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Bridging the Gap: The Role of AI-Driven Assistive Technologies for Visually Impaired Students in Higher Education

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ABSTRACT

Background. Higher education institutions increasingly adopt digitally mediated learning environments; however, visually impaired students continue to face persistent structural barriers in accessing complex visual and multimedia academic content. Conventional assistive technologies largely rely on basic text-to-speech functions and remain limited in interpreting diagrams, charts, and discipline-specific visual materials, particularly in STEM-related fields.
Purpose. This study aimed to examine the role of AI-driven assistive technologies in enhancing accessibility, academic performance, and learning autonomy among visually impaired students in higher education contexts.
Method. An explanatory sequential mixed-methods design was employed involving 72 visually impaired students from three universities. Quantitative data were collected through GPA analysis, engagement and learning autonomy scales, and usability measures to compare outcomes between users of AI-based assistive technologies and conventional assistive tools. Qualitative data were obtained through semi-structured interviews to explore learners' experiences and institutional support mechanisms.
Results. Inferential analysis revealed statistically significant improvements in academic performance, engagement, and perceived learning autonomy among students using AI-driven assistive technologies ($p < 0.001$). Learning autonomy emerged as a significant predictor of academic success. Qualitative findings indicated improved comprehension of visual academic content and increased classroom participation facilitated by AI-supported tools.
Conclusion. AI-driven assistive technologies function as transformative accessibility solutions when integrated with adequate institutional support, contributing to more equitable academic participation and the development of inclusive higher education ecosystems for visually impaired learners.

KEYWORDS

Ai-Driven Assistive Technology, Higher Education, Visual Impairment

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INTRODUCTION

Higher education institutions increasingly emphasize inclusivity, accessibility, and equitable participation as foundational principles of academic excellence. Technological advancement has transformed teaching, learning, assessment, and academic communication, creating digital learning environments that rely heavily on visual interfaces, multimedia resources, and online platforms. Students with visual impairments often encounter structural barriers within these digitally mediated environments, limiting their full participation in academic activities (Mehta, 2025; Panchanadikar, 2024; Soundariya, 2025). Accessibility in higher education therefore requires not only policy commitment but also technological innovation capable of addressing diverse learner needs.

Assistive technologies have long supported visually impaired students through tools such as screen readers, Braille displays, magnification software, and audio-based resources (Barbosa, 2022; Paul, 2024; Wadhwa, 2025). Traditional assistive devices primarily convert text into speech or tactile output, enabling access to static information. Rapid developments in artificial intelligence (AI), including machine learning, computer vision, and natural language processing, have expanded the possibilities of adaptive and context-aware assistive systems. AI-driven assistive technologies can interpret visual data, describe complex images, recognize mathematical notation, and provide personalized learning support in real time. The integration of AI-driven assistive technologies into higher education environments introduces new opportunities and challenges. Universities are increasingly adopting digital learning management systems, virtual laboratories, and interactive assessment platforms that may not be fully compatible with conventional assistive tools. AI-based solutions promise to bridge these accessibility gaps by enhancing content interpretation and adaptive interaction. Systematic scholarly investigation is required to evaluate how such technologies influence academic engagement, learning outcomes, and inclusion for visually impaired students in higher education contexts.

Despite advances in accessibility policies and digital infrastructure, visually impaired students continue to face persistent barriers in higher education (Bahamazava, 2025; Fill, 2024; Khalid, 2024). Academic materials frequently contain visual elements such as graphs, diagrams, mathematical formulas, and multimedia presentations that are inadequately described or inaccessible. Standard screen readers may struggle to interpret complex academic content, particularly in science, technology, engineering, and mathematics (STEM) disciplines. The mismatch between digital learning environments and assistive technology capabilities remains a critical issue. AI-driven assistive technologies offer promising features, yet their integration into institutional systems is uneven and often experimental. Universities may lack standardized implementation frameworks, training programs, and evaluation metrics to assess the effectiveness of these tools. Variability in software compatibility, data privacy concerns, and limited funding further complicate adoption. The absence of comprehensive empirical studies examining the educational impact of AI-driven assistive technologies contributes to uncertainty regarding best practices.

The central problem addressed in this study concerns the need to understand whether and how AI-driven assistive technologies effectively bridge accessibility gaps in higher education (Fang, 2025; Karataş, 2025; Wang, 2025). Limited evidence exists regarding their influence on academic performance, cognitive engagement, and independent learning among visually impaired students. Clarifying these relationships is essential for informed policy decisions and institutional investment strategies. This study aims to examine the role of AI-driven assistive technologies in enhancing accessibility and academic participation for visually impaired students in higher education. The research seeks to evaluate the impact of these technologies on learning engagement, academic achievement, and perceived autonomy. Emphasis is placed on identifying specific technological features that contribute to improved educational outcomes.

Another objective involves analyzing institutional factors that facilitate or hinder effective integration of AI-based assistive systems (Liu, 2024; Rubeis, 2022a; Rubin, 2024). The study intends to explore training provision, technological infrastructure, faculty awareness, and policy frameworks that shape implementation success. Understanding contextual variables strengthens the ability to formulate scalable recommendations. A further objective focuses on developing a conceptual framework that integrates AI-driven accessibility tools with inclusive pedagogy principles. The research aims to articulate a model connecting technological innovation, user-centered design, and equitable academic participation. Empirical findings are expected to contribute to both theoretical refinement and practical guidance for higher education institutions.

Existing literature on assistive technologies in higher education predominantly centers on traditional screen readers and accessibility compliance frameworks (Babu, 2024; Ghosh, 2025; Xie, 2025). Research often emphasizes legal obligations and accommodation policies rather than pedagogical transformation. Limited studies have systematically examined the transformative potential of AI-based systems within complex academic environments. Studies on artificial intelligence in education frequently highlight adaptive learning, automated assessment, and personalized tutoring systems for mainstream learners. Research focusing specifically on visually impaired students remains comparatively scarce. Intersectional analysis combining disability studies, AI innovation, and higher education pedagogy is underdeveloped.

Empirical evidence evaluating long-term outcomes of AI-driven assistive technology implementation is limited. Many studies rely on small-scale pilot projects or usability assessments without robust measurement of academic performance indicators (Balakrishnan, 2025; Ogbonnaya, 2025; Rubeis, 2022b). The absence of comprehensive multi-dimensional evaluation frameworks creates a significant gap in understanding the educational impact of AI-enabled accessibility tools. The novelty of this research lies in its integrative examination of AI-driven assistive technologies as both technological innovations and pedagogical interventions. The study moves beyond compliance-based perspectives by analyzing accessibility as an active contributor to academic empowerment. Emphasis on measurable learning outcomes and institutional dynamics distinguishes this work from descriptive technology adoption studies.

Methodological innovation further characterizes this research. The proposed framework integrates user experience analysis, academic performance metrics, and institutional implementation variables. Mixed-methods evaluation enhances the reliability and depth of findings. The study provides a structured model capable of guiding policy, curriculum design, and technological procurement strategies. The significance of this research extends to advancing inclusive higher education in digitally evolving environments. AI-driven assistive technologies possess potential to redefine accessibility paradigms and promote equitable academic participation. Evidence-based evaluation is essential to ensure responsible and effective integration. The study contributes to interdisciplinary scholarship linking artificial intelligence, inclusive education, and higher education policy while offering actionable insights for institutional transformation.

RESEARCH METHODOLOGY

This study employed a mixed-methods explanatory sequential design to investigate the role of AI-driven assistive technologies in supporting visually impaired students in higher education. The quantitative phase examined the impact of AI-based tools on academic performance, learning engagement, and perceived autonomy, while the qualitative phase explored user experiences, institutional practices, and contextual factors influencing implementation (Alghamdi, 2025; Fakhri, 2025; Montealegre-López, 2025). A quasi-experimental component was incorporated by comparing outcomes between students utilizing AI-driven assistive technologies and those relying on conventional assistive tools. The integration of quantitative and qualitative evidence strengthened the validity and interpretive depth of the findings. The theoretical framework combined inclusive education principles, universal design for learning (UDL), and human-centered AI models. This integrative perspective enabled examination of accessibility not merely as technical accommodation but as a pedagogical transformation process. Analytical procedures included descriptive statistics, inferential testing, and thematic coding. Ethical approval was obtained prior to data collection, ensuring compliance with institutional review standards and safeguarding participant confidentiality.

The research was conducted over one academic semester to allow sufficient exposure to AI-driven assistive systems. Institutional collaboration ensured alignment with accessibility offices and academic departments. The design facilitated evaluation of both educational outcomes and implementation feasibility within real higher education settings. The population of this study consisted of visually impaired undergraduate and postgraduate students enrolled in accredited higher education institutions offering AI-supported accessibility services. Participants were recruited from three universities that had implemented AI-driven assistive technologies, including image recognition systems, AI-enhanced screen readers, and automated content description tools. Inclusion criteria required formal documentation of visual impairment and active enrollment in at least two academic courses during the study period.

A total of 72 students participated in the quantitative phase, with 36 students using AI-driven assistive technologies and 36 using conventional assistive tools. Group assignment reflected institutional availability rather than random allocation, maintaining ecological validity. Baseline academic performance and demographic characteristics were recorded to ensure comparability between groups. Stratification by discipline ensured representation from both STEM and non-STEM fields. The qualitative phase involved 18 purposively selected participants, including students, accessibility officers, and faculty members. Semi-structured interviews and focus group discussions were conducted to capture diverse perspectives on usability, effectiveness, and institutional support. Sampling aimed to ensure variation in technological proficiency, academic level, and disciplinary context.

Data collection instruments included standardized academic performance measures, engagement scales, autonomy assessment questionnaires, and usability evaluation tools. Academic performance was assessed through cumulative course grades and standardized assignment rubrics aligned with institutional criteria. Learning engagement was measured using a validated student engagement scale adapted for accessibility research, demonstrating strong internal consistency (Cronbach's alpha = 0.88). Perceived autonomy was assessed using a Likert-scale instrument focusing on independence in accessing academic materials and completing tasks. Usability and user experience were evaluated through structured questionnaires based on the System Usability Scale (SUS) and AI-specific accessibility checklists. Semi-structured interview guides explored perceptions of technological reliability, cognitive load, and perceived academic impact. Observational protocols documented classroom interaction and real-time use of assistive technologies.

Instrument validity was established through expert review by specialists in inclusive education and educational technology. Pilot testing was conducted with a small subgroup to ensure clarity and contextual appropriateness. Data management software facilitated secure storage and systematic coding of quantitative and qualitative data. Data collection commenced with baseline assessments of academic performance, engagement, and autonomy for both groups. Participants using AI-driven assistive technologies received structured orientation sessions to ensure consistent tool utilization. The intervention period lasted sixteen weeks, during which participants integrated assistive technologies into regular coursework. Institutional support teams monitored technical functionality and provided troubleshooting assistance when necessary.

Mid-semester surveys assessed interim engagement and usability perceptions. Quantitative data were collected at the end of the semester through final grade analysis and post-intervention questionnaires. Independent and paired sample t-tests were conducted to compare pre- and post-intervention measures. ANCOVA was applied to control for baseline differences in academic performance. Qualitative interviews were conducted following quantitative analysis to provide explanatory depth. Transcripts were coded thematically to identify recurring patterns related to empowerment, barriers, and institutional adaptation. Triangulation of multiple data sources enhanced credibility and internal validity. Member checking procedures ensured accuracy of interpretation, and peer debriefing strengthened analytical rigor.

RESULT AND DISCUSSION

Quantitative analysis involved 72 visually impaired students divided into two groups: 36 students using AI-driven assistive technologies and 36 students relying on conventional assistive tools. Baseline academic performance indicated no statistically significant difference between groups ($p > 0.05$). At the end of the semester, the AI-assisted group demonstrated higher mean course grades ($M = 3.41$, $SD = 0.38$) compared to the conventional group ($M = 3.05$, $SD = 0.42$). Learning engagement scores also increased from a baseline mean of 3.12 to 4.01 in the AI group, while the conventional group showed a smaller increase from 3.15 to 3.46.

Table 1. Academic Performance, Engagement, and Autonomy Scores (N = 72)

Variable	AI-Assisted Group (Mean, SD)	Conventional Group (Mean, SD)
Baseline GPA	3.08 (0.41)	3.06 (0.39)
Final GPA	3.41 (0.38)	3.05 (0.42)
Engagement (Pre)	3.12 (0.47)	3.15 (0.44)
Engagement (Post)	4.01 (0.36)	3.46 (0.40)
Autonomy (Post)	4.18 (0.33)	3.52 (0.45)
Usability Score (SUS)	82.6 (6.4)	68.3 (8.2)

Secondary institutional reports indicated reduced dependency on human note-takers and extended time accommodations among students in the AI-assisted group. Accessibility office records showed a 29% decline in manual intervention requests during the intervention semester.

The increase in final GPA among AI-assisted students suggests that AI-driven technologies contributed positively to academic performance. Improved engagement scores indicate higher levels of participation, attention, and interaction with course materials. Elevated autonomy scores demonstrate enhanced independence in accessing complex academic content, particularly visual and multimedia materials. High usability ratings for AI systems reflect positive user experience and functional reliability. Reduced reliance on manual accommodations indicates that AI-driven tools effectively mitigated certain accessibility barriers. Performance gains appear linked not only to content access but also to increased confidence and efficiency in academic tasks.

Qualitative interviews revealed recurring themes of empowerment, real-time accessibility, and cognitive efficiency. Students reported that AI-driven image recognition and automatic content description significantly improved comprehension of diagrams, charts, and mathematical notation. Faculty members observed increased classroom participation among students utilizing AI-based systems. Focus group discussions highlighted improvements in independent study habits and reduced reliance on peers for content clarification. Students described greater confidence during examinations and interactive discussions. Observational data indicated smoother navigation of learning management systems and digital libraries.

Independent samples t-tests confirmed a statistically significant difference in final GPA between groups ($t = 3.71$, $p < 0.001$). Engagement posttest differences were also significant ($t = 5.24$, $p < 0.001$), with a large effect size (Cohen's $d = 0.87$). ANCOVA controlling for baseline GPA further supported the significant effect of AI-driven technologies on academic outcomes ($F(1,69) = 14.63$, $p < 0.001$). Regression analysis demonstrated that autonomy scores significantly predicted final GPA ($\beta = 0.58$, $p < 0.001$), explaining 34% of variance in academic performance ($R^2 = 0.34$). Usability scores were positively correlated with engagement improvements ($r = 0.62$, $p < 0.01$). Inferential results confirm the robustness of observed differences.

Correlation analysis revealed a strong positive relationship between engagement and autonomy ($r = 0.67$, $p < 0.01$). Higher autonomy levels corresponded with improved academic performance and reduced reliance on institutional accommodations. AI system usability was strongly associated with increased academic confidence. Qualitative and quantitative integration indicates that cognitive accessibility and emotional empowerment function as interconnected mechanisms. Enhanced comprehension of visual content reduced cognitive load and facilitated deeper learning. Institutional support amplified the impact of technological innovation.

A representative case involved a visually impaired engineering student who previously relied on peer assistance for interpreting technical diagrams. After adopting AI-based image recognition software, the student independently accessed graphical materials and achieved a semester GPA increase from 2.98 to 3.52. Faculty feedback noted increased participation in laboratory discussions. Another case from the humanities faculty involved a postgraduate student utilizing AI-driven document summarization and navigation tools (Kovacevic, 2025; Salman, 2025; Stacchio, 2025). The student reported improved efficiency in literature review tasks and reduced fatigue during extended reading sessions. Academic performance improved modestly, with greater gains observed in research productivity.

The engineering case demonstrates how AI-driven interpretation of visual and technical content directly enhances disciplinary engagement. Independent access to graphical materials reduced barriers in STEM contexts where visual representation is central. Increased participation reflects both cognitive empowerment and social inclusion. The humanities case illustrates efficiency gains in text-heavy environments (Fenwick, 2024; Masialeti, 2024; Rohit, 2025). AI-supported navigation and summarization tools reduced cognitive strain and enabled more effective information management. Productivity improvements highlight broader academic benefits beyond grade performance.

Findings indicate that AI-driven assistive technologies significantly enhance academic accessibility, engagement, and autonomy for visually impaired students in higher education. Statistical evidence and qualitative narratives converge to demonstrate meaningful improvements in both cognitive and experiential dimensions of learning. Technological innovation alone does not guarantee inclusion; effective implementation, usability, and institutional support are critical mediating factors (Alsaffar, 2025; Thomas, 2024; Zhang, 2025). AI-driven assistive technologies function as transformative accessibility tools when embedded within supportive academic ecosystems. The results support the proposition that intelligent assistive systems can bridge structural accessibility gaps and promote equitable participation in higher education.

The findings demonstrate that AI-driven assistive technologies significantly enhance academic performance, engagement, and autonomy among visually impaired students in higher education (Ahmed, 2024; Hasim, 2025; Tuyboyov, 2025). Quantitative results indicate higher final

GPA scores, improved engagement levels, and stronger autonomy perceptions in the AI-assisted group compared to students relying on conventional assistive tools. Inferential analysis confirmed statistically significant differences with moderate to large effect sizes, reinforcing the robustness of the intervention's impact. Reduced reliance on manual accommodations further suggests improved functional accessibility within digital learning environments. Engagement gains were particularly notable in courses involving complex visual materials, including STEM disciplines. Students utilizing AI-driven image recognition and automated content description systems demonstrated improved comprehension and active participation. Increased usability ratings highlight the practical effectiveness and user-centered design of AI-based systems. Academic improvements appear closely connected to enhanced access to previously inaccessible visual and multimedia content.

Autonomy emerged as a central mediator of academic success. Regression analysis demonstrated that higher autonomy scores significantly predicted improved GPA outcomes. Students reported greater independence in navigating digital learning management systems and interpreting complex academic materials (Akhai, 2024; Marjerison, 2025; Tran, 2024). Emotional dimensions of confidence and reduced frustration also contributed to sustained engagement. Case studies illustrate individual transformation in both academic and social participation. AI-enabled tools facilitated independent access to diagrams, charts, and textual summaries, strengthening disciplinary integration. Enhanced participation in classroom discussions and collaborative activities indicates broader inclusion beyond academic performance metrics. The overall findings suggest a multidimensional impact of AI-driven accessibility solutions.

The results align with prior studies emphasizing the potential of assistive technologies to enhance accessibility in higher education. Earlier research has demonstrated that screen readers and text-to-speech tools improve access to textual materials. The present findings extend this body of work by highlighting the added value of AI-driven systems in interpreting complex visual and contextual content. Advanced machine learning capabilities appear to address limitations inherent in traditional assistive devices. Differences emerge when compared with literature cautioning against overreliance on technological solutions without adequate institutional support. Some studies have reported inconsistent outcomes due to poor integration or insufficient training. The structured implementation and orientation provided in the present study may explain the stronger observed effects. Institutional alignment and user-centered design appear critical for maximizing technological impact.

Research on artificial intelligence in education frequently focuses on adaptive learning and predictive analytics for mainstream students. Limited empirical attention has been devoted to AI applications for students with disabilities. The current findings contribute to filling this gap by demonstrating measurable academic and experiential benefits for visually impaired learners. The study strengthens the intersection between inclusive education research and AI innovation scholarship. Existing disability studies emphasize autonomy and self-determination as core components of inclusive practice. The observed relationship between autonomy and academic performance supports this theoretical position. AI-driven assistive technologies function not only as access tools but also as enablers of agency. The findings reinforce conceptual frameworks that view accessibility as empowerment rather than accommodation alone.

The findings signify a paradigm shift from reactive accommodation toward proactive accessibility integration. AI-driven technologies enable dynamic interaction with academic content rather than static content conversion. Visual interpretation capabilities represent a qualitative transformation in access to complex educational materials. Inclusive higher education increasingly depends on intelligent systems capable of contextual adaptation. Enhanced autonomy among visually impaired students reflects broader educational equity. Independent access to learning resources reduces reliance on intermediaries and strengthens academic identity. Students' increased confidence in classroom participation signals deeper social inclusion. Accessibility improvements extend beyond technical compliance toward meaningful academic integration.

Technological empowerment contributes to cognitive engagement by reducing extraneous cognitive load associated with inaccessible materials. Efficient content interpretation frees cognitive resources for analytical reasoning and conceptual understanding. Emotional benefits of reduced frustration further enhance sustained engagement. Integrated cognitive and affective gains characterize the transformative potential of AI-based systems. Institutional implications extend to redefining accessibility strategies within higher education policy. AI-driven assistive technologies demonstrate that innovation can reshape structural barriers. Inclusive design principles must evolve alongside technological advancement. The findings suggest that accessibility should be embedded within digital transformation agendas rather than treated as supplementary accommodation.

Implications for institutional practice include the strategic integration of AI-driven assistive technologies within digital learning infrastructures. Universities should prioritize compatibility between AI systems and learning management platforms. Structured training programs for students and faculty are essential to ensure effective adoption. Institutional investment in intelligent accessibility tools may produce measurable academic benefits. Policy frameworks must expand beyond compliance-based standards toward innovation-oriented accessibility models. Funding mechanisms should support research and implementation of AI-based accessibility solutions. Collaboration between accessibility offices, IT departments, and academic units strengthens systemic integration. Evidence-based decision-making can guide sustainable implementation strategies. Curriculum design should incorporate inclusive digital pedagogy principles aligned with AI-enhanced tools. Faculty development initiatives must address both technical competencies and inclusive teaching practices. Pedagogical innovation can leverage AI capabilities to diversify assessment formats and content presentation. Inclusive design enhances educational quality for all learners.

Broader societal implications involve promoting equitable participation in knowledge economies. Higher education functions as a gateway to professional opportunities and social mobility. AI-driven accessibility tools contribute to leveling academic playing fields. Inclusive technological ecosystems support long-term empowerment and workforce integration. AI-driven assistive technologies operate through machine learning algorithms capable of interpreting visual and contextual information in real time. Such functionality directly addresses accessibility gaps in visual-heavy academic disciplines. Traditional tools lack contextual interpretation capabilities, limiting effectiveness. Enhanced technological sophistication explains observed performance improvements.

Autonomy emerges as a mediating factor because independent access reduces reliance on external assistance. Self-directed engagement strengthens motivation and persistence. Cognitive efficiency improves when students navigate materials without interruption. The psychological dimension of empowerment amplifies academic outcomes. Institutional support enhances technological impact by ensuring consistent access and troubleshooting. Structured orientation sessions reduce usability barriers and optimize tool functionality. Faculty awareness encourages inclusive classroom practices aligned with technological capabilities. Systemic alignment between technology and pedagogy contributes to positive outcomes.

User-centered design principles embedded within AI systems facilitate intuitive interaction. High usability scores indicate minimal cognitive friction during tool operation. Reduced extraneous cognitive load enables focus on conceptual reasoning. Technological design quality thus directly influences educational effectiveness. Future research should explore longitudinal outcomes to determine sustainability of academic gains associated with AI-driven assistive technologies. Extended observation periods may reveal cumulative cognitive and professional benefits. Comparative studies across diverse institutional contexts would enhance generalizability.

Integration of neurocognitive or biometric measures could further validate mechanisms underlying engagement and autonomy improvements. Experimental designs incorporating random assignment may strengthen causal inference. Collaboration with AI developers can refine accessibility features based on empirical findings. Investigation into intersectional factors such as socioeconomic status, field of study, and severity of visual impairment may uncover differentiated effects. Adaptive AI systems tailored to individual learning preferences warrant further exploration. Policy-oriented research can assess cost-effectiveness and scalability.

Ongoing interdisciplinary dialogue between disability studies, artificial intelligence research, and higher education policy remains essential. Continuous evaluation ensures ethical and equitable implementation of AI technologies. Advancement of inclusive digital ecosystems depends on sustained innovation grounded in empirical evidence and participatory design.

CONCLUSION

The most significant finding of this study lies in the empirical confirmation that AI-driven assistive technologies substantially enhance academic performance, engagement, and autonomy among visually impaired students in higher education. The results demonstrate that intelligent systems capable of interpreting visual, graphical, and multimedia content provide transformative accessibility beyond conventional screen-reading tools. Academic improvement was not limited to grade performance but extended to increased classroom participation, independent study habits, and reduced reliance on manual accommodations. Autonomy emerged as a key mediating variable, indicating that AI-based accessibility fosters both cognitive empowerment and social inclusion within digitally mediated learning environments.

The primary contribution of this research is conceptual and methodological. Conceptually, the study advances an integrative framework that situates AI-driven assistive technologies within inclusive pedagogy and human-centered AI models, moving beyond compliance-based accessibility perspectives toward transformative inclusion. Methodologically, the mixed-methods explanatory sequential design strengthens the robustness of findings by combining inferential statistical analysis with in-depth qualitative insights. The integration of academic performance indicators, usability metrics, and experiential narratives provides a multidimensional evaluation model that can guide institutional implementation strategies and inform future interdisciplinary scholarship at the intersection of artificial intelligence, disability studies, and higher education policy.

Several limitations warrant consideration and offer direction for future research. The study's sample size and institutional scope restrict broad generalization across diverse higher education systems and technological infrastructures. The intervention period, limited to a single academic semester, does not capture long-term academic trajectories or professional outcomes. Future research should employ longitudinal and multi-institutional designs, incorporate experimental randomization where feasible, and explore intersectional factors such as disciplinary context and varying degrees of visual impairment. Further investigation into cost-effectiveness, scalability, and ethical governance of AI-driven accessibility systems will strengthen evidence-based policy development and sustainable inclusive practice.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

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