

The Impact of AI on Student Engagement in Virtual Learning within Bangladesh's Higher Education Sector

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Userhub

Published: January 16, 2025

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Publisher: Userhub.

Citation:

Talukder, N. M., & bin Ahsan, W. (2025). *The impact of AI on student engagement in virtual learning within Bangladesh's higher education sector*. Userhub.

<https://doi.org/10.58947/journal.jtgx34>

Abstract

This study examines the impact of Artificial Intelligence (AI) on student engagement in virtual learning environments within Bangladesh's higher education sector, using a mixed-methods approach. The research integrates qualitative interviews with educators, students, and IT professionals, alongside a quantitative survey of 97 university students. Findings reveal that AI enhances academic performance by improving efficiency and simplifying complex tasks. However, concerns about over-reliance on AI, diminished critical thinking skills, and data privacy issues were prominent. Technical challenges such as inaccurate outputs and usability barriers further impede effective adoption. To maximize AI's potential, the study recommends fostering critical thinking, refining AI tools for accuracy and personalization, and prioritizing data security. These findings offer actionable insights for educators, policymakers, and developers seeking to integrate AI effectively into virtual learning environments.

Keywords: Artificial Intelligence (AI), Virtual Learning Environments, Student Engagement, Higher Education, Mixed-Methods Study, Data Privacy, Critical Thinking

Introduction

Artificial Intelligence (AI) is rapidly transforming educational landscapes worldwide, particularly within virtual learning environments. In higher education, AI tools have revolutionized teaching and learning by enabling personalized learning experiences, adaptive feedback, and collaborative opportunities, all of which enhance engagement and academic outcomes (Bushuyev et al., 2024;

Crompton & Song, 2021). These technologies have demonstrated immense potential in tailoring educational pathways to individual student needs, improving both motivation and achievement (Zhai et al., 2024).

However, alongside these benefits, significant challenges persist. Over-reliance on AI tools has been shown to hinder the development of critical cognitive skills, such as critical thinking and analytical reasoning. Studies highlight that

students often favor quick AI-generated solutions over deeper cognitive engagement, potentially undermining their ability to solve complex problems independently (Çela et al., 2024; Zhai et al., 2024). Addressing these concerns requires a balanced approach that integrates AI as a complement to traditional learning rather than a replacement.

In developing regions such as Bangladesh, these challenges are further magnified by infrastructural limitations, digital divides, and privacy concerns. The disparity in access to technology and the hesitation to engage with AI due to data privacy apprehensions present significant barriers to equitable adoption (Aprianto et al., 2024; Chima Abimbola Eden et al., 2024). Additionally, issues such as inconsistent AI-generated responses and algorithmic biases necessitate a tailored approach to ensure effective integration in resource-constrained contexts (Bushuyev et al., 2024).

This study explores the perceptions and experiences of university students in Bangladesh regarding AI-driven virtual learning. By examining key factors such as student engagement, academic performance, privacy concerns, and technical challenges, it aims to provide a nuanced understanding of AI integration in higher education. The findings seek to bridge global AI frameworks with localized strategies, offering actionable insights to address the unique needs and constraints of developing markets.

Methodology

This study used a mixed-methods approach to investigate the impact of AI on student engagement in virtual learning within Bangladesh's higher education sector. The qualitative component explored the perspectives of educators, students, and IT professionals, while the quantitative survey identified patterns and measurable trends related to AI's influence.

A total of 97 university students, representing various disciplines and levels from public and private universities across Bangladesh, participated in the survey. Additionally,

17 participants were interviewed, including 13 students, 2 university teachers, and 2 IT professionals, to capture diverse insights into the opportunities and challenges posed by AI-powered learning platforms.

Data were collected through online surveys and interviews conducted face-to-face or via Google Meet, lasting 16 to 20 minutes. Participants were selected based on their familiarity with virtual learning platforms. Qualitative data were analyzed using thematic analysis to identify key themes such as AI integration, student engagement, and technical challenges. Quantitative survey results were analyzed using descriptive statistics to summarize metrics like student satisfaction and engagement levels.

This study adhered to ethical guidelines outlined by the American Psychological Association (APA, 2017). Informed consent was obtained from all participants, and confidentiality was maintained through anonymization and secure data storage.

Findings

This section synthesizes insights from qualitative interviews and quantitative survey data, providing a comprehensive understanding of the factors influencing student engagement, academic performance, and the integration of AI in virtual learning environments in Bangladesh.

Engagement with AI in Virtual Learning

The survey results revealed that AI tools have a varied impact on student engagement. While a majority of students (59%) reported increased engagement, nearly 21% felt no significant change, and smaller groups experienced decreased engagement (Table 1). Students appreciated how AI tools like ChatGPT streamlined their learning by providing quick access to information and summarizing complex materials. As one student remarked, "AI tools make learning faster by summarizing content, but they don't always align with what we're studying in class."

Despite the reported benefits, teachers raised concerns that AI's ability to simplify tasks often leads to passive learning. For instance, "Students use AI to complete assignments quickly but miss out on deeper cognitive engagement," explained one teacher. This highlights a critical need to align AI tools more effectively with academic content to sustain meaningful engagement.

Table 1: Impact of AI on Student Engagement During Virtual Learning Sessions

Response Category	Percentage (%)
Significantly increase engagement	27.4
Slightly increase engagement	31.6
No effect on engagement	21.1
Slightly decrease engagement	11.6
Significantly decrease engagement	8.4

Table 1: Percentage of students reporting changes in engagement levels when using AI tools in virtual learning environments.

AI Dependency and Critical Thinking

Dependency on AI tools emerged as a prominent concern, particularly among technical students who rely heavily on AI for tasks like debugging or completing assignments. Over half (51.6%) of survey respondents expressed feeling overly reliant on AI for academic work, with many students noting that this reliance has hindered the development of critical thinking skills. "AI helps solve problems quickly, but it's making me less independent in thinking through complex issues," admitted one student.

Teachers echoed this concern, observing that many students rely on AI-generated content without applying their own analytical skills. "You can tell when students copy directly from AI—they skip the critical step of refining ideas," explained a teacher. These findings suggest that while AI enhances efficiency, its overuse may impede the cultivation of deeper learning skills.

Academic Performance and Efficiency Gains

AI tools significantly improved academic performance for many students, especially those managing heavy workloads. Nearly 65% of survey respondents reported that AI tools enhanced their efficiency by simplifying complex topics and saving time. One student explained, "AI tools like ChatGPT help me summarize large readings quickly, making it much easier to prepare for exams."

Teachers also observed that AI allows students to focus more on understanding concepts by reducing the time spent on repetitive tasks. However, they cautioned against viewing AI as a substitute for fundamental academic practices. "AI can complement learning, but students need to build their knowledge base through consistent study," noted a teacher.

Privacy and Security Concerns

Concerns over data privacy emerged as a barrier to AI adoption, with 18.9% of students reporting hesitations about the safety of their data (Table 2). Some students limited their use of AI tools for sensitive tasks due to fears about data collection and transparency. As one participant shared, "I worry about how much data AI tools collect and whether it's safe to use them for personal work."

IT professionals emphasized that robust encryption and transparent privacy policies are essential to alleviating these concerns. "We ensure user trust by implementing strong encryption protocols and regularly updating privacy measures," explained one IT expert.

Table 2: Data Privacy Concerns Among AI Tool Users

Response Category	Percentage (%)
Privacy or security concerns	18.9
No privacy concerns	81.1

Table 2: Percentage of students expressing concerns or no concerns about data privacy and security in AI-powered virtual learning platforms.

Technical and Usability Challenges

Many students encountered technical issues when using AI tools, with 42.1% reporting irrelevant or incorrect outputs and 16.8% struggling to interpret responses. These challenges often led to frustration and inefficiency. “Sometimes the AI’s response doesn’t make sense, and I have to spend extra time figuring it out,” said one student.

Teachers observed that such usability gaps not only delay task completion but also erode trust in AI tools. They highlighted the importance of designing interfaces that cater to diverse student needs, emphasizing ease of use and relevance to academic goals.

Opportunities for Enhanced AI Integration

Students, teachers, and IT professionals suggested actionable steps for improving AI’s role in education. Nearly 65% of students recommended enhancing the accuracy of AI suggestions, while 45.7% advocated for better integration with course content (Table 3). One student emphasized, “If AI tools aligned more closely with what we learn in class, they’d feel more natural to use.”

IT professionals noted that continuous updates to AI models and more robust personalization features could address many of these challenges. “To meet evolving user needs, AI systems must be frequently updated and tailored to specific educational contexts,” remarked one IT expert.

Table 3: Suggested Improvements for AI-Powered Learning Platforms

Suggested Improvement	Percentage (%)
Improved accuracy of AI suggestions	64.9
Better integration with course content	45.7
More personalized recommendations	42.6
Easier user interface	28.7
Better data privacy and security	39.4

Table 3: Recommendations from students for improving the usability, accuracy, and integration of AI tools in virtual learning environments.

Discussion

This study provides critical insights into the dynamics of student engagement with AI tools in Bangladesh’s virtual learning environments. While AI integration has enhanced academic performance and efficiency, it has also raised concerns about critical thinking, data privacy, and technical challenges. These themes are discussed below in light of the findings and relevant literature.

AI’s Influence on Engagement

AI tools enhance engagement by offering personalized learning and adaptive feedback, with 59% of respondents reporting increased engagement. These findings align with global studies highlighting how adaptive systems sustain motivation by tailoring content to individual needs (Bushuyev et al., 2024; Crompton & Song, 2021). Intelligent tutoring systems, for instance, adjust difficulty levels to match student abilities, fostering interaction and participation.

However, engagement benefits are unevenly distributed, particularly in under-resourced areas where limited access to advanced AI tools restricts opportunities (Bushuyev et al., 2024). Additionally, AI often promotes surface-level engagement, as students rely on quick solutions without deeply interacting with the material. Teachers in this study observed that students frequently skipped critical learning steps when using AI tools, echoing global concerns about AI’s potential to undermine deeper cognitive engagement (Çela et al., 2024).

Academic Performance and Efficiency Gains

The study found that 65% of students experienced efficiency gains with AI, particularly in simplifying complex topics and organizing study materials. This reflects broader trends where AI-powered tools improve academic performance by enhancing comprehension and providing personalized support (Çela et al., 2024; Crompton & Song, 2021).

However, reliance on AI comes with trade-offs. While tools improve grades, they often reduce opportunities for independent learning, particularly in research-intensive fields. Global literature supports this, showing that over-reliance on AI encourages quick solutions at the expense of critical thinking and deep analysis (Çela et al., 2024). To address this, active learning strategies must complement AI tools, ensuring students develop analytical and problem-solving skills alongside efficiency.

Privacy and Security Concerns

Privacy concerns, reported by 18.9% of respondents, pose significant barriers to AI adoption. Similar challenges are observed in other resource-constrained settings, where inadequate data protection policies exacerbate users' hesitations (Chima Abimbola Eden et al., 2024; Farooqi et al., 2024). In Bangladesh, limited infrastructure and weak privacy measures further discourage students from using AI tools for tasks involving sensitive data.

Transparent data handling and robust encryption are essential to build trust and address these concerns (Farooqi et al., 2024). Localized frameworks, as recommended by Chima Abimbola Eden et al. (2024), can help ensure equitable access to AI tools while safeguarding privacy in developing regions.

Balancing Efficiency, Engagement, and Security

This study highlights the need to balance AI's benefits with the risks of dependency and privacy issues. Teachers and IT professionals emphasized designing AI tools that promote independent thinking and secure data handling. For example, IT professionals recommended integrating user-friendly encryption features and conducting regular audits to maintain security without compromising usability.

Embedding AI into curricula in ways that encourage creativity and critical thinking is crucial. Reflective exercises and active learning strategies can complement AI-driven

efficiency, ensuring students engage deeply with content rather than relying solely on automated solutions.

Global Implications

These findings contribute to global discussions on AI in education by highlighting the compounded challenges of integration in resource-constrained settings. While AI tools hold immense potential to transform learning, addressing ethical concerns, infrastructural gaps, and inequitable access is vital. Localized policies prioritizing security and accessibility are critical for sustainable AI adoption, as emphasized in recent studies (Bushuyev et al., 2024; Crompton & Song, 2021; Farooqi et al., 2024).

Recommendations

To address the challenges identified in this study and foster the effective integration of AI tools in virtual learning environments, the following recommendations are proposed. Each recommendation outlines key actions and specifies responsible stakeholders, as summarized in Table 4.

1. Enhance Student Interaction with AI: Promote critical thinking by designing assignments that encourage active engagement with AI as a complementary tool. Simplify user interfaces to enhance accessibility, and collect regular feedback from students to address usability issues.

2. Optimize AI Tools for Context-Specific Learning: Refine AI algorithms to ensure accuracy and alignment with academic content. Introduce personalized features and adaptive learning models to cater to diverse student needs and improve learning outcomes.

3. Strengthen Trust Through Privacy and Transparency: Implement robust encryption protocols and establish transparent data-handling policies to safeguard user

Table 4: Key Recommendations for Enhancing AI Integration in Virtual Learning

Recommendation	Actions	Responsible Stakeholders
Enhance Student Interaction with AI	<ul style="list-style-type: none"> • Design assignments to foster critical thinking • Simplify interfaces • Collect feedback 	Educators, developers, universities
Optimize AI Tools for Context-Specific Learning	<ul style="list-style-type: none"> • Refine algorithms for accuracy • Introduce personalization features • Pilot adaptive learning models 	Developers, educators
Strengthen Trust Through Privacy and Transparency	<ul style="list-style-type: none"> • Implement strong encryption • Develop transparent policies • Conduct audits and awareness campaigns 	IT professionals, university administrators

Table 4: Key Strategies and Actions for Effective AI Integration in Virtual Learning

information. Conduct regular audits and awareness campaigns to build trust and promote responsible AI usage.

Conclusion

The integration of AI tools into virtual learning environments in Bangladesh presents significant opportunities and challenges. On one hand, AI has proven effective in enhancing academic performance by increasing efficiency, enabling quick access to information, and assisting in managing complex tasks. Students have reported improved grades and deeper understanding when AI tools were used to summarize large volumes of material or provide immediate clarifications.

However, concerns about over-reliance on AI and its potential to diminish critical thinking skills remain critical barriers to fully realizing its educational benefits. Similarly, issues with the accuracy and contextual relevance of AI-generated content highlight the need for continuous refinement of these tools. Privacy and security concerns further impede widespread adoption, as students lack trust in platforms that handle sensitive data without transparent safeguards.

To address these challenges, AI tools must prioritize robust data protection measures and transparent policies while evolving to provide personalized and adaptive learning experiences that cater to diverse student needs. Collaboration among universities, educators, and IT professionals will be essential to ensure critical thinking is promoted, AI accuracy is maintained, and user trust is established.

By fostering an ecosystem that balances AI's transformative potential with safeguards for independent thought, security, and accessibility, AI can become a cornerstone of virtual learning in Bangladesh. Future research should explore scalable models for implementing AI in resource-constrained settings, ensuring equitable access and sustainable growth in educational outcomes.

Limitations and Future Research

This study has several limitations that may affect its generalizability. The sample was restricted to university students in Bangladesh, limiting insights into other demographics or international contexts. Additionally, self-reported data may introduce biases, such as social desirability or recall inaccuracies. The cross-sectional design

captures a single point in time, preventing analysis of long-term effects, such as changes in critical thinking or reliance on AI.

Future research should expand sample diversity by including learners from various academic disciplines, age groups, and regions. Longitudinal studies can explore how AI impacts academic performance and cognitive skills over time, addressing trends and causal relationships. Comparative studies of AI tools, such as ChatGPT or adaptive learning platforms, could highlight best practices and their relevance across disciplines. Finally, research should focus on integrating AI into curricula and assessing its alignment with teaching methodologies, particularly in resource-constrained settings.

Acknowledgments

We extend our gratitude to the university students, teachers, and IT engineers who contributed valuable insights into AI's role in virtual learning. We also appreciate the universities and institutions that facilitated data collection and participant access, which were instrumental in this research.

We acknowledge Userhub for providing technical resources and logistical support. Additionally, AI tools assisted in data analysis, survey design, and language enhancement. All outputs were critically reviewed and finalized by the research team to ensure accuracy, coherence, and alignment with the study's objectives.

Declaration of Interest

The authors declare no conflicts of interest and affirm that this research was conducted independently, without external funding or undue influence.

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