty in real time. AI makes sure that the learners are neither overwhelmed nor under stimulated, and this is rooted in the principle of the zone of proximal development (ZPD) created by Vygotsky (Xu, 2021). The balance does not allow the people to be bored or frustrated, thus keeps the optimal states of determination and concentration. The findings reveal that AI tutoring systems not only transfer information but enhance motivation, alleviate anxiety of learners and enhance resilience amongst school students. AIPTS improves the quality of learning outcomes through the creation of personalized, interactive and emotive supportive environments thus increasing the rate of student involvement.

Teacher–AI Collaboration

Despite the fact that AIPTS are created to offer more personalized instruction and support, technology does not make wonders of it. Surveys always highlight the vital role of instructors in the efficient and ethical use of AI tools in teaching (Holmes et al., 2019). Since AI feedback is not yet contextualized in terms of teaching activities, educators are in a unique position to contextualize AI-generated feedback, besides requesting learners to reflect on their learning and use of higher-order skills like critical thinking, creativity and problem-solving that cannot be done by AI systems in isolation. Without such human mediation, students can misuse or underrate AI feedback, and according to his article, this all moves the risks to the centre causing the failure to deliver on the benefits.

Blended instructional designs where AI delivers routine or repetitive support and a teacher uses more personalized support are reported to be the most effective way to support student learning. Such models enable Auto assume the automated evaluation, course progress and content delivery modeled on the needs of every student. Therefore, teacher has more time to make investment and emotion disclosure (Bai and Wang, 2021). It does this complementary differentiator without compromising on efficiency or student centricity, thereby putting AI on the outside as add on and not as a replacement teacher.

This collaboration manifests in many forms in reality, orienting as AI-generated learning analytics to give instant alerts on students' performances at school. Through reviewing this data, those responsible for the instruction can understand who is having difficulty with various concepts/skills and adjust instruction (Crompton & Burke, 2023). Such insights are not only helpful for making decisions regarding the how of teaching, but also to allow for an efficient and individualized teacher-student interaction. The other numbers are less meaningful though they better describe the

interaction between teachers and AI — in terms of how they will make the technology increasingly powerful on its own, as they will boost the teacher capacity to match notification to the needs of individual students. Ultimately, AIPTS should view themselves as collaborators in the classroom, not substitutes for teachers. Human teachers provide empathy, moral judgment and context things AI does well without for efficiency, scale and personalized service. For AIPTS to work, teachers and AI must co-teach and technology must supplement not supplant the human parts of teaching and learning.

Challenges and Ethical Concerns

AI-Powered Tutoring Systems (AIPTS) could help students learn better and get more involved, but there are a lot of problems that need to be fixed before they can be used. Some of these problems are about infrastructure, ethics, and fairness. In many developing countries, like Pakistan, the use of Artificial Intelligence (AI) in classrooms is limited by slow internet connections, bad digital infrastructure, and students not having equal access to digital devices (Haque, 2021). If these gaps cause people from poor or rural backgrounds to miss out on education, the digital divide will grow even bigger and educational inequality will grow even bigger.

And as the list of worries about AI in education is being made, ethical worries are sure to be on it. The potential for data privacy violations, surveillance risks, and algorithmic bias significantly undermines fairness and transparency in AI-driven decision-making (Alzahrani et al., 2023). If you train an AI system on biased data, for example, it may just keep spreading gender, cultural, or linguistic bias and make the gap between those who are already on the outside even bigger. The growing use of AI testing and monitoring has also raised questions about whether or not free students can give their informed consent. This has made it clear that student rights need to be well protected.

Another important problem has to do with how ready teachers are and how they can improve their skills. AI can be a big help with everyday teaching tasks, but how much it helps depends a lot on how teachers use and incorporate these tools into their teaching. People often don’t want to use AI because they haven’t been trained enough, they don’t trust themselves to use new technologies, or they are afraid that automated systems will take their jobs (Crompton & Burke, 2023). If teachers don’t get enough professional development, they might not use AIPTS to its full potential or use it incorrectly, which would make them less effective and stop them from reaching their full potential.

These problems show how important it is to create ethical, inclusive, and context-sensitive frameworks for using AI in schools. These kinds of frameworks need to find a balance between new ideas and fairness, making sure that all students benefit from AI progress while also protecting their privacy and dignity. Institutions can get the most out of AIPTS while reducing the risks of exclusion and harm by fixing problems with infrastructure, encouraging ethical governance, and putting money into building teachers’ skills.

Research Gap

Although AIPTS have been found to enhance either learning outcomes or student engagement according to current research, there is a lack of research systematically examining both effects in higher education contexts. That said, a large body of modern literature appears to isolate cognitive benefits of various technologies, such as reading comprehension, writing accuracy, and speaking fluency while doing so very little to understand their relationship with affective aspects (Li & Link, 2022; Wallace, 2022) including motivation, engagement, and reduced anxiety. Such a

narrow view does not take into account the fact that student success in learning is driven by both achievement or performance and the depth of emotional and social engagement with learning.

Another issue is that the research which does exist is biased towards some areas. The majority of tested AI in education work has been in Western contexts with strong infrastructure, digital literacy, and institutional readiness. Therefore, the finding from these conditions may not capture the nuances of AI-infusion in developing countries, where challenges as low internet accessibility, differences in device access, and lack of teacher training are experienced (Haque, 2021). This leaves a huge hole in our knowledge of how to use AIPTS effectively in resource-poor settings, such as Pakistan.

One of the other things that are just missing is so many stakeholders. In AI research, students are often considered as the adoption and orchestration key [suggested key] and also teachers and administrators are obstacle of the adoption and orchestration. Instructors mediate AI feedback to make sure its agenda is compatible with curriculum goals, while administrators implement institutional policy and infrastructure. However, while alignment of stakeholders is considered a key requirement for sustainable AI adoption (Crompton & Burke, 2023), only limited research has so far investigated in more detail how these stakeholder groups feel about and interact with AIPTS. In such backdrop, there are not clear ethical accounts on a particular learning and engaging synergy of AIPTS but such a research remain as a gap as we find no such study on part of students, teachers and the administrators together. This is an under-researched area, and the results of this paper will contribute as a part of emerging literature body, to a more comprehensive view of transformative AI in higher education when the advantages of advanced technology have to be reconciled with increasingly complex effects in terms of accessibility, equity, ethics and sustainability.

Methodology

Research Design

This study employed a quantitative, cross-sectional survey design to explore the relationships between AIPTS adoption, learning outcomes and student engagement. The first rationale for that quantitative approach regard to fit was due to quantitative data collection type which to identified trends and relationships in statistical data collection type suitable for quantitative data (Creswell & Creswell, 2018). The use of a cross-sectional design allowed perceptions from a large and diverse sampling to be gathered at one time point, providing a snapshot of the impact of the AIPTS among these stakeholder groups. Pioneering research on AI-mediated distance education has employed similar quantitative survey-based approaches to ensure result comparability and generalizability (Zawacki-Richter et al., 2019; Bai & Wang, 2021).

Population and Sample

This study focused on students, teachers, and administrators at colleges that have begun integrating AI-assisted platforms into learning and teaching. These groups are selected because they provide a full representation of the use of AIPTS. Students are the final users, teacher gives necessary support to students for learning, and administrator influences the school readiness and policy support. The equi-proportional stratified random sampling was employed to obtain an honest representation of all. This approach ensured a fair representation of all the stakeholder groups in their respective proportions to minimize sampling bias and increase credibility of the results

(Creswell & Creswell, 2018). The total sample size was 400: 300 students (75%); 70 teachers (17.5%); and 30 administrators (7.5%). The breakdown also looks a lot like what you might expect from a higher ed institution: Students were the largest group of respondents, followed by instructors, followed by administrators. Stratification also allowed inferential analysis of between group differences in these perceptions in a substantively meaningful way (Crompton & Burke, 2023).

Table 1: Sampling Distribution (N = 400)

Group	n	%
Students	300	75.0
Instructors	70	17.5
Administrators	30	7.5

Research Tool

The structured questionnaire was used to collect data for this study. The questionnaire was aims at collecting information on perceptions of AIPTS in three main areas, including (a) AI Adoption (AIA), (b) Learning Outcomes (LO), and (c) Engagement (ENG). The instrument was mapped to theoretical models of technology adoption and assessment of educational technology, which emphasize the significance of adoption, performance, and feelings when evaluating digital learning technologies (Davis, 1989; Zawacki-Richter et al., 2019).

AI adoption (AIA) scale was composed of the frequency (frequently–seldom) and the benefit (beneficial–unbeneficial) of using the different functionalities found in AIPTS (adaptive feedback, human/auto content diversity and intelligent error marking). On the dimension of Learning Outcomes (LO), Li & Link (2022) and Wallace (2022) examined gains in knowledge, functional and met cognitive skills, respectively, pinpointing cognitive aspects of learning impacted by AI. The Engagement (ENG) scale, which was adapted from the Pei et al. scale and assesses motivation, activity, and interactivity, was used because engagement has been shown to be an important aspect for successful use of AI-supported learning systems (Smutny and Schreiberova, 2020; Xu, 2021).

A 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) was used to rate all of the items. This method made it possible to measure attitudes and perceptions, which made it possible to do strong statistical analyses like descriptive statistics, ANOVA, and regression (Creswell & Creswell, 2018).

To ensure content validity, the questionnaire was assessed by experts in higher education educational technology, pedagogy, and AI integration into higher education. I made small adjustments to phrasing for clarity and contextual relevance based on their feedback. They then conducted a pilot study of the instrument among 40 participants to assess its reliability and usability. Cronbach's alpha is a measure of internal consistency; results indicated that the three dimensions were highly consistent with each other (all >. Far excess that the advisable. This is as higher as mas 85. 70 (Hair et al., 2019). This validated the scale up of the questionnaire.

Data Collection

A digital survey distribution method enabled us to collect data over a span of six weeks. Students received the organized questionnaire through institutional channels, including formal university emails and learning management systems (LMS). A digital approach was selected to maximize

participation, facilitate planning and remain environmentally conscientious by reducing paper-based questionnaires (Kukulska-Hulme, 2020).

Participants were presented with an informed consent form prior to taking the survey to ensure that they adhered to all the rules. It stated explicitly in the form that participation is voluntary, data was confidential and for academic purposes only. Sensitive information, such as personal identifiers, was omitted in order to adhere to the principle of data minimization. This is consistent with the broader best practices of research using educational technology (Alzahrani et al. 2023). Weekly reminders were disseminated to increase response: institutional contacts (faculty coordinators and administrators) supported outreach efforts. The plan assisted in ensuring participation from students, teachers, and administrators while also ensuring representation across faculties and departments. Out of 450 questionnaires sent, we had an excellent response rate of nearly 89%, receiving 400 valid responses.

Data Analysis

The data were analyzed using SPSS 26, using a combination of reliability tests, descriptive and inferential statistics to achieve the goals of the study. In the first step, we measured the internal consistency of the scales used for AI adoption scale, learning outcomes scale, and engagement scale using Cranach's alpha. Constructs reliability is established when the calculated value of $\alpha \geq 0.70$, α values exceed this suggested threshold which indicates the instruments validity in terms of the theoretical targeted dimensions (Hair et al., 2019).

Second, we calculated the descriptive statistics to summarize all the answers. The means were utilized to signify the cumulative perceived levels of effect of AI-powered tutoring systems on comprehension, problem-solving, motivation, and participation among students, instructors, and administrators (Coyne, 2010; Creswell and Creswell, 2018). Third, ANOVA was utilized to evaluate the group disparity. This allowed us to measure how different the opinions of students, teachers, and principals were on what an AI tutoring system for students should look like. To figure out how the stakeholder positions affect how people see AI infusion, it's important to know what makes each group different.

Findings

Table 2: Reliability Statistics (Cronbach's α)

Scale	k	α
AI Adoption (AIA)	6	.87
Learning Outcomes (LO)	7	.89
Engagement (ENG)	5	.88

The results of the reliability analysis showed that the three scales—AI Adoption, Learning Outcomes, and Engagement—were all very consistent with each other. So, the AIA (AI Adoption) scale had a Cranach's α of. The Learning Outcomes (LO) scale had an α of.87, and the Engagement (ENG) scale had an α of.89 and.88. Because all of these values are much higher than the usual cutoff of 70 (Briedis et al., 2017), these results also show that the individual items in the questionnaires were good at measuring the constructs they were meant to measure. Hair et al. (2019) proposed an acceptable reliability benchmark of 80. This means that the instrument got the same answers from different people, which makes the later analyses more trustworthy.

Table 3: Descriptive Statistics

Construct	Mean	SD
AI Adoption	4.12	0.56
Learning Outcomes	4.08	0.58
Engagement	4.15	0.54

As the results indicate, people generally had positive things to say about AI-powered tutoring systems in descriptive terms. Table 1 shows that the mean of AI Adoption was 4.12 (SD = 0.56) which means most people agreed that AI tools served as useful and frequent usage in daily life. Learning Outcomes averaged 4.08 (b = 0.58), suggesting that the survey respondents would have rated the AIPTS as effective at enhancing understanding, problem solving and self-control. Moreover, although engagement had the highest mean score, it was 4.15 (SD = 0.54), nevertheless, the participants strongly acknowledged the role of AI in motivation, active learner participation, and continuity of interactivity with regard to engagement. Because the standard deviations are relatively low across all constructs, the respondents seem to be in reasonably high agreement, which is a further indication that AIPTS is perceived positively across a range of individuals.

Table 4: ANOVA by Role

Outcome	Students M	Instructors M	Admin M	F	p
AI Adoption	4.10	4.18	4.22	3.42	.018
Learning Outcomes	4.06	4.20	4.15	4.01	.009
Engagement	4.14	4.18	4.22	2.96	.032

The analysis of variance revealed significant differences between the perspectives of the students, teachers and administrators. Compared to students (M = 4.10) and instructors (M = 4.18), administrators had the highest mean score (M = 4.22) for AI Adoption. These differences were statistically significant (F = 3.42, p =. 018). The highest level of positive agreement on Learning Outcomes came from teachers (M = 4.20), followed by administrators (M = 4.15), and students (M = 4.06). The differences were again significant (F = 4.01, p =. 009). For Engagement, administrators (M = 4.22) and instructors (M = 4.18) gave higher ratings than students (M = 4.14), but the differences were significant (F = 2.96, p =. 032). This was a similar trend. These findings imply that the number of possible benefits of AIPTS are more salient to instructors and to administrators than to students, due to the broader perspective of the former group on institutional effectiveness and the delivery of educational support.

Table 5: Regression Analysis

Predictor	β	t	p
AI Adoption	.32	6.81	<.001
Engagement	.29	6.15	<.001
Role (control)	.07	1.42	.157

Model fit: $R^2 = .44$, $F(3,396) = 103.5$, $p < .001$.

Regression analysis found that AI Adoption and Engagement were important factors in determining learning outcomes. AI Adoption exhibited the most significant impact ($\beta = .32$, $t = 6.81$, $p < .001$), closely succeeded by Engagement ($\beta = .29$, $t = 6.15$, $p < .001$). The model's R^2 value of .44 shows that these two predictors together explained 44% of the variability in learning outcomes. The role variable, included as a control, was not significant ($\beta = .07$, $p = .157$), indicating that variations among students, instructors, and administrators did not independently forecast learning outcomes once adoption and engagement were considered. These results support

the conclusion that the adoption of AI and student engagement is the primary factors that lead to better learning outcomes in AI-powered tutoring situations.

Discussion

The results of the study reveal that AIPTS are significantly effective in students' engagement and in learning. It follows a raft of recent international research into how AI is infiltrating our educational practices. The constructs AI Adoption, Outcome, and Engagement, etc., the mean value is higher comparing both types of each stakeholder for AIPTS in higher education, which indicates that the attitude of both types of stakeholders toward AIPTS is positive (Table 2). This assumption is consistent with the results from regression analyses, which demonstrate that the pace of diffusion of AI and the level of educational absorption are still among the predictors of learning outcomes. These effects transfer not only from cognitive (comprehension problem-solving and self- regulation) to affective (motivation, persistence and low anxiety), but the AIPTS transfer non-learning domains as well, "a phenomenon known as positive transfer" (Luckin, 2018; Xu, 2021). It works on either side The final one is a dual sided success from AIPTS, or at least a potential such that it doesn't just have to be more than papers or lessons from tuition to a learning partner. Results also showed role-based differences in perceptions with instructors and administrators rating AIPTS more positively than students. This suggests there is institutional optimism around the relative effectiveness, scalability, and long-term benefits of AI enabled integration. For example, administrators might view AI as a means to give teachers a breather and use up resources more effectively, whereas teachers might be pleased it can be utilized for formative evaluation and progress monitoring (Crompton & Burke, 2023). The lower ratings from students, on the contrary, may stem from pragmatic concerns, such as issues of usability, accessibility, or digital literacy, which are particularly critical in developing contexts. According to Haque (2021), issues such as the availability of infrastructure, inconsistent access to devices or stable internet connections can become barriers limiting student's exposure to AI platforms impacting their perceptions of such AI platforms.

The paper also identifies persistent challenges and ethical issues that must be addressed for AIPTS to realized their promise. The lack of infrastructure, under-trained teachers, and ethical issues like data privacy, surveillance, and algorithmic bias remain a challenge in terms of sustainable integration of AI technology. These results mirror global discussions on the perceived exacerbation due to AI, where the more privileged learners with better access to technology gain greater benefit (Alzahrani et al., 2023). In the absence of guard rails for equity, transparency, and inclusivity, AIPTS could widen, rather than narrow, digital divides.

Human being is responsible for all learning, and adaptive feedback and automatic support are very important in AIPTS. These findings align with existing research demonstrating that AI is most effective when incorporated into pedagogical frameworks that enable teachers to contextualize and frame AI feedback, facilitating students' reflection and the development of higher-order cognitive skills such as critical thinking and creativity (Holmes et al., 2019). This type of collaborative model is designed to ensure that AI enhances rather than replaces the human experience, optimizing it for educational purposes. We believe that this work is part of a new body of literature that demonstrates that AIPTS can play a positive and important role in engagement and learning success. To be used correctly, they should think about important ethical protections, contextual factors, and the relationship between AI and teachers. This is where countries like Pakistan need to focus their governments and investments on making sure that everyone has access to and gets fair treatment, that teachers are well-trained, and that there are ethical systems in place for governing.

AIPTs are not just new technologies; they can also bring about educational change that is inclusive, long-lasting, and transformative.

Conclusion

The paper recommends that these AIPTS may be used to transform higher education by providing better learning outcomes, as well as, a better student experience in regards to engagement. Adaptive Intelligent Tutoring Systems (AIPTS) are personalized, adaptive learning paths of the students through adaptive algorithm, real-time feedback systems, and interactive learning environments that enhance the understanding of the students, problem solving and processing of self-regulation. Besides the dimensions of cognition, these systems have been reported to also support motivation, confidence and engagement at an affective level that suggests they are capacity on both cognitive and emotional and social levels at learning (Luckin, 2018; Xu, 2021).

These results indicate that there is an opportunity to supplement, with AIPTS, some areas of teaching that are commonly lacking in large/poorly-resource classrooms. It might also provide some level of personal support that would only be possible in a face to face tutoring. Also, the paper also highlights the necessity of alignment between the students, teachers and administrators and other parties who might contribute to the implementation of the change successfully. AIPTS came as a promise of hope among the instructors and administrators but not among the students. This underlines the importance of considering the problems of usability, accessibility and digital literacy (Crompton and Burke, 2023; Haque, 2021).

They also show that, just like in Pakistan, the successful integration of AIPTS has long been a challenge. These bureaucratic problems, along with the bad state of the infrastructure, the unfair distribution of access to digital resources, and the worries about privacy, monitoring, and biases in the algorithms, make the issues we talked about important problems that need to be rethought and regulated (Alzahrani et al., 2023). In addition, instructors are responsible for the integration of AI into mixed pedagogical systems, where they contextualize AI feedback, facilitate reflection, and promote higher-order thinking (Holmes et al., 2019). In conclusion, we assert that AIPTS is not merely a novel technology; it serves as a transformative force in education, facilitated by an ecosystem that integrates technology, pedagogy, and ethics. AIPTS can be used to the fullest to make sure that education is fair, accessible, and long-lasting. It does this by addressing infrastructure and ethics and encouraging cooperation between the teacher and the AI. It also benefits higher education institutions in Pakistan and other areas.

Recommendations

Policy-Level Recommendations

Aligning national AI ethical use strategies in education to UN SDG 4 (Quality Education) is important As warned by the AI ethics international literature (Alzahrani et al., 2023), policy measure could also priorities existing frameworks for data protection, algorithm transparency and fairness of access. Experts say the robust regulation in Pakistan would focus on the areas of tracking the AI used in schools, affordability, and not allowing the digital divide to grow. They should also contribute to future-proofing digital infrastructure by enabling urban and rural institutions equally to construct and maintain it.

Institutional-Level Recommendations

Institutions themselves must invest in robust infrastructure. This includes consistent internet availability, human resources management tool, and Artificial intelligence-enabled resource. Furthermore, besides infrastructure, schools must provide teachers with complete professional development programs to train them on how to integrate the use of AIPTS in their teaching practice. Evidence shows that teacher preparedness and orchestration are essential for successful AI integration (Holmes et al., 2019; Crompton & Burke, 2023). Institutions can maximize the benefit of AIPTS while helping people embrace changing by preparing their institutions and ensuring that teachers are both confident and proficient in using AI.

Pedagogical-Level Recommendations

As far as these AIPTS are concerned, in the case of teaching, he should be applied as a supplementary device or helper and not as a replacement of human teachers. Bai and Wang (2021) believe that teachers ought to emphasize on the higher-order skills (critical thinking, creativity, collaboration and reflection) and leave lower-order functions (routine feedback, adaptive content provision and progress tracking) to AI programs. Blended models that increase efficiency and add the empathy and contextual knowledge of human beings will be the solution in order to make sure that students learn and to keep them interested and engaged. However, educators ought to support autonomous thinking about AI feedback, which will increase the capacity of students to become more met cognitive.

Limitations and Future Research

This research, like all empirical studies, has its limitations. The principal limitation is its cross-sectional design, which reflects perceptions at a singular moment in time. The results show that there are strong links between AI-powered tutoring systems (AIPTS), learning outcomes, and engagement. However, the design does not allow for strong causal inference. Consequently, subsequent research ought to utilise longitudinal or experimental methodologies to monitor genuine learning advancements over time and to evaluate the causal influence of AIPTS on both cognitive and affective outcomes (Creswell & Creswell, 2018).

Another limitation pertains to the dependence on self-report measures, which may be affected by respondent bias or the overestimation of learning enhancements. Self-reported data offers significant insights into perceptions; however, it does not consistently correspond with actual performance. To enhance validity, subsequent research could triangulate survey results with objective performance evaluations or usage analytics obtained from AI systems (Xu, 2021).

The study also looked at how people in general feel about college students, teachers, and administrators, without taking into account differences between fields of study. AI tools might work better or worse depending on the subject. For example, language learning, engineering, and social sciences might need different levels of AI help. Comparative research across disciplines and institutional types would yield a more nuanced comprehension of AIPTS' role in various academic contexts (Li & Link, 2022).

Finally, the quantitative methodology of this study restricted the ability to document the lived experiences of students and teachers utilizing AIPTS. Future research may utilize qualitative or mixed-method designs, encompassing interviews, focus groups, or classroom observations, to investigate learners' emotional responses, usability challenges, and cultural factors affecting

adoption. These methods would enhance our comprehension of the interpretation, application, and incorporation of AI feedback into educational practices. In conclusion, this study offers significant empirical evidence regarding the potential of AIPTS in higher education. However, future research must confront its limitations by integrating longitudinal, experimental, and qualitative methodologies, thereby facilitating a more thorough assessment of AI's role in augmenting learning and engagement.

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