

ARTIFICIAL INTELLIGENCE FOR INCLUSIVE LEARNING IN ISLAMIC HIGHER EDUCATION: EVIDENCE FROM UZBEKISTAN ON EDUCATIONAL EQUITY AND STUDENT ENGAGEMENT

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ABSTRACT

The growing adoption of Artificial Intelligence (AI) in education has created new opportunities to strengthen inclusive pedagogical practices that accommodate diverse learner needs. However, empirical evidence concerning the role of AI in supporting inclusive learning within Islamic higher education remains limited. This study investigates the effects of AI-supported inclusive learning on academic achievement, learner participation, accessibility, motivation, and instructional effectiveness in Islamic higher education institutions in Uzbekistan. Employing a convergent mixed-method design, the study involved 96 students and 12 teachers who participated in an eight-week intervention. Quantitative data were collected through pretest–posttest assessments, engagement and motivation questionnaires, technology acceptance surveys, and system analytics, while qualitative data were obtained through classroom observations and semi-structured interviews. The findings revealed that students exposed to AI-supported inclusive learning achieved significantly higher academic outcomes and demonstrated stronger engagement, greater accessibility, enhanced autonomy, and more positive perceptions of inclusion than those receiving conventional instruction. Additionally, teachers also reported improvements in instructional efficiency, progress monitoring, and differentiated learning support. Drawing on principles of Universal Design for Learning, Self-Determination Theory, and Islamic educational concepts of *tarbiyah*, *ta'lim*, and *ta'dib*, the findings suggest that AI can support more responsive, equitable, and learner-centered educational practices when integrated within coherent pedagogical frameworks. This study contributes to the growing scholarship on inclusive pedagogy in Islamic higher education by demonstrating how AI-supported learning environments can promote educational equity, meaningful participation, and sustainable quality education in diverse learning contexts.

Keywords: Artificial Intelligence, Educational Equity, Inclusive Learning, Islamic Higher Education, Student Engagement, Universal Design for Learning

INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) has significantly transformed contemporary education systems by enabling personalized learning, automated feedback, predictive analytics, and more efficient instructional management (Bilotta et al., 2025;

Nnanguma, 2025). Across diverse educational settings, AI technologies are increasingly utilized to support learner-centered approaches that accommodate variations in learning pace, prior knowledge, and academic needs (Katel, 2026). Recent studies have demonstrated that intelligent technologies can enhance student engagement, improve learning efficiency, and strengthen educational decision-making through real-time data analysis (Holmes et al., 2019; Zawacki-Richter et al., 2019). As education systems continue to undergo digital transformation, AI has emerged as a strategic instrument for improving both educational quality and accessibility, particularly in contexts requiring flexible and differentiated instruction.

These developments are especially relevant to inclusive education, which seeks to ensure meaningful participation and equitable learning opportunities for all learners regardless of their cognitive abilities, learning preferences, social backgrounds, or support needs (Li, 2026; Wang et al., 2026). Moreover, inclusive education extends beyond physical access to classrooms by emphasizing active engagement, responsive pedagogy, and the removal of barriers that hinder learning participation (Cleveland et al., 2025). However, conventional instructional models often encounter difficulties in addressing learner heterogeneity because educators are required to simultaneously manage diverse learning levels, behavioral characteristics, and differentiated instructional tasks within limited time constraints. Previous research consistently highlights persistent challenges related to individualized support, accessibility, and learner participation in inclusive settings (Gil Jr, 2025; Oktamovna & Ruslanovna, 2024; Ainscow, 2020; Florian, 2014). Consequently, there is a growing need for innovative educational approaches capable of enhancing instructional responsiveness while preserving the principles of educational inclusion.

Furthermore, artificial Intelligence has been increasingly recognized as a promising avenue for addressing these challenges (Mohamed, 2025). Intelligent tutoring systems, adaptive learning platforms, and automated assessment tools have been shown to improve instructional effectiveness by generating personalized learning pathways, reducing cognitive overload, and providing immediate formative feedback (Latif et al, 2026; Luckin et al, 2016; Woolf, 2010). Similarly important, AI-supported learning environments may strengthen learner motivation by enabling students to progress according to their individual abilities while receiving timely instructional support. For students requiring additional assistance, technologies such as speech recognition systems, recommendation engines, and adaptive interfaces may facilitate greater accessibility and participation (Rahim & Apzhaparovna, 2026). Collectively, these findings suggest that AI possesses considerable potential to support inclusive pedagogical practices when implemented thoughtfully and ethically.

Despite the growing body of research on Artificial Intelligence (AI) in education, important gaps remain. Existing studies primarily examine AI applications in general higher education or online learning environments, with limited attention to inclusive educational settings characterized by diverse learner needs. Moreover, prior research often focuses on isolated technologies, such as chatbots, intelligent tutoring systems, or learning analytics, without considering how these tools interact with broader pedagogical processes and institutional contexts. This gap is particularly evident in Islamic higher education, where educational modernization must be balanced with commitments to justice, responsibility, and public benefit. Without a coherent pedagogical foundation, technological innovations risk remaining fragmented and difficult to sustain in authentic educational practice (Selwyn, 2019).

These concerns are closely linked to global efforts to achieve inclusive and equitable quality education as reflected in Sustainable Development Goal 4. While educational technologies have the potential to expand participation and reduce learning barriers, their effectiveness depends on pedagogically grounded approaches that promote accessibility,

responsiveness, and meaningful learner engagement. In response to these gaps, this study investigates the implementation of AI-supported inclusive learning in Islamic higher education institutions in Uzbekistan. Specifically, it examines the extent to which AI-assisted learning environments enhance academic achievement, learner participation, accessibility, and instructional effectiveness, thereby contributing empirical evidence to the emerging scholarship on inclusive pedagogy and educational equity in Islamic higher education.

METHOD

This study employed a convergent mixed-method design to investigate the implementation of Artificial Intelligence (AI)-supported inclusive learning in Islamic higher education settings in Uzbekistan. A mixed-method approach was selected because it enables a comprehensive understanding of educational phenomena by integrating measurable outcomes with participants' experiences and perceptions (Creswell & Plano Clark, 2018). The study involved 96 students and 12 teachers, selected through purposive sampling for their active participation and willingness to engage with AI-supported learning environments. The intervention was conducted over a period of eight weeks. The AI-supported learning framework comprised three interconnected components: input, process, and output. Specifically, the input component included learner profiles, accessibility needs, prior achievement, and instructional objectives. The process component, on the other hand, integrated adaptive learning systems, intelligent tutoring systems, Natural Language Processing tools, and ChatGPT-assisted learning support to facilitate differentiated instruction and personalized feedback. Meanwhile, the output component focused on learning achievement, learner engagement, inclusive participation, and instructional effectiveness. Additionally, the framework was informed by Universal Design for Learning principles emphasizing multiple means of engagement, representation, and action, alongside Systems Engineering perspectives highlighting feedback loops and continuous optimization processes (David et al., 2015).

As illustrated in Figure 1, the framework conceptualizes AI-supported inclusive learning as an interconnected system in which learner characteristics and instructional goals inform adaptive processes that subsequently influence educational outcomes. Data collection involved four instruments: (1) an Inclusive Learning Engagement Questionnaire measuring behavioral, emotional, and cognitive engagement; (2) a Technology Acceptance Scale adapted from the Technology Acceptance Model assessing perceived usefulness, ease of use, and intention to continue use (Davis, 1989); (3) a Classroom Observation Checklist examining participation, accessibility support, and teacher responsiveness; and (4) semi-structured interviews exploring students' and teachers' experiences with AI-supported learning. Instrument validity was established through expert review by three specialists in educational technology and inclusive pedagogy, while pilot testing with 30 participants yielded acceptable reliability coefficients (Cronbach's $\alpha = .81-.90$) consistent with recommended educational research standards (Hair et al., 2019). Meanwhile, pre-intervention assessments were administered before implementation; weekly classroom observations and system analytics were conducted during the intervention; and posttests, questionnaires, and interviews were administered at the conclusion of the study.

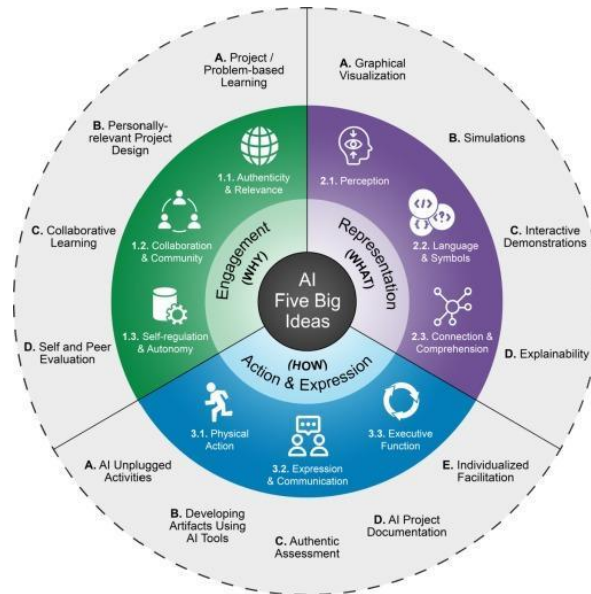


Figure 1. AI-based framework for optimizing inclusive education processes.

Figure 1 depicts the operational flow of the intervention implemented in this study. Learner profiles, accessibility requirements, and instructional objectives served as inputs for adaptive instructional processes facilitated through AI-supported technologies. These processes generated personalized feedback, differentiated learning experiences, and ongoing monitoring of student progress. Quantitative and qualitative data were analyzed concurrently and subsequently integrated during interpretation. Quantitative analyses included descriptive statistics, paired-samples *t*-tests, independent-samples *t*-tests, and ANCOVA to examine differences in learning outcomes and engagement indicators between groups while controlling for baseline performance. Afterwards, Cohen's *d* effect sizes were calculated to assess the practical significance of the observed differences (Field, 2018). Qualitative data derived from interviews and classroom observations were analyzed thematically through open coding, category development, and cross-case comparison to identify recurring themes related to inclusion, learner engagement, accessibility, and instructional effectiveness (Braun & Clarke, 2006). Finally, triangulation was conducted by comparing evidence obtained from surveys, observations, interviews, and system analytics to enhance interpretive validity and minimize single-source bias (Denzin, 2012). Ethical approval was obtained from the institutional research ethics committee, and informed consent was secured from all participants before data collection commenced.

RESULTS AND DISCUSSION

Participant Characteristics and Baseline Conditions

A total of 96 students participated in the quantitative phase of the study and were equally assigned to the experimental group ($n = 48$) and the comparison group ($n = 48$). Prior to the intervention, baseline equivalence testing was conducted to determine whether the groups differed significantly in demographic characteristics and academic readiness. Independent-samples *t*-tests and proportional comparisons were used to examine mean age, prior experience with learning management systems (LMS), and pretest achievement scores.

Table 1 presents the baseline characteristics of participants in both groups. The findings revealed no statistically significant differences in age ($p = .441$), prior LMS experience ($p = .812$), or pretest achievement scores, $t(94) = 0.27$, $p = .789$. These results indicate that the two groups were comparable before implementation of the AI-supported inclusive

learning intervention. Establishing baseline equivalence strengthens the internal validity of the quasi-experimental design and provides greater confidence that subsequent differences observed between groups are attributable to the intervention rather than to pre-existing disparities.

Table 1. Baseline Comparison of Student Groups

Variable	Experimental	Comparison	p-value
Mean age	17.9	18.1	.441
Prior LMS experience (%)	68.7	66.4	.812
Pretest score (100)	61.84	62.27	.789

From Table 1, it can be drawn that the absence of significant baseline differences suggests that both groups commenced the study from comparable academic and demographic starting points, thereby supporting the validity of subsequent analyses examining the effects of AI-supported inclusive learning on student outcomes.

Effects of AI-Supported Inclusive Learning on Academic Achievement

Following the eight-week intervention, students in the experimental group who participated in AI-supported inclusive learning demonstrated higher levels of academic achievement than those in the comparison group receiving conventional instruction. Descriptive statistics indicated that the experimental group attained a higher mean posttest score ($M = 81.46$, $SD = 6.72$) than the comparison group ($M = 72.93$, $SD = 7.35$). To examine the effect of the intervention while accounting for baseline differences, an analysis of covariance (ANCOVA) was conducted using pretest scores as a covariate. The results revealed a statistically significant treatment effect, $F(1, 93) = 21.58$, $p < .001$, partial $\eta^2 = .188$, indicating a moderate-to-large effect of AI-supported inclusive learning on students' academic achievement.

Table 2. Pretest–Posttest Comparison of Learning Achievement

Group	Pretest Mean	Posttest Mean	Gain Score
Experimental	61.84	81.46	19.62
Comparison	62.27	72.93	10.66

As shown in Table 2, both groups demonstrated improvements in posttest performance relative to their baseline scores. However, students in the experimental group exhibited a substantially larger gain in achievement (19.62 points) compared with those in the comparison group (10.66 points). Moreover, the ANCOVA findings, together with the descriptive gain scores, indicate that students exposed to AI-supported inclusive learning achieved stronger academic outcomes than their peers who received conventional instruction.

These findings suggest that the integration of adaptive and responsive learning supports within inclusive educational settings was associated with improved academic performance. Subsequent analyses examined whether these improvements were accompanied by enhanced learner engagement and inclusive participation.

Student Engagement in AI-Supported Inclusive Learning

Student engagement during the intervention period was examined using participation records and platform usage data. As presented in Table 3, students in the experimental group demonstrated consistently higher levels of engagement than those in the comparison group

across all measured indicators. Students receiving AI-supported inclusive learning logged into the learning platform more frequently ($M = 6.1$ vs. 3.8 times per week, $p < .001$), completed a greater proportion of assigned tasks (92.4% vs. 76.8% , $p < .01$), and participated more actively in online discussions (84.1% vs. 63.7% , $p < .01$). In addition, students in the experimental group spent significantly more time engaged in learning activities than those in the comparison group (142 vs. 109 minutes per week, $p < .05$).

Table 3. Student Engagement Indicators

Indicator	Experimental	Comparison	p-value
Weekly login frequency	6.1	3.8	< .001
Task completion rate (%)	92.4	76.8	< .01
Discussion participation (%)	84.1	63.7	< .01
Average time-on-task (minutes/week)	142	109	< .05

The findings, as portrayed in Table 3, indicate that students exposed to AI-supported inclusive learning exhibited stronger behavioral engagement throughout the intervention period than those receiving conventional instruction. Higher platform access frequency, higher task completion rates, increased discussion participation, and longer time devoted to learning activities collectively suggest more active involvement in the educational process.

System usage records further showed that students in the experimental group made frequent use of adaptive support features, with an average of 14.7 feedback requests per student and a mean system response time of 3.8 seconds. These usage patterns indicate that learners regularly interacted with the AI-supported functionalities available within the learning environment.

Taken together, the observed differences in engagement outcomes complement the previously reported achievement findings, suggesting that improvements in academic performance occurred alongside greater participation in AI-supported inclusive learning activities.

Accessibility and Inclusive Participation

Students' perceptions of accessibility and inclusive participation were examined through post-intervention surveys and supported by classroom observation data. As presented in Table 4, all indicators were rated within the high category, suggesting that participants viewed the AI-supported learning environment as accessible, understandable, and conducive to active involvement. Students reported favorable perceptions regarding ease of content access ($M = 4.38$, $SD = 0.56$), instructional clarity ($M = 4.31$, $SD = 0.61$), participation confidence ($M = 4.27$, $SD = 0.59$), and perceived inclusion ($M = 4.35$, $SD = 0.54$).

Table 4. Accessibility and Inclusive Participation Indicators

Indicator	Mean	SD	Interpretation
Ease of content access	4.38	0.56	High
Instructional clarity	4.31	0.61	High
Participation confidence	4.27	0.59	High
Perceived inclusion	4.35	0.54	High

Table 4 shows that the highest ratings were observed for ease of content access and perceived inclusion, indicating that students generally considered the learning environment

supportive of their participation needs. Likewise, positive ratings for instructional clarity and participation confidence suggest that learners experienced the AI-supported activities as understandable and encouraging of active involvement.

Classroom observations further complemented these survey findings. Teachers consistently reported that students who had previously demonstrated limited participation became more willing to engage in learning activities when adaptive supports and individualized feedback were available. Observational records also indicated increased student responsiveness during collaborative tasks and class discussions. The convergence of survey responses and classroom observations suggests that the AI-supported learning environment was associated with enhanced accessibility and more inclusive patterns of participation among learners.

Technology Acceptance and Teacher Perspectives

Technology acceptance of the AI-supported learning environment was examined through post-intervention survey responses from students and teachers. As presented in Table 5, participants reported high levels of perceived usefulness ($M = 4.44$, $SD = 0.49$), perceived ease of use ($M = 4.29$, $SD = 0.57$), satisfaction ($M = 4.33$, $SD = 0.55$), and intention to continue using the system ($M = 4.47$, $SD = 0.46$). Among these dimensions, intention to continue use received the highest rating, indicating favorable acceptance of the AI-supported learning environment.

Table 5. Technology Acceptance Outcome

Dimension	Mean	SD
Perceived usefulness	4.44	0.49
Perceived ease of use	4.29	0.57
Satisfaction	4.33	0.55
Intention to continue use	4.47	0.46

The findings indicate that participants generally perceived the AI-supported system as useful, accessible, and satisfactory for facilitating learning activities. High ratings across all dimensions suggest positive attitudes toward the integration of AI technologies within inclusive learning contexts.

In addition, qualitative interview data complemented these findings. Several teachers reported that the AI-supported platform reduced the amount of time required for repetitive instructional tasks and routine feedback provision, thereby enabling them to devote greater attention to individualized support and learner guidance. Teachers also noted that the system facilitated more efficient monitoring of student progress and supported differentiated instructional practices. These qualitative accounts aligned with the survey results, indicating favorable perceptions regarding the practicality and usability of AI-assisted learning environments.

Learner Motivation and Autonomy

Students' motivational perceptions following participation in AI-supported inclusive learning were assessed across three dimensions: autonomy, competence, and relatedness. As presented in Table 6, all dimensions were rated within the high category, indicating positive motivational experiences among participants. Competence received the highest mean score ($M = 4.36$, $SD = 0.52$), followed by autonomy ($M = 4.32$, $SD = 0.58$) and relatedness ($M = 4.18$, $SD = 0.63$).

Table 6. Motivation Outcomes

Dimension	Mean	SD
Autonomy	4.32	0.58
Competence	4.36	0.52
Relatedness	4.18	0.63

As shown in Table 6, students reported strong perceptions of competence, suggesting confidence in their ability to accomplish learning tasks within the AI-supported environment. Similarly, the high autonomy rating indicates that participants perceived opportunities to exercise choice and self-direction throughout the learning process. Although relatedness received the lowest mean score among the three dimensions, it nevertheless remained within the high category, reflecting positive perceptions of interpersonal connection and support during the intervention.

Collectively, these findings suggest that the AI-supported learning environment was associated with favorable motivational experiences characterized by learners' confidence in their capabilities, perceptions of autonomy in learning activities, and continued experiences of social connectedness. The subsequent section further explores how teachers perceived the influence of AI-supported learning on instructional effectiveness and classroom practice.

Teacher Perspectives on Instructional Efficiency

Teachers' perceptions of instructional efficiency were examined through post-intervention surveys and semi-structured interviews. As presented in Table 7, teachers reported favorable evaluations across all measured indicators, suggesting positive experiences with the integration of AI-supported learning within inclusive educational settings. The highest rating was observed for faster feedback delivery ($M = 4.48$), followed by reduced grading burden ($M = 4.41$), easier progress monitoring ($M = 4.36$), and improved differentiation of instruction ($M = 4.29$).

Table 7. Teacher Perceptions of Instructional Efficiency

Indicator	Mean
Reduced grading burden	4.41
Easier progress monitoring	4.36
Faster feedback delivery	4.48
Improved differentiation	4.29

The findings from Table 7 indicate that teachers perceived AI-supported learning environments as facilitating more efficient instructional processes. High ratings for progress monitoring and grading support suggest that participants experienced improvements in managing student information and routine classroom tasks. Similarly, favorable evaluations of instructional differentiation indicate that teachers considered the adaptive features of the platform beneficial in addressing diverse learner needs.

Building on these quantitative results, qualitative interview data provided additional insights. Several teachers reported that automated feedback functions and real-time learning analytics reduced the time devoted to repetitive administrative activities. Participants also indicated that the availability of student progress data enabled more targeted instructional support and facilitated decision-making related to differentiated learning activities.

Collectively, these findings demonstrate that teachers viewed AI-supported learning as a practical resource for enhancing instructional efficiency within inclusive educational contexts.

System Utilization Patterns

System usage records were analyzed to examine how participants interacted with the AI-supported learning environment throughout the intervention period. The findings indicated sustained use of the platform and frequent engagement with adaptive support features designed to facilitate learning activities. The most commonly accessed functionalities included automated feedback tools, assignment guidance modules, and personalized revision recommendations, suggesting that students regularly utilized resources intended to support task completion and self-regulated learning. The indicator of the system's utilization can be captured in Table 8.

Table 8. System Utilization Indicator

Indicator	Value
Average weekly logins per student	6.1
Mean feedback requests	14.7
Assignment completion rate (%)	92.4
Average response time (seconds)	3.8

As shown in Table 8, students interacted with the system regularly throughout the intervention period. The average of 14.7 feedback requests per student indicates active use of adaptive support mechanisms, while the short mean response time of 3.8 seconds reflects the system's capacity to provide timely assistance. The high assignment completion rate further suggests consistent participation in learning activities facilitated by the platform. These indicators collectively demonstrate that the AI-supported environment was actively utilized during instructional implementation.

Qualitative Themes from Interviews and Classroom Observations

Thematic analysis of interview transcripts and classroom observation records identified three recurring themes that complemented the quantitative findings and provided deeper insight into participants' experiences with AI-supported inclusive learning.

Students consistently described the adaptive learning features as facilitating greater confidence in engaging with learning activities. Interview participants indicated that individualized feedback, adjustable learning pace, and tailored content recommendations enabled them to progress through instructional tasks with reduced apprehension. Observation records similarly documented increased willingness among previously hesitant students to participate in classroom discussions and complete learning activities independently.

Moreover, participants frequently reported that adaptive supports improved accessibility and encouraged broader participation. Students indicated that clearer instructional guidance, scaffolded task sequences, and appropriately challenging activities enhanced their ability to contribute actively during learning sessions. Teachers likewise observed that learners who had previously demonstrated limited engagement became more responsive when instructional supports were aligned with individual learning needs. Classroom observations further revealed increased participation during collaborative activities and greater persistence in task completion.

Writing in a similar vein, teachers emphasized the value of automated progress tracking and immediate feedback mechanisms in supporting instructional decision-making. Interview participants reported that access to real-time learner data enabled more efficient

monitoring of student progress and informed the provision of targeted academic support. Teachers also noted that reductions in routine administrative tasks created additional opportunities for mentoring and differentiated instruction. Observation data corroborated these perceptions, indicating more frequent teacher–student interactions focused on individualized guidance rather than procedural clarification.

Collectively, these qualitative themes complement the quantitative findings reported earlier in the study. Participants' experiences suggest that AI-supported inclusive learning environments were characterized by enhanced learner confidence, reduced barriers to participation, and greater instructional responsiveness. The convergence of interview accounts and observational evidence provides additional insight into how students and teachers experienced the implementation of AI-supported learning within Islamic higher education contexts.

Triangulation of Findings

Evidence derived from multiple data sources demonstrated a consistent pattern across the quantitative and qualitative phases of the study. Improvements in academic achievement were accompanied by higher levels of student engagement, positive perceptions of accessibility and inclusion, favorable evaluations of technology acceptance, and enhanced motivational outcomes. Furthermore, qualitative interview data further indicated that students valued personalized learning supports and opportunities for self-paced progression, while teachers emphasized the usefulness of adaptive feedback and progress-monitoring functions. Classroom observations similarly documented increased participation among learners who had previously demonstrated limited engagement. Importantly, the convergence of findings across achievement tests, surveys, interviews, observations, and system usage records provides complementary evidence regarding participants' experiences with AI-supported inclusive learning in Islamic higher education contexts.

Factors Associated with Academic Achievement

A multiple regression analysis was conducted to explore the relationships between selected learner characteristics and posttest achievement scores. Student engagement, perceived usefulness of the platform, accessibility support use, and autonomy were entered simultaneously into the model. The overall regression model was statistically significant and accounted for 56% of the variance in academic achievement ($R^2 = .56$), and it can be seen in Table 9, which captures the factors associated with academic achievement.

Table 9. Factors Associated with Academic Achievement

Predictor	Beta	p-value
Student engagement	.39	< .001
Perceived usefulness	.33	.002
Accessibility support use	.28	.009
Autonomy	.22	.028

As shown in Table 9, student engagement emerged as the strongest correlate of academic achievement ($\beta = .39, p < .001$), followed by perceived usefulness of the learning platform ($\beta = .33, p = .002$). Accessibility support use and learner autonomy were also significantly associated with posttest performance. These findings indicate that multiple dimensions of students' experiences within AI-supported learning environments were related to their academic outcomes.

The findings of this study indicate that AI-supported inclusive learning was associated with improvements in academic achievement, learner engagement, accessibility, motivation, and instructional efficiency within Islamic higher education contexts in Uzbekistan. The convergence of evidence derived from achievement assessments, surveys, interviews, classroom observations, and system analytics suggests that the educational value of AI lies not merely in technological sophistication but in its capacity to support pedagogically responsive and inclusive learning environments. These findings reinforce the view that digital innovation contributes most effectively to educational transformation when integrated with coherent instructional design rather than implemented as isolated technological interventions.

From the perspective of Universal Design for Learning (UDL), the positive outcomes related to accessibility and participation provide empirical support for the importance of flexible learning environments that accommodate learner variability. UDL emphasizes multiple means of engagement, representation, and action to ensure meaningful participation for students with diverse abilities and needs (David et al., 2015). Students in the present study reported greater ease of access to learning materials, clearer instructional guidance, and stronger confidence in participating in learning activities. These findings suggest that AI-supported adaptive systems may operationalize UDL principles by adjusting learning pathways, feedback mechanisms, and instructional supports in ways that are difficult to achieve through conventional approaches alone.

The findings also resonate with the Social Model of Disability, which conceptualizes disability as arising primarily from environmental and structural barriers rather than individual deficits (Oliver, 1990). Students in the present study perceived higher levels of inclusion and participation when adaptive supports were available. This suggests that AI-assisted learning environments may contribute to reducing barriers associated with inaccessible materials, delayed feedback, and rigid instructional structures. Rather than requiring learners to adapt to existing educational systems, the findings indicate the potential for educational systems to become increasingly responsive to learner diversity. Such responsiveness is particularly important in inclusive education, where equitable participation represents a central objective.

The enhanced engagement and motivational outcomes observed in this study can be interpreted through Self-Determination Theory. Deci and Ryan (2000) argued that sustained motivation emerges when learners experience autonomy, competence, and relatedness. Students participating in AI-supported learning reported high levels of competence and autonomy while maintaining positive perceptions of relatedness. These findings suggest that adaptive learning environments may facilitate self-directed learning without diminishing interpersonal support. This is particularly noteworthy because concerns have frequently been raised regarding the potential of digital technologies to weaken human interaction within educational settings. Instead, the present findings indicate that AI-supported learning may complement rather than replace meaningful teacher–student relationships.

Positive evaluations of usefulness, ease of use, and intention to continue using the system further align with the Technology Acceptance Model (Davis, 1989). Participants perceived the platform as beneficial and manageable within everyday instructional activities. Similar findings have been reported by Nagaraju and Ramakrishna (2024) and Abosedo et al. (2025), who found that confidence in the practical utility of AI technologies significantly

influenced willingness to adopt such innovations in educational settings. The present study extends this body of knowledge by demonstrating that technology acceptance within inclusive learning environments is closely linked to perceptions of pedagogical value rather than technological novelty alone.

Teacher perspectives provide an additional dimension to understanding the educational implications of AI-supported inclusive learning. Participants reported reductions in routine workload, improvements in progress monitoring, and enhanced capacity to differentiate instruction according to learner needs. These findings are consistent with Zawacki-Richter et al. (2019), who highlighted the potential of AI to support instructional decision-making and administrative efficiency. In inclusive educational settings, where teachers often navigate substantial pedagogical complexity, such support may enable greater emphasis on mentoring, emotional support, and individualized guidance.

The systems engineering perspective adopted in this study offers further insight into the effectiveness of the intervention. Rather than focusing on isolated technological tools, the framework integrated learner characteristics, adaptive instructional processes, and measurable educational outcomes through continuous feedback mechanisms (David et al., 2015). This integrated approach offers a potential explanation for the simultaneous improvements observed across multiple domains, highlighting the importance of a holistic strategy. Educational innovations often encounter obstacles when new technologies are adopted in isolation, without careful alignment with existing curriculum structures, pedagogical methods, and assessment practices. The present findings imply that coherence and synergy among these components are crucial; such alignment not only enhances the immediate effectiveness of innovations but also contributes to their long-term sustainability. By fostering a more comprehensive integration, educational stakeholders can better respond to diverse challenges and ensure that improvements are deeply rooted and enduring.

The findings may also be interpreted through the lens of Islamic educational philosophy, particularly the interconnected concepts of *tarbiyah*, *ta'lim*, and *ta'dib*, which emphasize the holistic development of learners through intellectual, moral, spiritual, and social cultivation (Al-Attas, 1991; Ashraf, 1985; Hashim, 2004). Unlike educational approaches that focus primarily on knowledge acquisition, Islamic education seeks to nurture balanced individuals capable of contributing positively to society while fulfilling their responsibilities as ethical human beings (Al-Abrasyi, 1974; Halstead, 2004). From this perspective, inclusive educational practices are closely aligned with the Islamic principles of justice (*'adl*), compassion (*rahmah*), and public benefit (*maslahah*), all of which emphasize equitable access to educational opportunities and the recognition of human dignity (Halstead, 2004; Kamali, 2008). The improvements observed in learner participation, accessibility, confidence, and instructional responsiveness suggest that AI-supported learning environments may contribute to creating educational conditions in which diverse learners are provided equitable opportunities to learn, participate, and flourish.

The findings further indicate that technological innovation can complement rather than replace the humanistic foundations of Islamic education. Participants consistently emphasized the value of individualized guidance, timely support, and meaningful interactions with teachers. These experiences resonate with the concept of *ta'dib*, which emphasizes the formation of responsible, knowledgeable, and ethically grounded individuals through educational relationships and purposeful guidance (Al-Attas, 1991). In this regard, AI should not be understood solely as a tool for improving efficiency but as a pedagogical resource that may assist educators in fulfilling their ethical responsibility to provide accessible, responsive, and inclusive learning experiences. The present study therefore suggests that AI-supported inclusive learning can contribute to the broader mission of Islamic higher education by

promoting educational equity, supporting learner development, and enhancing instructional responsiveness while maintaining the human-centered orientation that characterizes Islamic pedagogical traditions (Ashraf, 1985; Hashim, 2004).

The Uzbekistan context further enhances the relevance of the present study. Khudayshukurovna et al. (2024) identified pedagogical and psychological factors as central to strengthening inclusive education within the country, while Baxtiyor and Sardor (2024) emphasized the transformative role of information technologies in special and inclusive education. The current findings complement these national priorities by providing empirical evidence that AI-supported learning may simultaneously support educational modernization and inclusive participation. Similar conclusions have been advanced by Ashurova et al. (2026), who emphasized the importance of continuous inclusive educational models in promoting equity and quality learning experiences.

The present study also contributes to broader international discussions concerning Sustainable Development Goal 4, which advocates for inclusive and equitable quality education. By demonstrating improvements in accessibility, participation, learner outcomes, and instructional responsiveness, the findings illustrate how AI-supported pedagogical practices may contribute to more equitable educational systems. Nevertheless, technological innovation alone cannot guarantee educational justice. The effectiveness of AI depends upon pedagogical intentionality, ethical implementation, and sustained attention to learner diversity.

Several limitations should be acknowledged. First, the study was conducted within a specific institutional and cultural context, potentially limiting transferability to other educational settings. Second, self-report measures may be susceptible to social desirability bias. Third, the relatively short duration of the intervention may not fully capture the long-term effects of AI-supported inclusive learning. Future studies should consider longitudinal and multi-site designs involving diverse educational contexts and learner populations, including students with specific support needs. Comparative investigations across Islamic higher education institutions in different regions may further enhance understanding of how AI can support inclusive educational transformation across diverse sociocultural environments.

CONCLUSION

This study demonstrates that AI-supported inclusive learning can positively contribute to academic achievement, learner engagement, accessibility, motivation, and instructional efficiency in Islamic higher education contexts. The convergence of quantitative and qualitative evidence indicates that adaptive learning technologies, when integrated within a coherent pedagogical framework, can support more equitable and responsive learning environments for students with diverse needs. The findings extend existing scholarship on inclusive education by illustrating how principles of Universal Design for Learning, learner motivation, technology acceptance, and systems integration may be operationalized through AI-assisted instructional practices. From an Islamic educational perspective, the observed improvements in participation, accessibility, and individualized support reflect broader commitments to justice (*'adl*), compassion (*rahmah*), and the holistic development of learners embodied in the concepts of *tarbiyah*, *ta'lim*, and *ta'dib*. These findings suggest that AI should be viewed not merely as a technological innovation but as a pedagogical resource capable of supporting inclusive and ethically grounded educational transformation. Consequently, Islamic higher education institutions may benefit from strategically integrating AI-supported learning systems to enhance educational equity, strengthen learner participation, and advance sustainable quality education in increasingly diverse learning environments.

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