Adoption of AI-Powered Learning Tools in Pakistani Universities: A TAM (Technology Acceptance Model)-Based Analysis

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Abstract

This qualitative research investigates the opportunities and challenges faced by educators in implementing AI technologies in higher education. Using a questionnaire guide, the interviews were conducted with thirty instructors across various disciplines. The study explores the potential of utilizing different forms of AI, such as adaptive learning systems, automated assessments, and AI-based instruction, to enhance existing teaching methods, improve student performance, and provide personalized learning opportunities. Participants highlighted the transformative benefits of AI technology, noting that it alleviates the paperwork burden in education, thereby allowing teachers to teach and students to learn. The theoretical framework for presenting the results is the Technology Acceptance Model (TAM), which explains the extent to which educators are willing to embrace technological changes within their belief systems. These changes raise ethical concerns regarding privacy, discrepancies in educational equity, and the risk of dehumanizing education. This line of research is enriched by the anonymized survey data and qualitative findings, which strongly advocate for a multi-stakeholder approach to recognizing and addressing ethical and practical challenges. Additionally, this research emphasizes the need for fair policies and practices concerning artificial intelligence applications. Therefore, the study offers original insights into the acceptability of AI in terms of its prospects and limitations within the context of Pakistani higher education.

***Keywords**:* Artificial Intelligence (AI), Higher Education, Prospects, Challenges, Semi-Structured Interviews, TAM-Technology Acceptance Model.

Introduction

Artificial Intelligence (AI) has transformed various sectors, including education, by offering advanced learning tools such as adaptive learning systems, automated assessments, and AI-driven tutoring. The adoption of AI in Pakistani universities is still at a nascent stage due to technological, institutional, and ethical challenges. This study applies the Technology Acceptance Model (TAM) to explore

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the extent to which educators in Pakistan accept AI-powered learning tools and the barriers they encounter. Teachers may improve learning experiences and streamline their jobs with the use of artificial intelligence. Whether it's accelerating lesson preparation, creating evaluations, or exchanging tactics with other educators, educators worldwide are coming up with innovative ways to incorporate AI into their everyday tasks. It is important to remember that one of the focuses of the SDGs is education, which is necessary to accomplish all of the other objectives and to create a more sustainable future.

The ability of AI to tailor learning experiences to each person's needs is one of its unique features in the educational space. Adaptive learning systems evaluate a student's strengths and weaknesses using machine-learning algorithms, and then dynamically adjust the speed and content to optimize learning outcomes. This customized approach fosters an inclusive learning environment by taking into account the many learning styles and ability levels that exist in a classroom. Beyond the conventional classroom, artificial intelligence is being investigated in education. AI is used by online learning platforms to enable learning at any time and from any location, removing regional restrictions and giving students worldwide access to education. A worldwide approach to education is also promoted by AI-powered language translation technologies, which improve intercultural communication and cooperation. As we traverse the revolutionary effects of artificial intelligence in education, privacy and ethical issues become more pressing. Carefully considered procedures and regulations are needed to strike a balance between the advantages of data-driven insights and the need to protect sensitive data (Tariq, 2024).

These ethical aspects will be examined in depth in this investigation, offering a comprehensive grasp of the ethical incorporation of AI in learning environments. In a nation like Pakistan, which has enormous cultural and socioeconomic disparities as well as impediments to inequality, generative AI can help close these gaps. Students, instructors, and parents are just a few of the stakeholders in the educational system who may benefit from it. Given the significance of helping kids improve their AI skills, nowadays, a wide range of use cases are witnessing several similar projects. In the context of education, "artificial intelligence" (AI) refers to the application of AI methods and tools to enhance, automate, and personalize a range of learning procedures (Visnudharshana, & Kishore, 2024). Artificial intelligence (AI) in education refers to a wide range of tools, methods, and applications that transform traditional teaching and learning practices via the use of data analytics, machine learning, natural language processing, and other AI-related technologies. The main applications of artificial intelligence (AI) in education include chatbots for student support, data analytics for predicting and resolving learning challenges, virtual and augmented reality for immersive learning experiences, automated grading and assessment tools, intelligent tutoring systems, and adaptive learning platforms (Pokrivčáková, 2019).

The ultimate goal of these apps is to enhance educational results by fostering a more dynamic, student-centered, and engaging learning environment. Apart from AI's revolutionary potential in education, ethical issues, privacy problems, and the requirement for responsible application are important factors that require careful study. To build trust and encourage the appropriate use of technology in educational settings, it is crucial to strike a balance between utilizing AI's advantages and protecting sensitive student data. These days, technology is an unavoidable part of life. Technology has not only changed people's lives, but it has also changed the way we work, interact, and learn. Our work and activities are made more helpful and efficient by the constant emergence of innovations of all kinds. One example of a more recent technological development is artificial intelligence, or AI for short, which is starting to become more and better known as a tool for behaviour imitation. As artificial intelligence has advanced, it has also affected the educational sector. People can study with the aid of education helpers like bots thanks to AI technologies. As times change, the educational sector must also change to keep up with technological advancements in order to raise educational standards, particularly with regard to information and communication technologies (Xing, 2022).

Problem Statement

Despite the global advancement in AI-driven educational tools, Pakistani universities face hurdles in adopting these technologies. The reluctance of educators, concerns about data privacy, lack of infrastructure, and institutional policies act as significant barriers. This study aims to investigate these challenges through qualitative research. In several domains, including education, artificial intelligence (AI) technology is gaining prominence. Artificial intelligence (AI) technology has altered the curriculum, especially in the fields of technology, science, math, and engineering. However, AI is also going to change schooling as a whole. A recent technological advancement that has generated interest is artificial intelligence (AI). Numerous work activities, particularly those in the realm of education, are made easier by this technology. AI has applications in the field of education as well. Teachers and lecturers are better able to comprehend the demands of their students (Fitria, 2021). Additionally, the pupils may study in accordance with their demands without any problems.

Research Objectives

1. To explore university educators' perceptions of AI-powered learning tools.
2. To identify factors influencing AI adoption using the TAM framework.
3. To assess the challenges educators face in implementing AI in their teaching practices.
4. To provide recommendations for facilitating AI integration in Pakistani universities.

Significance of the Study

This research provides insights into the opportunities and limitations of AI in higher education, particularly in the Pakistani context. The study aims to help policymakers, academic institutions, and educators develop strategies to integrate AI effectively into their teaching methodologies. Over time, there have been notable breakthroughs in Artificial Intelligence (AI) technology in educational contexts, which have changed conventional teaching and learning approaches. Several significant phases may be used to trace the progression: Early 60s–1980s AI in Education: The first attempts to use AI in education were characterized by experimental systems that offered computer-assisted training. Basic activities like drill-and-practice exercises were the main emphasis of early systems (Bunderson & Inouye, 2013).

The intricacy of educational tasks and processing power restrictions, however, limited the broad application of AI in this age. Ethical issues and appropriate AI practices are becoming more and more important as AI continues to play a significant role in education. Active discussions about data privacy, algorithmic bias, and the moral use of AI in decision-making processes have an impact on the creation and application of AI technology in the classroom. AI's development in educational contexts shows a progression from simple computer-assisted instruction to complex, immersive, and adaptable learning environments. In order to resolve ethical issues, encourage inclusion, and guarantee responsible implementation in education, continuous efforts must be made as AI technologies develop (Nasir, 2024).

Research Questions

1. What are educators' perceptions of AI-powered learning tools in Pakistani universities?
2. What factors influence the acceptance and adoption of AI in higher education?
3. What challenges do educators encounter while using AI-based educational tools?
4. How can universities enhance the adoption of AI in teaching and learning?

Literature Review

AI technologies have revolutionized higher education by offering personalized learning, automated assessments, and intelligent tutoring systems (Chen et al., 2021). Studies highlight that AI enhances student engagement and provides data-driven insights for educators (Zawacki-Richter et al., 2019). A rising focus on ethical issues and appropriate AI practices continues to play a significant role in education. The development and application of AI technologies in education are influenced by the ongoing discussion of issues pertaining to data privacy, algorithmic

bias, and the moral application of AI in decision-making processes (Alam et al., 2024). The trajectory of AI's development in educational environments in the field of computer science, known as artificial intelligence, or machine intelligence, involves machines being designed to carry out intellectual activities that are typically completed by people (Kurzweil et al., 1990).

Computers use AI approaches and other devices to comprehend, analyse, and learn from data using specially created algorithms. Since its establishment as a field of study in the 1950s, artificial intelligence has been extensively studied in many fields. Two key methods in AI machine learning are classification and clustering. Both algorithms accept input in the form of text, numbers, images, and videos. Large volumes of data are used as training datasets for classification algorithms, including Bayesian networks, neural networks, and decision trees (Auld et al., 2007). These classification algorithms fall into two categories: supervised learning and unsupervised learning. Labelled data vectors are used during training in supervised learning, as opposed to unsupervised learning methods. In the testing phase of both methods, class labels are utilized. Another AI model that analyses sequential data by forecasting the subsequent unit element from the preceding element is called a Recurrent Neural Network (RNN).

The prevention of dropouts and engagement has been the subject of several studies. In order to identify the emotions of students, Leony et al. (2013) use machine image recognition algorithms to analyse the facial expressions that are recorded by cameras. A machine-learning model is trained using historical system log data by Pereira et al. (2019) to determine if a student would discontinue an online course that also offers instructor support in terms of engagement. It seems unlikely that the entire impact of using AI in education has been completely realized yet. Despite its growing popularity in the field of computer science, Afzaal et al. (2021) employed a counterfactual approach. AI will simplify the creation of media and instructional materials, eliminating the need for teachers to have a thorough understanding of technology. Teachers only need to sort and select based on their needs among the numerous platforms and applications that are currently accessible.

Teachers no longer have to spend a lot of time grading student work because of artificial intelligence. Students' assignments may be automatically assessed, and item analysis can be provided directly, saving teachers from having to perform the analysis one at a time. The use of AI in education also leads to direct scores for students. It does not take them long to discover their worth. The teacher will have more time to concentrate on the teaching and learning process if they can reduce the amount of time they spend on assessments. As more courses are being taught online and made remotely accessible, managing the data produced by the system is likewise becoming more difficult. AI and big data mining are becoming commonplace when analysing information technology in educational settings. Kohnke, & Zaugg, (2025) described the various fields and applications that AI may serve and offer valuable

insights for future study. The ways in which AI may assist ITSs in the direction of sustainable education are viewed from many angles. It seems sense to examine various implementations using a common framework that may aid academics in developing a reasonable understanding and promoting the use of sustainable education. Gillani et al. (2023) carefully outlined several aspects of reviewing procedures to aid researchers, and our study likewise used those (Anwar et al., 2024).

AI Adoption Challenges

Barriers to AI adoption in education include a lack of technical skills, ethical concerns, and resistance to change (Selwyn, 2020). Studies also indicate that institutional policies and infrastructure play a crucial role in the successful implementation of AI in education (Fletcher & Griffiths, 2022). Some adoption challenges are as under

- Data quality, ethical issues, integration with current systems, a shortage of qualified personnel, organizational resistance to change, and worries about data security and privacy are some of the obstacles to AI adoption.
- The efficacy of AI applications may be hampered by inaccurate, incomplete, or poor data quality.
- A significant barrier is worries about data security and privacy, particularly when handling sensitive data.
- Limited data availability can be a major problem, especially for certain use cases.
- Biased data can be used to train AI models, which can then reinforce and magnify societal biases and produce unfair or discriminatory results.
- Since many AI models are "black boxes," it can be challenging to comprehend how they make judgments, which raises questions about fairness and accountability.

Theoretical Framework

This study employs the Technology Acceptance Model (TAM), a theory adopted in information systems, which explains how users accept and use modern technology. The theory suggests that the perceived usefulness and perceived ease of use are the key factors influencing a user's decision to adopt a new technology. These perceptions, in turn, affect a user's attitude toward the technology and their intention to use it, ultimately affecting actual system use. In essence, the TAM provides a framework for understanding the fact that why people accept or reject new technologies, which is crucial for successful implementation and adoption in various settings. To understand educators' acceptance of AI-powered learning tools. The model’s key components perceived usefulness, perceived ease of use, and external variables, help analyse educators' willingness to integrate AI into their teaching practices (Venkatesh & Bala, 2008).

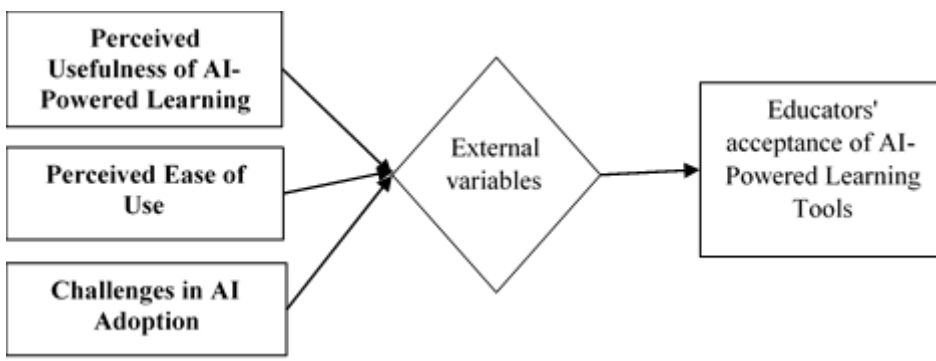
Technology Acceptance Model (TAM)

Davis (1989) developed TAM, which uses two main constructs, perceived utility and perceived ease of use, to describe how people embrace and employ technology. Studies indicate that these elements have a major impact on teachers' inclination to use AI-powered teaching resources (Teo, 2011). The Technology Acceptance Model (TAM) has been used in studies on new e-technology acceptance. It has been demonstrated that attitudes and intentions to utilize technology are connected to users' perceptions of its utility. Perceived usefulness and utilization have a more harmonious relationship than other model variables. The Technology Acceptance Model (TAM), created by Davis in 1987, is one of the most popular models for examining user acceptance behaviour.

Of all the constructions, PU and PEOU are the most important since they assist in moulding an end user's perception of a technology, which in turn helps to forecast their feelings and acceptance of it. The development of the technology acceptance model and metrics has brought significant theoretical advancements as well as significant practical benefits. It was previously impossible to gauge people's willingness to adopt a range of technologies since there were no verified subjective measures. Nonetheless, this is now possible because of the model's use in evaluating IS usefulness. It was made easier to comprehend the cognitive and affective factors that regulate how system characteristics affect technology adoption by establishing constructs that demonstrated a significant and robust correlation with use behaviour.

In conclusion, Figure 1 depicts the theoretical underpinnings of the enhanced model put out in this investigation. Three-layer perception, cognition, and decision are formed by the seven components that make up the model. The factors at the user perception layer include perceived utility, perceived ease of use, and safety cognition risk. The impact pathways from the user perception layer to the cognitive stratum and ultimately to the decision level are covered by the suggested model.

Figure. 1: *Theoretical Framework Developed by Researcher in AI Adoption Methodology*



This study adopts a qualitative research design using semi-structured interviews. Thematic analysis was used to interpret the data. The semi-structured interview is one method of data collection that relies on asking questions within a predetermined thematic framework. However, the order and content of the questions are not present. In research, semi-structured interviews are often qualitative in nature. They are commonly used as an experimental tool in marketing, social science, survey methodology, and other research fields. They are also commonly employed in multi-interview field research, offering the same theoretical framework but allowing each interviewer to focus on different facets of the research problem.

Sample

Ten university educators from different disciplines were selected through purposive sampling. The participants had varying levels of experience with AI-based educational technologies (Aziz et al., 2024). University teachers of Punjab province were chosen as the sample of the study, and the sample size of the study was determined based on the need to achieve depth and wealth of the description. According to Gutterman (2015), the sample size is a matter of wealth of information rather than a matter of opinions and views. In this study, the sample size was 16 teachers from four different universities in the Punjab, of Lahore two were public universities and two were private universities. From each university, four of the respondents were purposively chosen in the sense those their experience is more than five years in higher education teaching. The selected universities are the University of Punjab, the University of Education, the University of Management and Technology, and the University of Central Punjab.

Research Tool

A semi-structured interview guide was used to explore educators' perceptions, challenges, and recommendations regarding AI adoption. To reveal complicated attitudes regarding AI, pedagogical philosophies, perceived benefits and downsides of AI in the education sector, and privacy concerns, the study used semi-structured interviews with ten teachers from various colleges. Three major topics are highlighted in the study: AI's ability to adjust to different learning demands, its impact on pedagogical dynamics, and the requirement for technical expertise to incorporate AI, and security and ethical concerns around AI use.

Findings and Thematic Analysis

1. Perceived Usefulness of AI-Powered Learning Tools

Participants highlighted AI's potential to enhance teaching efficiency and provide personalized learning experiences. The majority of professors noted:

i. *"AI-driven adaptive learning systems help tailor content according to student needs, making learning more effective."*

ii. *"AI-powered resources in the education sector, such as interactive and adaptive learning platforms, can increase student engagement and encourage active participation".*
iii. *"In the education sector, AI tools can give users access to more instructional materials and individualized help, especially when it comes to writing and programming".*
iv. *In a private university professor noted that "It is imperative that AI be used in education responsibly, and ethical issues must be taken into account".*
v. *Another explained that "Inadequate infrastructure, resources, and teacher training may make it more difficult to use AI tools effectively".*

2. Perceived Ease of Use

A paradigm known as the Technology Acceptance Model (TAM) explains why individuals are more or less inclined to adopt new technology and emphasizes the significance of perceived utility and ease of use. Many educators found AI tools complex and required training for effective implementation (Lopes et al., 2024):

i. "*User happiness increases with AI solutions that are simple to use. Users' intentions are positively impacted by perceived ease of usage*".
ii. Another private university assistant professor noted, "*People gain more from and are more likely to use AI products frequently when they are simple to use, which can enhance both academic achievement and work performance*".
iii. Furthermore, *"User-friendly AI applications must be designed to accommodate educators with limited technical expertise."*

3. Challenges in AI Adoption

Key barriers included technological infrastructure, ethical concerns, faculty resistance, and lack of institutional policies. Using AI-powered learning tools comes with several obstacles that call for specialized resources and solutions, such as data protection issues, ethical considerations, integration hurdles, a lack of expertise, and resistance to change (AlAjmi et al., 2025)

i. *"AI has the potential to transform education, but ethical concerns regarding student data security must be addressed."*
ii. Another paid his notions as "*The use of extensive data collection by AI systems to personalize learning experiences raises questions about the security and privacy of student data. Strong data protection rules and processes are necessary to ensure that student data is handled properly*".
iii. "*Among the new technologies that many educational institutions and instructors are hesitant to adopt are AI-powered learning aids. Overcoming this hesitancy will require training, transparent communication, and evidence of AI's benefits*".

4. Thematic Analysis of Interviews

i. **Technical Readiness:** Several educators noted that universities lack proper infrastructure for AI adoption. In the contemporary digital era, artificial intelligence (AI) has emerged as a disruptive influence in many businesses. Along with enhanced productivity and personalized educational experiences and services, it promises innovative solutions to persistent issues. However, despite AI's immense potential, many institutions struggle to adequately implement and integrate technology into their operations. Insufficient and unreliable technological and physical systems are needed to enable the efficient use and deployment of different technologies, procedures, and projects within the company. This can involve deficiencies in areas like power supplies, communication networks, data processing and storage capacities, and other auxiliary infrastructure. Educational institutions may face serious difficulties because of insufficient infrastructure, technical readiness, especially about data management, system dependability, and general operating efficiency.

ii. **Pedagogical Integration:** Some participants struggled to integrate AI tools into their traditional teaching practices. Artificial Intelligence (AI) is a major revolutionary force in the rapidly evolving field of education. The AI design framework for education is examined in the abstract, along with important components and considerations required for the successful use of AI in learning settings. AI can evaluate student performance, identify areas that require development, and dynamically modify the content of lessons. Additionally, Pedagogical Integration is given a lot of weight in the educational framework. Instead of replacing human teachers, AI is meant to supplement their skills. This collaborative method allows instructors to focus on higher-level activities like mentoring, guiding, and developing critical thinking abilities by employing AI to handle repetitive duties like grading and administrative work.

iii. **Training Needs:** Many interviewees highlighted the necessity of faculty development programs. A deeper comprehension of digital resilience and training practices informs market offerings and models as digital innovation transforms educational processes, if they hope to have a unique and innovative internal educational structure.

iv. **Ethical Concerns:** Most respondents raised concerns about AI algorithms potentially misusing student data. AI, revealing concerns about confidentiality and data security; ethical aspects of AI integration, highlighting the challenges of integrating. AI ethically; highlighting the need to strike balance between moral behaviour and technological advancement; human physical touch versus technological innovation, emphasizing the importance of traditional education despite technological advancements. The need for further in-depth teaching and training on the ethical use of AI in education sector is indicated by ethical education and preparedness through use of AI.

v. **Institutional Support:** The need for strategic university policies to facilitate AI adoption was repeatedly emphasized. Stakeholder perceptions of AI's usability and simplicity of use have a substantial impact on its perceived value, which is determined by organizational complexity, preparedness, competency, compatibility, and competitive advantage. These elements strengthen the desire to implement institutional support from AI in Pakistan's higher education system. The greatest effect size is attributed to perceived usefulness, whereas private and public universities place different values on usability. While competitive advantage and some internal elements are sufficient requirements for AI adoption, by institutional support, external factors such as partner support and competitive advantage must be taken into account.

vi. **Resistance to Change:** Some educators were hesitant about shifting from traditional teaching methods. The obstacles to the effective application of artificial intelligence (AI) in businesses emphasize the ethical, organizational, and psychological issues. To ensure a smooth integration of AI technology into company operations. Resistance is made worse by ethical issues like prejudice, accountability, and privacy abuses. AI adoption can be greatly accelerated and opposition reduced by employing tactics including promoting openness, coordinating AI projects with corporate objectives, putting strong governance in place, and tackling ethical dilemmas.

vii. **Personalized Learning Benefits:** AI's ability to provide individualized learning experiences was seen as a significant advantage. Users can effectively receive better learning using a personalized e-learning system. Personalized material can be delivered in several ways, but the most popular ones are adaptive and adaptable learning. In the former and traditional method, a recommendation system is developed that presents information based on the learner's comprehension level.

viii. **Cost Concerns:** Several participants indicated that AI integration is expensive and requires substantial funding. Adoption of AI can be costly, requiring a large initial investment for research, implementation, and maintenance, in addition to possible expenditures for compliance and regulations and the requirement for qualified staff. A substantial financial investment in specialized equipment, infrastructure, and qualified personnel is necessary for the development and implementation of AI systems. AI models require vast quantities of high-quality data, which can be expensive to acquire, clean, and label. AI models need constant training and upkeep, which can be expensive in terms of processing power, data storage, and professional staff.

ix. **Equity and Accessibility:** Some educators highlighted AI's potential to bridge educational gaps; while others worried, it might widen disparities. Addressing the digital divide in Pakistan, integrating a range of viewpoints into AI research, and reducing potential biases are all necessary to ensure equity and accessibility in AI adoption. Regardless of socioeconomic background or place of residence, make sure that everyone has access to the technology and digital literacy skills they need

to engage in the AI era. The government should put laws and measures in place to reduce the digital gap, such as subsidized devices, training programs for digital literacy, and reasonably priced internet connections.

x. **Perceptions of Future AI Trends:** Many interviewees acknowledged AI as an inevitable aspect of future education but emphasized the need for careful implementation. Future AI trends are viewed with a mixture of excitement and trepidation. While many anticipate that AI will transform various industries and everyday life, others are concerned about job displacement, ethical concerns, and possible abuse. It is seen as a tool to increase overall efficiency, improve decision-making, and automate processes in a variety of industries, such as manufacturing, healthcare, and customer service. While some are concerned about job displacement, others think AI will boost economic growth by enabling businesses to run more effectively and efficiently, leading to the creation of new job possibilities.

AI has the potential to enhance human talents by offering resources for creativity, learning, and problem solving. It is anticipated that AI will be essential in addressing difficult societal issues, including resource management, illness prevention, and climate change.

Discussion

The results are consistent with other studies, demonstrating that perceived utility and usability have a major impact on the adoption of AI in higher education (Teo, 2011). However, obstacles, including a lack of institutional backing and ethical issues, prevent wider use. Adoption of AI can be facilitated by addressing these obstacles through training initiatives and legislative changes (Fletcher & Griffiths, 2022). While it might be able to instruct students, artificial intelligence is unable to assist them in developing their character. It is what educators do. How to inspire, motivate, and shape students into successful learners, AI cannot replace instructors in areas like character development, inspiration, and motivation, since it lacks the feelings and emotions that humans do. If we consider technological advancements, we must ultimately be able to adjust as they occur. If we do not adapt, technology may eventually replace us as educators (lecturers and teachers). According to the TAM framework, perceived usefulness and perceived ease of use strongly influence educators' willingness to adopt AI. This study reaffirms that while AI is seen as beneficial, its complexity and ethical concerns reduce its perceived ease of use. To increase adoption, institutions must address these concerns through well-structured interventions, aligning with previous TAM-based research in education (Venkatesh & Bala, 2008).

Conclusion

This study underscores the potential of AI-powered learning tools in enhancing education but highlights the challenges of adoption in Pakistani universities. Institutional support, professional development, and ethical

considerations are essential for successful AI integration (Leask & Younie, (2024). In conclusion, the launch of ChatGPT gained significant traction throughout the end of the pandemic, and its cutting-edge features expanded swiftly into several industries and other domains, including educational settings. But with the advancement of technology, a number of new problems and moral oddities have been discovered, highlighting new paradoxes that are difficult to resolve. Based on our conversations thus far, it appears that generative AI tools are both disruptive and transformative technological interventions. But as tech professionals and seasoned users think about how it may be widely used, generative AI technologies like ChatGPT are now being discussed and investigated academically (Hill-Yardin et al., 2023).

Additionally, the worldwide epidemic prompted the demand for asynchronous learning platforms and increased self-reliance. In this case, students now need a great deal of autonomy in terms of their learning style and rate. Theoretically, generative models like ChatGPT and artificial intelligence may represent a learner's sociocultural background while also accommodating the new demands and ease of learning (Iqbal, 2003). However, this shift to AI has exacerbated a number of quality-related pedagogical problems, such as the digital gap between people with and without access to advance. Generative AI models, including limited engagement, a lack of academic preparedness, ethical concerns, and inadequate accountability, have also highlighted other disadvantages. There are many restrictions on the present review. First, published articles in peer-reviewed publications and reliable databases were the only focus of the manuscript and search procedure (Božić & Poola, 2023).

Applying certain quality parameters should be used with caution while using such literature. The writers' assessment of the emergent themes and their presentation are other limitations of this review. For example, future studies might examine how generative models affect other theoretical designs in fields like organizational learning, information systems, and health-related fields like electronic health records. Researchers of the future generation may look at ChatGPT's intriguing dimensions. Although this field of study is still in its infancy, its comprehensive acceptance across many industries has been quick and complete. However, the education industry has adopted generative AI more slowly. Investigate AI resources and keep yourself updated. Examine the capabilities and possible uses of AI technologies such as ChatGPT in early childhood education by experimenting with fake data.

To keep informed about AI-based learning analytics solutions for ECE, set up Google Alerts. Talk cooperatively with co-workers. Call frequent staff meetings to go over the possible advantages, difficulties, and moral issues of using AI in learning analytics. Put in place AI monitoring and detection systems in your classroom to make sure that instructors and support personnel follow rules and moral principles when utilizing AI technologies. Make a comprehensive internal policy for your school that

covers topics like data protection, ethical AI tool use, and a well-rounded strategy that incorporates AI suggestions with the knowledge and training of your instructors.

Recommendations

- **Faculty Training Programs:** Universities should offer workshops to improve AI literacy among educators.
- **Institutional Support:** Policies and resources should be developed to facilitate AI adoption.
- **Ethical Frameworks:** Clear guidelines on AI use and data privacy must be established.
- **Collaboration with AI Developers:** Universities should partner with tech companies to customize AI tools for educational needs.

References

Afzaal, M., Nouri, J., Zia, A., Papapetrou, P., Fors, U., Wu, Y., ... & Weegar, R. (2021). Explainable AI for data-driven feedback and intelligent action recommendations to support students self-regulation. *Frontiers in Artificial Intelligence*, *4*, 723447.

AlAjmi, Q., AlRoshdi, Y., & Rostaq, A. (2025, August). Impact of Perceived Ease of Use and Usefulness, with Trust and Individual Impact as Mediators on AI Adoption Intentions among IT Students. In *Advances on Intelligent Computing and Data Science II: Proceedings of the 4th International Conference of Advanced Computing and Informatics (ICACIN 2024), Volume 1* (Vol. 254, p. 173). Springer Nature.

Alam, M. K., Afzal, S., & Basit, A. (2024). Effectiveness of the Use of the Internet as Supplementary Tool for Academic Learning: A Case Study of University Students. *Journal of Social Sciences and Media Studies*, *8*(1), 79-89.

Alam, M. K., Afzal, S., & Basit, A. (2024). Effectiveness of the Use of the Internet as Supplementary Tool for Academic Learning: A Case Study of University Students. *Journal of Social Sciences and Media Studies*, *8*(1), 79-89.

Anwar, H. M. N., & Basit, A. (2023). Online Teaching, University Teachers and the COVID-19 Pandemic: Exploration of Technology Acceptance Model (TAM). *Global Educational Studies Review*, *8*(1), 61-74.

Auld, T., Moore, A. W., & Gull, S. F. (2007). Bayesian neural networks for internet traffic classification. *IEEE Transactions on neural networks*, *18*(1), 223-239.

Aziz, F., Malik, G. M., Shamim-ur-Rasool, S., Khan, N., Alam, M. K., Afzal, S., & Scholar, M. P. (2024). Impact of Online Learning vs Traditional Mode of Learning on University Student's Educational Performance in Pakistan. *Remittances Review*, *9*(2), 870-881.

Božić, V., & Poola, I. (2023). Chat GPT and education. *Preprint*, *10*.

Bunderson, C. V., & Inouye, D. K. (2013). The evolution of computer-aided educational delivery systems. In *Instructional technology* (pp. 283-318). Routledge.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.

Davis, F. D. (1989). Technology acceptance model: TAM. *Al-Suqri, MN, Al-Aufi, AS: Information Seeking Behavior and Technology Adoption*, *205*(219), 5.

Fletcher, G., & Griffiths, M. (2022). Ethical considerations in AI-driven higher education. *AI & Society*, *37*(1), 89-102.

Gillani, N., Eynon, R., Chiabaut, C., & Finkel, K. (2023). Unpacking the "Black Box" of AI in education. *Educational Technology & Society*, *26*(1), 99-111.

Hill-Yardin, E. L., Hutchinson, M. R., Laycock, R., & Spencer, S. J. (2023). A Chat (GPT) about the future of scientific publishing. *Brain, behavior, and immunity*, *110*, 152-154.

Iqbal, A. M. (2003). *Evaluation of computer aided instruction: Assessing the value and effectiveness of operational systems*. University of London, University College London (United Kingdom).

Kohnke, S., & Zaugg, T. (2025). Artificial intelligence: an untapped opportunity for equity and access in STEM education. *Education Sciences*, *15*(1), 68.

Kurzweil, R., Richter, R., Kurzweil, R., & Schneider, M. L. (1990). The age of intelligent machines (Vol. 579). *Massachusetts: MIT press Cambridge*.

Leask, M., & Younie, S. (2024). *Teaching and learning with technologies in the primary school*. Routledge.

Leony, D., Muñoz-Merino, P. J., Pardo, A., & Kloos, C. D. (2013). Provision of awareness of learners' emotions through visualizations in a computer interaction-based environment. *Expert Systems with Applications*, *40*(13), 5093-5100.

Lopes, J. M., Silva, L. F., & Massano-Cardoso, I. (2024). AI meets the shopper: Psychosocial factors in ease of use and their effect on e-commerce purchase intention. *Behavioral Sciences*, *14*(7), 616.

Nasir, T., Siraj, S. A., Hannan, F. Z. U., Hussain, W., & Javed, S. (2024). A perception of university students regarding the influence of social media on the academic performance. *Journal of Peace, Development and Communication*, *8*(03), 431-450.

Pokrivčáková, S. (2019). Preparing teachers for the application of AI-powered technologies in foreign language education. *Journal of language and cultural education.*

Tariq, M. U. (2024). AI-powered language translation for multilingual classrooms. *Integrating generative AI in education to achieve sustainable development goals* (pp. 29-46). IGI Global Scientific Publishing.

Teo, T. (2011). Technology acceptance research in education. In *Technology acceptance in education* (pp. 1-5). Rotterdam: Sense Publishers.

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision sciences*, *39*(2), 273-315.

Visnudharshana, R., & Kishore, H. S. (2024). AI-driven language enhancement strategies for libraries: Empowering information access and user experience in an English language context. In *Improving library systems with AI: Applications, approaches, and bibliometric insights* (pp. 244-253). IGI Global Scientific Publishing.

Xing, H. (2022, December). Application Study of AI-powered Non-translatable Function in Computer-aided Translation. In *Proceedings of the 2022 5th International Conference on Education Technology Management* (pp. 104-109).

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators?. *International journal of educational technology in higher education*, *16*(1), 1-27.