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AI-DRIVEN PEDAGOGY: TRANSFORMING THE ROLE OF EDUCATORS AND LEARNERS

Muhammad Jamil[1], Shafiq Hussain[2], Muhammad Farhan[3], Yawar Abbas[4], Imran Shehzad[5]

Abstract

Artificial Intelligence (AI) has quickly transformed the way education is often delivered. Although AI continues to advance, there is still a significant need to investigate the new roles that educators and learners play in digital learning environments. The existing challenges that students face include the fact that not all teachers are ready to use AI, AI systems are designed for general use, and privacy aspects are debated. Currently, AI-powered education platforms facilitate personalized learning and automation; however, they often overlook the importance of teaching theory, practical application, and teacher involvement. In this study, we examine how AI technology can transform instructors' roles, proposing a new pedagogical transformation framework that keeps students at the center while utilizing AI automation. We introduced a multi-layered AI-human collaboration with AI advisor model that helps in adaptive content delivery and continuous teacher involvement. Our research is grounded in qualitative and empirical evaluations across various hybrid learning backdrops, delivering actionable insights into how AI can complement rather than entirely replace human pedagogy. We implemented our research by developing an AI-powered Learning Management System (LMS) that is integrated with Gemini APIs. The research contributes to the discussion about sustainable AI usage in 21st-century pedagogy by highlighting its potential to assist teaching, facilitate student learning, and drive overall advancements that lead to more resilient and intelligent education.

Keywords: *AI-Driven Pedagogy, Educators, Learners*

Introduction

Education has undergone significant changes over the past two decades, primarily due to advances in technology that have revolutionized learning and teaching. Among these advancements, Artificial Intelligence (AI) has emerged as a powerful catalyst for change, offering opportunities to enhance the learning experience, improve teaching efficiency, and personalize instruction at scale. It started with simple automation, but today's AI-powered training applications can adjust what a learner sees based on their achievements, point out where they need help, and provide immediate advice (Ray & Sikdar, 2024). The widespread integration of AI technologies—such as intelligent tutoring systems, automated assessment tools, and virtual learning assistants—has signaled the beginning of a paradigm shift in education: from teacher-centered instruction to a more learner-centric, data-informed pedagogical approach (Muhammad Farhan, Aslam, Jabbar, Khalid, & Kim, 2017).

[1] Department of Computer Science, COMSATS University Islamabad, Sahiwal Campus. jamil138.amin@gmail.com
[2] Department of Computer Science, University of Sahiwal. drshafiq@uosahiwal.edu.pk (Corresponding Author)
[3] Department of Computer Science, COMSATS University Islamabad, Sahiwal Campus. farhansajid@gmail.com
[4] Department of Computer Science, COMSATS University Islamabad, Sahiwal Campus. yawar.ravian@gmail.com
[5] Department of Computer Science, COMSATS University Islamabad, Sahiwal Campus. maniedulive@gmail.com

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Despite these advancements, the introduction of AI in educational environments has also surfaced numerous pedagogical, ethical, and practical challenges. Among the most significant challenges is determining how educators will work in AI-supported learning environments. For a long time, educators have been at the forefront of organizing, mentoring, and teaching their students. Because AI now generates content, monitors progress, and provides feedback to learners, the teacher's role has expanded beyond direct instruction (Muhammad Farhan et al., 2018). Now, educators are required to help guide learning, plan activities and act as the link between computerized resources and students. This transformation demands not only a shift in skills and mindset but also a critical re-evaluation of pedagogical frameworks that accommodate the unique dynamics introduced by AI systems (Ullah, Wang, Farhan, Habib, & Khalid, 2021).

Students both welcome and hesitate regarding the introduction of AI into the classroom. They can benefit from learning paths tailored to their needs, engaging in digital activities, and recommendations that match their learning pace and schedule. Yet, they may find it harder now as they deal with increased reliance on AI, less time spent on discussions with others, and a lack of motivation if the system doesn't understand the context. Additionally, because students interact with AI differently, it creates differences in their academic achievements. These problems are exacerbated when educators either lack sufficient knowledge about AI or are discouraged by a lack of funding, the high cost, or doubts about the new technology (Zootzky & Pfeiffer, 2024).

There is further complexity because of the way AI systems operate. Most AI products in education are designed to serve multiple purposes rather than being tailored for specific and contextualized teaching. Although they can handle creating and assessing quizzes, grading, or providing recommendations, they often overlook important aspects of learning, including teaching theory and the social-emotional aspects of education. Such barriers may cause the technology to fail to meet the requirements of students and teachers as part of their diverse and evolving learning experiences. Many educators and organizations remain hesitant about privacy, as they worry about the ethics of AI systems collecting data, surveilling students, and making decisions based on algorithms (Strielkowski, Grebennikova, Lisovskiy, Rakhimova, & Vasileva, 2025).

To address these issues, we developed an AI-powered learning management system that incorporate features such as Virtual Instructor (AI advisor chatbot), AI content generation and automation, AI-generated thumbnail of the course, student performance analytics, interactive course summaries, and automated quizzes.

Our research aims to explore how educators and learners are being redefined in classrooms where AI is utilized. Rather than viewing AI as an alternative to traditional teaching, we approach it as a co-agent that can enhance and augment pedagogical interactions. In doing so, we proposed a novel pedagogical transformation framework that places the student at the center of

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the learning ecosystem while ensuring continuous educator involvement. At the core of this framework lies a multi-layered AI-human collaboration model that distributes instructional tasks across human and machine agents based on their respective strengths—cognitive empathy, contextual awareness, and content expertise on the part of teachers; scalability, automation, and pattern recognition on the part of AI (Waqar, Aslam, & Farhan, 2019).

The model we propose allows for flexible content, supports the development of students' higher-order skills, and enables educators to focus more on emotional and social support. We evaluate how well this framework holds up in real-world hybrid learning situations, using both research and observations. The researchers review interviews with educators, student opinions, and the use of the AI platform to determine how teaching roles change, what ongoing issues arise, and which interventions are most effective.

The significance of this research lies in its contribution to the growing discourse on AI in education, particularly from a pedagogical standpoint. The study demonstrates that focusing on the potential of AI for various roles, rather than solely on the technology itself, provides valuable insights for educators, policymakers, and EdTech creators seeking to utilize AI responsibly and effectively (Kayal, 2024). Moreover, it emphasizes that in education, we should prioritize people and their qualities, such as empathy, critical thinking, and adaptability, while leveraging the advantages of intelligent systems to support learning. Ultimately, this project aims to enhance, improve, and modernize the education systems required for our current age.

Related Work

The intersection of AI and modern education has emerged as a vibrant research domain, with a rapidly growing body of literature studying the application of AI technologies in personalized education, intelligent tutoring systems, educational analytics, and sustainable curriculum automation. Considerable researchers have found that AI plays a role in helping students learn more effectively, automating certain teaching routines, and facilitating better decision-making (Yadav, 2025). There have been few studies to date examining how AI is transforming the work of educators and learners. It reviews the main aspects of related research that are relevant to our study, including AI-based learning systems, teachers' interactions with AI, understanding students, frameworks for teaching, and the ethical issues associated with using AI.

Impact of AI in Intelligent Tutoring Systems for Education

Intelligent Tutoring Systems (ITS) are a significant early application of artificial intelligence in education. AutoTutor and Cognitive Tutor utilized machine learning to adjust the delivery of their lessons based on how users interact with them (M Munwar Iqbal, Farhan, Saleem, & Aslam, 2014). The authors conducted a thorough analysis demonstrating that ITS perform as well as human tutors under certain conditions. To understand learners effectively, they rely on

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Natural Language Processing (NLP), Bayesian knowledge tracing, and Reinforcement Learning (RL) (Malik, Mir, Farhan, Rafiq, & Aslam, 2017).

Similarly, with Knewton, DreamBox, and Squirrel AI, students receive content tailored to their learning abilities. These platforms could enhance engagement and outcomes, particularly in large online educational programs (Muhammad Farhan et al., 2012; Muhammad Munwar Iqbal, Farhan, Jabbar, Saleem, & Khalid, 2019). Even so, these platforms are often criticized for focusing primarily on how learners use them, thereby missing out on a deeper understanding of emotions and culture in learning.

Should AI assist, step in, or work in conjunction with the teacher?

Recently, various studies have focused on the impact of artificial intelligence (AI) on teaching. AI should not replace teachers but rather enhance how teachers teach. They described a system in which AI supports teachers with paperwork, reviews student work, and designs learning content, enabling teachers to prioritize mentorship and teaching deeper concepts like the assistance of ChatGPT (Ruksana, 2024).

In 2018, Holstein and his team conducted ethnographic research in K-12 schools, noticing that teachers struggled to interpret what AI systems produced and apply it to what they already taught. The study highlighted that AI should assist teachers rather than complicate their jobs. Likewise, Real-time feedback offered through teacher dashboards provided instructors with insight; however, most systems did not guide them, causing teachers to think more critically while learning (Muhammad Farhan et al., 2017).

There is tension in the literature between AI systems that involve teachers closely and those that could render the teacher less important. It demonstrates that we still do not know how to create the most effective teaching models in AI-based learning environments without compromising teacher agency. M. Farhan et al. (M Farhan, 2015; Muhammad Farhan & Aslam, 2017; Muhammad Farhan, Iqbal, & Naeem, 2015) has analyzed the TEDx video and other videos for visual assessment.

Students and AI Learning and Learning Independence

Learners frequently experience AI tools as empowering tools that provide focused feedback, scaffolding, and small assessments that encourage independent learning (Muhammad Munwar Iqbal, Farhan, & Saleem, 2015). Self-regulated learning (SRL) with the aid of AI, noting that AI can only prompt metacognitive thinking, and students still benefit from instruction on how to maximize the effectiveness of these systems. People often see AI systems as objective and are too quick to follow their decisions, even if those decisions differ from what they already understand (Muhammad Farhan, Zahra, Iqbal, & Aslam, 2014). Additionally, AI technology has not yet fully supported aspects such as student motivation and team efforts. The emotion-sensing systems in education can enhance students' learning. Still, using these tools in classrooms is not

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possible at the moment due to privacy, hardware, and understanding difficulties (Usman et al., 2017).

Models for Teaching with AI

Several learning approaches have been suggested for using AI in the classroom. Holmes et al. introduced the phrase "AI-augmented pedagogy," which applies AI to teaching that builds upon students' experiences and encourages inquiry-based learning (Dadhich, Yadav, Yadav, Huzooree, & Dewasiri, 2025). They point out that models should facilitate teacher-student discussions and increase students' reflection rather than merely automating the delivery of assignments (Yousaf et al., 2024).

Similarly, Chen et al. (2020) developed a "Symbiotic Learning Framework" that highlights how both human and machine agents mutually benefit each other (Saghafian & Idan, 2024). The framework explains the differences in how AI and human teachers provide content analysis versus improving student emotions. Despite being conceptually well-developed, many of these models are not verified in practice or tested in classrooms (Pallathadka et al., 2023).

Ethical, Privacy, and Bias Concerns

Ethical issues are a significant aspect of academic research on AI in education. Many news stories have addressed concerns about student privacy, potential biases from algorithms, and a lack of clarity regarding their use. According to Williamson and Eynon (2020), the extensive use of predictive analytics in education may overlook particular learners and exacerbate the gap between those who have access to resources and those who do not (Williamson, Eynon, & Potter, 2020).

Furthermore, the vast majority of educational AI is difficult to explain, which limits the extent to which teachers and students can understand it (Singh, 2024). Because the model cannot be interpreted, trust is reduced, and implementing significant improvements becomes challenging. According to Wang et al. (2021), incorporating Explainable AI (XAI) features into educational technology can make it more user-friendly and equitable. Even so, using XAI as a teaching tool is still at an early development stage (Minh, Wang, Li, & Nguyen, 2022).

Identified Gaps and Research Positioning

Although current studies significantly influence how we view AI in education, they often overlook the extensive changes required in how teachers teach, their support roles, and students' learning methods. No approach is yet available that uses AI as a true co-teacher by directly engaging with students in education. Additionally, there is little that helps educators smoothly transition into these new roles without compromising their teaching style. As before, there is

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little attention paid to how AI and people can work together to enhance learning in settings where digital and physical factors converge.

In the light of these findings, this study proposes a model for AI and human collaboration that incorporates updated perspectives on the roles of educators and learners in utilizing AI in classrooms. We use data collected in hybrid learning to develop our framework, focusing on AI that is both genuinely useful and ethical while prioritizing students' needs. By doing this, we aim to align AI's potential with the needs of real-world teaching, enabling AI to work in tandem with teachers rather than replace them.

Research Methodology

The research employs design-based research (DBR) to investigate how incorporating AI into a Learning Management System (LMS) alters the roles of educators and learners. Researchers view Artificial Intelligence as a collaborative partner with educators, aiming to enhance the way teaching and learning occur. The investigation centers on the AI-human relationship model built into a specialized Learning Management System (LMS), which automates content, offers additional instructional feedback, and supports current student assistance.

The methodology comprises three iterative phases as shown in figure 1.

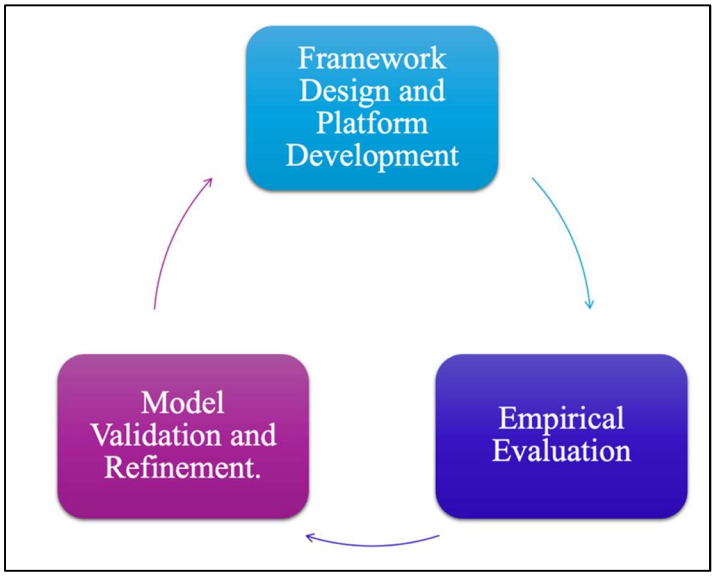

Figure 1. Research Methodology Phases

Phase 1: Framework Design and Platform Development

1.1 System Architecture

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We developed a fully functional Learning Management System (LMS) using Laravel 12, a modern PHP framework known for its modular, secure, and scalable architecture. The LMS is accessible at this link: https://sfa.dslogics.com/. The LMS integrates Gemini APIs for dynamic content generation and dialog-based learner assistance.

The AI-human collaboration framework is implemented across the 4 layers as shown in Figure 2.

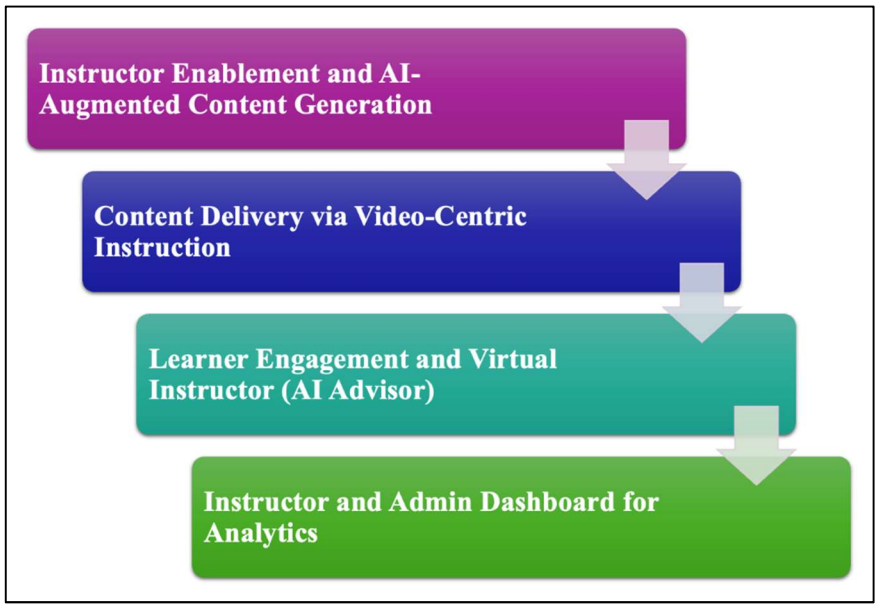

Figure 2. Proposed multi-layered AI-human Collaboration Model

- **Layer 1: Instructor Enablement and AI-Augmented Content Generation**
  Instructors are provided with automated input and output fields to generate:
  - Course outlines
  - Lesson plans
  - Topic summaries
  - Quiz templates

  The instructors need to write course title and a course brief and then they can generate all the stuff related to course. These are powered by prompt-chaining interactions with Gemini APIs, triggered through Laravel service classes. The framework uses role-based middleware to ensure only authenticated instructors can access AI-driven tools.

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- **Layer 2: Content Delivery via Video-Centric Instruction**

  For each lesson, instructors need to record instructional videos directly linked to the corresponding lesson plan. These videos are uploaded on designated course folder at Google Drive.

- **Layer 3: Learner Engagement and Virtual Instructor (AI Advisor)**
  Once enrolled, students can:
  - Access AI-generated course materials
  - Watch instructor-recorded videos
  - Engage with a **Virtual Instructor** powered by Gemini APIs

  The Virtual Instructor (AI Advisor) provides **contextual, real-time guidance** based on the video lesson. It supports prompt engineering strategies where video metadata (title, transcript, and lesson objective) is appended to learner queries to provide context-aware responses from AI.

- **Layer 4: Instructor and Admin Dashboard for Analytics**
  Teachers can monitor:
  - Video view counts
  - Drop-off rates
  - AI chat usage patterns
  - Feedback trends

  We have created a separated dashboards for the instructors and system administrators for real time analytics. The administrators can check the students' engagements like video views, number of queries asked to the virtual instructors in a particular course.

Phase 2: Empirical Evaluation

2.1 Participants and Scope

The system was deployed for 12 courses across a 8-week duration involving:

- **Instructors**: 12
- **Students**: 156
  The deployment covered wide disciplines of computer science ranging from web development to mobile app development. The courses level include begginer level, intermediate level and expert level.

2.2 Research Instruments

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- **System Usage Logs**
  Tracked how frequently learners watched videos, used the Virtual Instructor, or engaged with AI-generated materials.
- **Pre/Post-Surveys**
  Captured perception shifts in instructor roles, learner satisfaction with AI assistance, and perceived cognitive gains.
- **Interviews and Focus Groups**
  Conducted to analyze experiential feedback from both students and teachers on the LMS-AI integration.
- **Performance Metrics**
  Included quiz scores, time spent on tasks, AI query complexity levels, and overall course completion rates.

Phase 3: Model Validation and Refinement

The effectiveness of the AI-human collaboration framework was evaluated based on **pedagogical efficiency, learner support depth,** and **AI interpretability.**

3.1 Key Evaluation Metrics

- **Role Transformation**
  Analysis of how AI-enabled tools influenced the instructional focus of educators (e.g., shift from content delivery to mentorship).
- **Support Effectiveness**
  Measured how frequently the Virtual Instructor resolved learner queries without requiring instructor intervention.
- **AI Trust and Usefulness**
  Derived from Likert-scale ratings on explainability, satisfaction, and accuracy of AI-generated responses.
- **Content Relevance and Alignment**
  Reviewed by subject-matter experts to assess alignment of AI-generated material with pedagogical objectives.

3.2 Iterative Refinement

Insights from Phase 2 led to several refinements:

- **Prompt Tuning**
  Improved context injection for Gemini prompts by integrating video transcripts and student progress history.

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- **Chat Session Summarization**
  Introduced short summaries of previous learner-AI interactions for instructor review.
- **Instructor Override Mechanism**
  Enabled educators to pre-approve or modify AI-suggested responses for sensitive or high-stakes topics.
- **Scaffolded Learning Sequences**
  Enhanced the AI output structure to align with Bloom's Taxonomy levels (e.g., understanding, applying, analyzing).

Results and Discussion

The following section reports on the empirical results from using the AI-augmented LMS and investigates how these results relate to the proposed framework for AI and teacher collaboration. On LMS, 12 different courses of 12 different instructors were tested by 156 students. By reviewing the logs, hearing from users, checking results and consulting teachers, we recognized key aspects about how learning and teaching have evolved.

Learner Interaction with AI Advisor (Virtual Instructor)

A significant part of the research was to evaluate the usability and reception of the Virtual Instructor. Logs from the system displayed that 78.2% of students engaged with the AI advisor at least once per lesson. Table 1. shows the frequency distributions of student interaction with the AI advisor.

Table 1. Frequency distribution of student interactions with the AI Advisor across different use cases.

AI Advisor Usage Category	Percentage (%)
Clarification on Video Content	43.1
Follow-up Explanation on Concepts	36.5
Request for Examples	12.4
Other Queries	8.0

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Students found the AI especially helpful when instructors were unavailable, primarily using it for reinforcing lesson comprehension.

Instructor Role Transformation

Qualitative interviews and dashboard usage metrics revealed that instructors were increasingly focusing on:

- Designing lesson video content.
- Monitoring AI interactions to assess learner confusion patterns.
- Using AI-generated lesson summaries as scaffolds for quizzes and discussions.

The LMS analytics showed that 83.3% of instructors found the automated course planning tools time-saving, and 66.7% reported that the AI-assisted planning improved lesson quality.

Learning Performance Improvement

A comparison of pre- and post-AI implementation quizzes showed a statistically significant improvement in student scores is shown in Table 2.

Table 2. Comparison of learner performance metrics before and after the integration of the AI-powered LMS.

Metric	Pre-AI LMS (%)	Post-AI LMS (%)	Improvement
Average Quiz Score	64.3	74.6	+10.3
Quiz Completion Rate	78.2	88.9	+10.7
Lesson Engagement (Video Watch Time)	63%	81%	+18

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The improvement suggests that AI-supported scaffolding enhanced learner motivation and understanding, especially among mid-performing learners.

Student Feedback on Virtual Instructor

After successful completion of a course post-course survey (1–5 scale, 5 being highest satisfaction) provided in the Table 3.

Table 3. Summary of student perceptions on the usefulness, usability, and preferences of the AI-powered Virtual Instructor.

Evaluation Metric	Average Rating (out of 5)
Helpfulness of AI Explanations	4.2
Relevance of AI Responses	4.0
User-friendliness of AI Interface	4.5
Preference to Use AI Over Peers	3.9

Discussion and Interpretation

The analysis confirms that using AI in conjunction with teachers is a valuable approach. Many learners use AI frequently, and student results show that the platform can tailor education effectively. Primarily, teachers transitioned from simply delivering information to guiding, mentoring, and collaborating with learners while setting aside much of the administrative work.

At the same time, some issues were noticed:

- Certain students relied solely on the AI for help, which hindered teamwork.
- Some instructors believe that AI-crafted explanations for technological areas should be better filtered to avoid misleading information.

The results indicate that well-planned AI in education does not replace the teacher but instead enhances teaching methods, making learning more accessible, flexible, and tailored to students' needs.

Conclusion

This research highlights that Artificial Intelligence will alter the roles of teachers and students in learning environments. Creating and assessing an AI Learning Management System that integrates with Gemini APIs revealed how teaming AI with human support successfully enhances personalized learning, automates content, and facilitates real-time assistance. Data collected from the use of the system showed that students became more engaged, performed

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better on quizzes, and helped the instructor work more efficiently, demonstrating that AI is a partner, not a replacement, in education. Most importantly, this strategy kept the educator's role central and helped them shift time spent on routine activities to teaching new skills, giving advice, and providing emotional help. Overall, learners received helpful support from the Virtual Instructor, yet it was still necessary for real humans to step in to prevent them from overusing AI. The results have shown that AI works well in education when it is well-integrated, incorporates teachers' teaching expertise, focuses on students, respects their privacy, and also helps combat any potential discrimination. This work contributes to the conversation on sustainable AI by providing a proven model that equips AI with the ability to learn from humans—thereby ensuring that academic environments are adaptable and welcoming for students in the 21st century.

References

Dadhich, A., Yadav, R., Yadav, M., Huzooree, G., & Dewasiri, N. J. (2025). Teacher-AI Collaboration and the Future of the Educator's Role. In *Transformative AI Practices for Personalized Learning Strategies* (pp. 355-378): IGI Global Scientific Publishing.

Farhan, M. (2015). *A methodology to enrich student-teacher interaction in eLearning.* Paper presented at the The 30th ACM/SIGAPP Symposium on Applied Computing.

Farhan, M., & Aslam, M. (2017). An interactive assessment framework for visual engagement: statistical analysis of a TEDx video. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(4), 1107-1119.

Farhan, M., Aslam, M., Jabbar, S., Khalid, S., & Kim, M. (2017). Real-time imaging-based assessment model for improving teaching performance and student experience in e-learning. *Journal of Real-Time Image Processing, 13*, 491-504.

Farhan, M., Iqbal, M. M., & Naeem, M. R. (2015). ANALYSIS OF VIDEO LECTURE'S IMAGES FOR THE COMPRESSION FORMATS SUPPORT FOR THE STUDENTS IN ELEARNING PARADIGM. *Science International, 27*(2).

Farhan, M., Jabbar, S., Aslam, M., Ahmad, A., Iqbal, M. M., Khan, M., & Maria, M.-E. A. (2018). A real-time data mining approach for interaction analytics assessment: IoT based student interaction framework. *International Journal of Parallel Programming, 46*, 886-903.

Farhan, M., Munwar, I., Aslam, M., Enriquez, A. M., Farooq, A., Tanveer, S., & Mejia, A. P. (2012). *Automated reply to students' queries in E-Learning environment using Web-BOT.* Paper presented at the 2012 11th Mexican International Conference on Artificial Intelligence.

Vol. 5, No. 3 (2025)
EDUCATIONAL RESEARCH AND INNOVATION (ERI)
e-ISSN:2710-4354
p-ISSN:2076-9660
Received: 02/08/2025 Accepted: 14/09/2025

Farhan, M., Zahra, R., Iqbal, M. M., & Aslam, M. (2014). EXTRACTING PARAMETERS FROM E-FEEDBACK TEXT DATA BASED ON KEYWORD BASED PARSING IN ELEARNING ENVIRONMENT. *Science International, 26*(3).

Iqbal, M. M., Farhan, M., Jabbar, S., Saleem, Y., & Khalid, S. (2019). Multimedia based IoT-centric smart framework for eLearning paradigm. *Multimedia Tools and Applications, 78*(3), 3087-3106.

Iqbal, M. M., Farhan, M., & Saleem, Y. (2015). Personalization with Agent in E-Learning Framework. *Sci Int, 26*, 2541-2543.

Iqbal, M. M., Farhan, M., Saleem, Y., & Aslam, M. (2014). Automated web-bot implementation using machine learning techniques in eLearning paradigm. *J Appl Environ Biol Sci, 4*(9), 152-166.

Kayal, A. (2024). Transformative Pedagogy: A Comprehensive Framework for AI Integration in Education. In *Explainable AI for Education: Recent Trends and Challenges* (pp. 247-270): Springer.

Malik, K. R., Mir, R. R., Farhan, M., Rafiq, T., & Aslam, M. (2017). Student query trend assessment with semantical annotation and artificial intelligent multi-agents. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(7), 3893-3917.

Minh, D., Wang, H. X., Li, Y. F., & Nguyen, T. N. (2022). Explainable artificial intelligence: a comprehensive review. *Artificial Intelligence Review*, 1-66.

Pallathadka, H., Wenda, A., Ramirez-Asís, E., Asís-López, M., Flores-Albornoz, J., & Phasinam, K. (2023). Classification and prediction of student performance data using various machine learning algorithms. *Materials today: proceedings, 80*, 3782-3785.

Ray, S., & Sikdar, D. P. (2024). AI-Driven flipped classroom: Revolutionizing education through digital pedagogy. *Psychology, 7*(2), 169-179.

Ruksana, T. (2024). AI-Driven Pedagogy: Unveiling ChatGPT's Influence in Education. *Journal of Applied Science, Engineering, Technology and Management, 2*(01), 09-14.

Saghafian, S., & Idan, L. (2024). Effective generative ai: The human-algorithm centaur. *arXiv preprint arXiv:2406.10942*.

Singh, A. (2024). The future of learning: AI-driven personalized education. *Available at SSRN 5076438*.

Strielkowski, W., Grebennikova, V., Lisovskiy, A., Rakhimova, G., & Vasileva, T. (2025). AI-driven adaptive learning for sustainable educational transformation. *Sustainable Development, 33*(2), 1921-1947.

Vol. 5, No. 3 (2025)
EDUCATIONAL RESEARCH AND INNOVATION (ERI)
e-ISSN:2710-4354
p-ISSN:2076-9660
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Ullah, F., Wang, J., Farhan, M., Habib, M., & Khalid, S. (2021). Software plagiarism detection in multiprogramming languages using machine learning approach. *Concurrency and Computation: Practice and Experience, 33*(4), e5000.

Usman, M., Iqbal, M. M., Iqbal, Z., Chaudhry, M. U., Farhan, M., & Ashraf, M. (2017). E-assessment and computer-aided prediction methodology for student admission test score. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(8), 5499-5517.

Waqar, M. M., Aslam, M., & Farhan, M. (2019). An intelligent and interactive interface to support symmetrical collaborative educational writing among visually impaired and sighted users. *Symmetry, 11*(2), 238.

Williamson, B., Eynon, R., & Potter, J. (2020). Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency. In (Vol. 45, pp. 107-114): Taylor & Francis.

Yadav, S. (2025). Advancing Education With AI-Driven Education for Diverse Learners: Integrating AI Into Pedagogical Practices. In *Integrating AI Into Pedagogical Education* (pp. 49-80): IGI Global Scientific Publishing.

Yousaf, M., Farhan, M., Saeed, Y., Iqbal, M. J., Ullah, F., & Srivastava, G. (2024). Enhancing driver attention and road safety through EEG-informed deep reinforcement learning and soft computing. *Applied Soft Computing, 167*, 112320.

Zootzky, G., & Pfeiffer, A. (2024). *Educational transformation through AI: Preparing for a new era of learning.* Paper presented at the INTED2024 Proceedings.