

A critical study on the use of artificial intelligence in E learning technologies to enhance learners' performance

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Abstract: The integration of artificial intelligence (AI) with e-learning technologies has significantly influenced modern educational practices by improving learners' performance, adaptability, and engagement. E-learning, defined as the use of digital and Internet-based tools to deliver flexible learning solutions, has become an essential method for enhancing academic outcomes and developing digital competence. This study critically examines how AI-enhanced e-learning systems contribute to learners' performance within higher education contexts. Quantitative data were collected from undergraduate students in computing and information disciplines at Al Baha University to evaluate their perceptions, experiences, and behavioral intentions toward AI-driven e-learning platforms. Statistical analysis revealed strong positive attitudes toward AI integration, with mean scores exceeding 4.3 regarding the usefulness, accessibility, and effectiveness of AI-based e-learning tools, with statistically significant P values ($p < 0.05$). The findings also show that AI tools promote collaboration among peers. These results confirm that AI-powered e-learning environments play a vital role in improving learning performance, efficiency, and a high level of behavioral intention to employ AI in e-learning. The study contributes empirical evidence to the importance of integrating AI technologies into e-learning systems and proposes directions for future work on personalization, adaptivity, and optimization of learning. It offers implications for educators and policymakers seeking to enhance digital learning environments.

Keywords: Adaptive learning, Artificial intelligence, Behavioral intention, Digital pedagogy, E learning, Higher education, Learning performance.

1. Introduction

In recent years, the integration of Artificial Intelligence (AI) into education has reshaped the landscape of teaching and learning, especially within e-learning environments. AI enables features such as adaptive content delivery, intelligent feedback, and predictive analytics, thereby supporting personalized and responsive educational experiences [1, 2]. E-learning, with its flexible delivery and digital infrastructure, provides the backbone for these intelligent enhancements.

Higher education institutions increasingly adopt AI-enhanced e-learning systems to boost student engagement, performance, and collaboration [3, 4]. By leveraging data about learner behavior, these systems can tailor instruction, identify at-risk students, and recommend interventions in real time [5]. Despite this momentum, gaps remain in understanding how students perceive the utility, usability, and effectiveness of AI tools embedded in e-learning platforms, particularly within specialized disciplines such as computing and information.

To better understand individuals' intentions to adopt and accept new technologies, many researchers have employed the Technology Acceptance Model (TAM). The Technology Acceptance Model (TAM) was developed by Davis [6] is one of the most commonly applied frameworks for

examining users' acceptance of technology [7]. Its primary aim is to explain and predict users' behaviors regarding the adoption of new AI technologies in E-Learning [8].

This study aims to explore the perceptions of undergraduate students at Al-Baha University regarding AI-integrated e-learning tools. The primary objective is to assess how students evaluate the intention of usability, usefulness, and overall effectiveness of these tools in their academic performance. Additionally, the research seeks to determine the extent to which students believe that AI integration enhances their learning outcomes and promotes academic collaboration. Another core objective is to identify the challenges and limitations students face when engaging with AI-driven e-learning systems. Through this exploration, the study intends to generate empirical insights and actionable recommendations that can support the effective and ethical implementation of AI technologies in digital learning environments.

2. Literature Review

Adaptive learning, powered by AI, is one of the most prominent themes in the literature on AI in education. It refers to systems that adjust instructional content, pacing, and difficulty in real time, based on learner performance and behavior [9, 10]. A comprehensive review in 2023 found that AI/ML techniques have been extensively employed in e-learning to optimize learning paths, increase engagement, and improve performance across diverse contexts [9]. The review covered several articles published since 2010, highlighting benefits as well as challenges such as privacy and system complexity.[9].

Another study examined algorithms and frameworks for adaptive AI systems, emphasizing how learner modeling and predictive analytics are central to these systems [11]. A separate systematic review synthesized modern research trends, revealing patterns in application, benefits, and research gaps in AI-adaptive systems [12]. A crucial benefit of AI in e-learning lies in automated assessment and feedback. AI-based systems can grade assignments, quizzes, and short answers, and provide instant, tailored feedback, reducing instructor load and increasing responsiveness [10, 11, 13]. For example, a study conducted in a Moodle environment showed that pre-service teachers using AI-based personalized tools improved in performance, motivation, and engagement compared to a control group [14].

Learning analytics, another dimension of AI in education, uses data mining, predictive modeling, and pattern detection to guide both instructors and learners. One investigation into AI-based learning analytics highlighted how predictive models can intervene early to help students before they fall behind [1]. AI-driven analytics can help detect at-risk learners, recommend remedial content, and guide instructional design.

Recent advances incorporate multimodal AI (using multiple data sources such as text, audio, video) and explainable AI (XAI) to make adaptive systems more transparent and trustworthy. One study explores how multimodal approaches can advance toward more general AI in educational contexts [15]. Another proposes frameworks to generate personalized explanations that learners can understand, enhancing trust and adoption [16].

Generative AI is another emerging frontier. Research in this area explores how large language models can dynamically generate content and adapt instructions [17]. Additional work shows how learners' feedback can iteratively guide AI content generation, enhancing personalization and engagement [18].

Empirical work supports the positive role of AI in educational settings. An evaluation of an AI-based adaptive system in secondary schools found significant improvements in student performance and satisfaction, particularly among lower-performing students [18]. Another controlled study across universities found that students using AI-adaptive systems outperformed the control group in engagement and academic achievement [11].

In STEM education, a computer-vision-based engagement detection system was developed to adapt learning content, finding that increased engagement and self-efficacy translated into better performance

[16]. A study in Bangalore examined the interplay between AI usage, self-efficacy, and learning performance, uncovering both positive correlations and cautionary associations with social loafing behavior [15]. Another comparison between AI-based adaptive pedagogy and traditional methods concluded that AI can foster engagement and personalized learning, though concerns about ethical constraints and infrastructure persist [5].

Despite its promise, AI integration in education faces significant challenges. Data privacy and security remain major concerns, particularly when systems collect and analyze sensitive learner data [10, 12]. Algorithmic bias and lack of transparency may undermine learner trust and equity [12, 16]. Technical infrastructure and cost barriers are obstacles in many educational institutions [5, 11].

Further, human capacity is essential: educators and students must be trained to use AI tools effectively; otherwise, the technology may be underutilized or misused [3, 5]. Some researchers argue that AI should augment, not replace, human teaching, preserving the role of human judgment, mentorship, and social interaction [5, 11].

While abundant research explores AI in educational theory and controlled settings, fewer studies capture learners' perceptions within specific disciplinary contexts in real-world universities. This study addresses that gap by focusing on computing and information students' experiences at Al-Baha University, assessing perceived usability, effectiveness, and challenges. It adds to the literature by providing localized, empirical insights that can inform implementation strategies in similar settings.

3. Research Methodology

This study adopts a descriptive quantitative research design to explore and analyze undergraduate students' perceptions regarding the use of artificial intelligence (AI) integrated with e-learning technologies to enhance learning performance. The quantitative approach allows for the collection and interpretation of numerical data that reflect learners' opinions, behaviors, and attitudes, providing a foundation to evaluate the relationships between AI-based e-learning tools and students' academic experiences.

The research was conducted at Al-Baha University during the 2024–2025 academic year, targeting undergraduate students enrolled in the Faculty of Computing and Information. Participants represented various academic levels, ensuring a broad and diverse sample of students who actively engage with digital learning tools. To ensure relevance, a purposive sampling technique was employed, selecting students with prior exposure to AI-enhanced e-learning platforms.

Data collection was carried out using an online structured questionnaire distributed electronically. Out of 110 questionnaires sent, 103 were completed and returned with valid responses, representing a high response rate suitable for quantitative analysis.

The questionnaire consisted of two main sections. Section 1 gathered demographic information such as age group, field of study, and academic level. Section 2 was divided into two subsections: Part A contained seven closed-ended statements designed to capture students' perceptions of AI-powered e-learning tools. However, Part B included five questions related to the behavioral intention of integrating AI tools into e-learning technologies. Respondents rated each item using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). These statements addressed the following key dimensions:

1. I currently use e-learning technologies merged with AI tools frequently.
2. I use e-learning merged AI tools to improve my study skills.
3. I feel AI-augmented e-learning tools are easy to use.
4. I use AI-powered e-learning platforms to access resources from lecturers.
5. I use AI tools to share/discuss resources with peers.

These questions were crafted to reflect practical use, usability, accessibility, collaboration, and perceived academic benefits associated with AI in e-learning environments. The structure and content of the questionnaire were informed by the Technology Acceptance Model (TAM), which emphasizes perceived usefulness and perceived ease of use as key factors influencing user acceptance of technology

and shaping their intention to use it. The internal consistency of the questionnaire items was confirmed using Cronbach's Alpha, with a coefficient exceeding 0.80, indicating strong reliability.

On the other hand, the statements of part B, which relate to the willingness and attitudes to integrate AI technologies into learners' learning processes, are as follows:

1. I intend to participate in e-learning merged with artificial intelligence (AI) applications in the future.
2. I believe that using AI in e-learning will help me achieve significant improvements in the learning process.
3. Integrating AI tools into e-learning is one of my future educational plans.
4. I consider using AI in e-learning to be useful and effective, which motivates me to adopt it in my educational activities.
5. I would like to continue using AI-supported e-learning systems in my current and future learning or teaching practices.

The collected data were analyzed using SPSS software. Descriptive statistical measures such as means, standard deviations (SD), and significance levels (p-values) were computed to evaluate trends in student responses. Mean scores greater than 4.3 indicated strong positive perceptions, while low standard deviation values (ranging from 0.74 to 0.88) signified consistency across the dataset. All variables showed statistically significant results at a p-value less than 0.05, confirming a strong association between the integration of AI technologies and enhancements in student learning outcomes and collaborative behavior.

4. Results

4.1. Demographics

The frequencies and percentages of demographic variables of the survey participants are presented in Table 1.

Table 1.
Frequencies and percentages of demographic variables.

Variable	Classes	Frequency	Percentage
Gender	Female	57	56
	Male	46	44
	Total	103	100
Age	18-21	90	89
	21-25	13	11
	Total	100	100
Field of study	Computing & Information	100	100
Year of Study	1 st Year	2	2
	2 nd Year	67	66
	3 rd Year	15	14
	4 th Year	19	18
	Total	100	100

From Table 1, more than half of the survey participants (n=57) were female. The majority were younger students, with 89% aged between 18 and 21 years. All respondents were enrolled in the Computer and Information program, with most (66%) being in their second year of study. There were also 19 final-year students. The distribution of their course and year level suggests that they were well-positioned to provide informed responses regarding AI-powered e-learning tools.

Furthermore, the results in Table 2 revealed that students held strongly positive attitudes toward AI-enhanced e-learning across all measured items. All statements achieved mean values exceeding 4.3, and standard deviations ranged from 0.74 to 0.88, reflecting limited dispersion in responses. All p-values were less than 0.001, indicating statistical significance at the conventional level. The following table summarizes the data:

Table 2.
Relative advantages of using AI in E-Learning.

No.	Statement	Mean	SD	P-value	Interpretation
1	I currently use e-learning technologies merged with AI tools frequently	4.41	0.88	0.000	Statistically significant
2	I use e-learning merged AI tools to improve my study skills	4.43	0.78	0.000	Statistically significant
3	I feel AI-augmented e-learning tools are easy to use	4.40	0.85	0.000	Statistically significant
4	I use AI-powered e-learning platforms to access resources from lecturers	4.36	0.76	0.000	Statistically significant
5	I use AI tools to share/discuss resources with peers	4.42	0.74	0.000	Statistically significant

Overall, the data in Table 2 indicate that students perceive AI-integrated e-learning tools as useful, accessible, and effective in supporting their academic work.

In addition, the results in Table 3 showed that the mean scores of participants' responses regarding the behavioral intention to use Artificial Intelligence (AI) in e-learning were high, ranging from 4.28 to 4.46 on a five-point Likert scale, which reflects a strong positive orientation toward using AI in educational contexts.

Table 3.
The behavioral intention to use AI in e-learning.

No.	Statement	Mean	SD	P-value
1	I intend to participate in e-learning merged with artificial intelligence (AI) applications in the future.	4.26	0.93	< 0.001
2	I believe that using AI in e-learning will help me achieve significant improvements in the learning process.	4.46	0.66	< 0.001
3	Integrating AI tools into e-learning is one of my future educational plans.	4.28	0.88	< 0.001
4	I consider using AI in e-learning to be useful and effective, which motivates me to adopt it in my educational activities.	4.36	0.89	< 0.001
5	I would like to continue using AI-supported e-learning systems in my current and future learning or teaching practices.	4.37	0.82	< 0.001

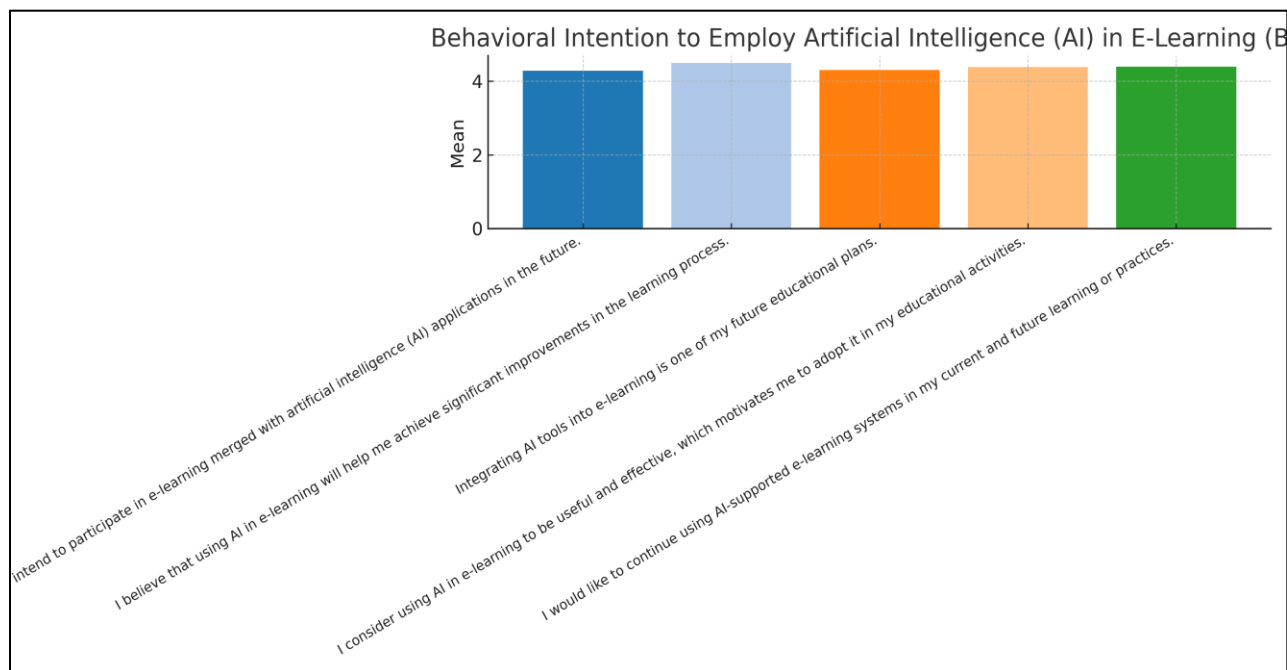


Figure 1.
Behavioral intention to employ Artificial Intelligence (AI) in E-learning.

From Figure 1, the statement “I believe that using AI in e-learning will help me achieve significant improvements in the learning process” achieved the highest mean of 4.46, showing a strong belief in the benefits of AI. Also, the statement “I would like to continue using AI-supported e-learning systems in my current and future learning or practices” recorded the second-highest mean score of 4.37, indicating a very strong willingness among participants to continue using AI tools in e-learning. Furthermore, the statement “Integrating AI tools into e-learning is one of my future educational plans” scored 4.28, which reflects readiness for future adoption. Although the statement “I intend to participate in e-learning merged with artificial intelligence (AI) applications in the future” scored 4.26, which, while slightly lower than the others, still indicates a positive and strong intention. Finally, “I consider using AI in e-learning to be useful and effective, which motivates me to adopt it in my educational activities” scored 4.68, reflecting a strong motivational factor. The overall mean for this dimension was 4.51, indicating a high level of behavioral intention to employ AI in e-learning. This high average confirms the participants’ favorable attitudes and willingness to integrate AI technologies into their learning practices.

5. Discussion

The findings support the notion that integrating AI within e-learning systems is positively received by learners. High mean scores across all dimensions underscore that students believe AI tools help with study skills, resource access, collaboration, and usability, as presented in Table 2. The low standard deviations suggest a strong consensus in favor of AI adoption. These results align with earlier work showing that adaptivity, personalization, and immediate feedback are among the main advantages of AI-powered systems [9, 14, 17]. For example, Tarun et al. [18] found improvement in performance and motivation when AI-personalized tools were used in a Moodle-based environment [14]. In addition, Alenezi's [19] Study in Pakistan showed that AI adaptive systems led to higher engagement and academic results compared to traditional methods [11].

The participants (students) in computing and information fields appear particularly ready to embrace AI tools, possibly due to their technical background. This supports literature indicating that domain familiarity influences adoption and perceived ease of use [5, 9, 10]. In addition, emerging AI directions such as multimodal and explainable AI provide avenues to enhance transparency and learner trust [15, 16]. Generative AI and human-in-the-loop designs also promise more fluid adaptation and responsiveness to learner feedback [17, 20].

Nevertheless, challenges must be acknowledged. Students may experience concerns related to data privacy, algorithmic bias, and over-dependence on AI. The literature warns that AI should not replace human interaction entirely, but rather augment it [5, 21]. Infrastructure constraints, cost, and readiness of both faculty and students could hamper effective deployment [22, 23].

In terms of participants’ acceptance and intention to use AI in e-learning, it is strategic and sustainable, not just short-term reactions. The consistently high mean scores across all statements confirm their strong belief in the effectiveness and usefulness of AI for enhancing learning outcomes and teaching quality. This aligns with previous research [24, 25], which emphasizes that behavioral intention is a key predictor of actual technology adoption. Strengthening this intention through targeted professional development, institutional support, and accessible AI tools can significantly contribute to effective and sustainable integration of AI in education [3, 26, 27].

Future research should connect these perceptions with objective metrics (e.g., grades, retention), explore longitudinal effects, and test hybrid models where AI complements rather than substitutes human teaching.

6. Conclusion

This study provides empirical evidence that undergraduate students at Al-Baha University hold favorable attitudes toward AI-integrated e-learning tools. The high mean values and statistically significant results indicate that learners perceive these tools as beneficial for improving study skills,

promoting collaboration, and enhancing their overall learning experience. These findings affirm that AI has the potential to play a transformative role in digital education, particularly when aligned with learners' needs and institutional goals. By effectively bridging the gap between theory and practice, this research demonstrates that AI-enhanced e-learning environments can meaningfully contribute to academic performance when properly deployed. However, the realization of this potential depends on thoughtful implementation, ongoing evaluation, and ethical oversight. Future efforts should focus on longitudinal studies, objective performance metrics, hybrid AI-human teaching models, and context-specific adaptivity to strengthen the role of AI in education and ensure equitable access and outcomes for all learners. Based on the findings of this study, several key recommendations are proposed to support the effective integration of AI technologies into e-learning environments. First, universities should allocate sufficient resources to develop, implement, and maintain AI-enabled e-learning systems, ensuring scalable and sustainable infrastructure that can meet the evolving demands of digital education. Alongside this, it is essential to provide continuous training and technical support for both faculty and students, enabling them to effectively engage with AI tools and adapt to emerging technologies. Furthermore, institutions must establish ethical frameworks that address critical concerns such as data privacy, algorithmic transparency, fairness, and user autonomy, in order to foster trust and safeguard the rights of all stakeholders. Monitoring and evaluation efforts should also be prioritized, with longitudinal studies conducted to assess the long-term effectiveness of AI tools by tracking academic performance, student engagement, and retention rates over time. Importantly, AI systems should be designed to complement rather than replace human instruction, promoting hybrid instructional models that preserve the social, emotional, and pedagogical dimensions of the learning process. To enhance adaptability and responsiveness, human-in-the-loop strategies and iterative feedback mechanisms should be integrated, allowing continuous refinement of AI-generated decisions based on real-time learner input. Finally, the adoption of explainable AI (XAI) techniques is crucial to help students understand how AI systems operate and arrive at decisions, thereby improving transparency, interpretability, and overall user confidence in these technologies.

Transparency:

The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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