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EFFECTIVENESS OF AI-BASED APPLICATIONS FOR CHILDREN WITH MILD INTELLECTUAL DISABILITIES: PERSPECTIVES OF SPECIAL EDUCATION TEACHERS

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ABSTRACT

The integration of artificial intelligence-based applications in special education has attracted increasing attention due to their potential to support individualized learning. This study examined special education teachers' perceptions of the effectiveness of AI-based applications in addressing the learning needs of children with mild intellectual disabilities. The quantitative survey research design was used, and data were gathered from teachers working in government special education institutions of Punjab. A 5-point Likert-scale questionnaire with excellent reliability (Cronbach's α = .96) was used to measure perceptions of instructional effectiveness, usability, and implementation challenges. The trends of perception were summarized with the help of descriptive statistics, whereas inferential analysis was applied to investigate the difference between teacher-related variables. The results showed that AI-based applications are effective and convenient to use as instructional tools for children with MID (M = 4.0-4.3). Most demographic variables showed no significant variation, but differences in effectiveness by gender (p = .002, d = 0.76) and division (p = .050, d = 0.60) can be attributed to contextual and systemic factors in AI use. The study concludes that AI-based applications can effectively enhance individualized learning, engagement, and learning processes. It suggests that teachers can enhance children's learning by incorporating AI apps into their instructional methods.

Keywords: *Artificial Intelligence, Mild Intellectual Disability, Teacher Perceptions, AI-Based Applications, Special Education.*

INTRODUCTION

Education is crucial in human development and social inclusion especially of persons with disabilities (Siahaan, 2022). The current developments in digital technologies have transformed the educational practice by employing new tools that allow the individualization and student-centered teaching (Zou et al., 2025). Artificial intelligence (AI), in particular, has become one of such developments with its capability to personalize the teaching material, give feedback instantly, and react to specific requirements of the learning process (Chen et al., 2020). These characteristics have raised enthusiasm in the application of AI-based applications in the various educational contexts.

Instructional challenges are even more accentuated in the sphere of special education since cognitive and learning profiles of students

are different. Children with mild IDs usually have problems with attention, memory, reasoning and processing information and may struggle with the comprehension of conventional classroom education (Hronis et al., 2017; Schalock et al., 2021). Such cognitive barriers often make teachers change their instructional methods and pursue supportive teaching, which encourages effective learning activities.

Educational applications based on AI can provide possible solutions in connection with these challenges because it is possible to provide an adaptive instruction based on the abilities of the individual learners. These applications may be used to change the level of difficulty of the content, strengthen learning with repetition, and give guided instructions in an organized way that corresponds to the cognitive level of learners (Zhai et al., 2021). Studies show that AI-assisted solutions may improve interaction and introduce acquisition of skills when successfully introduced to special education learning (Yaseen et al., 2025). Artificial intelligence (AI) has also been involved in advancing educational activities, providing new devices to support individual and flexible learning. AI-based applications have attracted interests in special education where learners need personalized learning, and therefore such application can be useful in teaching and learning. They are applications that assist teachers in their practice by offering system activities, adaptive feedback, and instructional strategies that leverage technology to provide educational opportunities for learners with diverse needs, such as children with mild intellectual disabilities (Almarzouq et al., 2025).

Although international research has examined the role of AI in special education, much of the existing literature focuses on technology development and learner outcomes rather than classroom-level instructional use (Harkins-Brown et al., 2025; Binmahfooz, 2024). Compared with other perspectives, limited research has addressed how AI supports instruction from the viewpoint of teachers (Almarzouq et al., 2025; Alsudairy & Eltantawy, 2024). The use of instructional technologies plays a central role in teachers' practice, and thus their views are critical to the body of knowledge on the feasibility of AI applications in special education context (Alnaim and Al-Otaibi, 2025).

In Pakistan, particularly at government special education institutions, no study has examined teachers' views on AI-based applications. Minimal knowledge has been acquired on how teachers perceive the effectiveness, usefulness, and educational usefulness of these applications in the teaching of children with mild intellectual disabilities. Lack of teacher-oriented evidence can lead to application of AI tools that are not widely applicable to the classroom realities, as well as professional needs of teachers. Such a deficiency regarding the understanding of the views of teachers may influence the process of instructional planning, professional development programs, and the successful implementation of AI-based solutions into special education classes. The policymakers and school administrators might not be able to create the right support systems, training, and implementation strategies of AI-based teaching without knowing the perception of teachers.

Thus, the current research paper will focus on the perceptions of special education teachers regarding the usefulness of AI-based applications in teaching children with mild intellectual disabilities in Pakistan. The paper in question, in particular, examines the perceptions of teachers regarding the instructional usefulness and usability and the challenges in implementation with the view of influencing the educational practice, planning of policies, and successful application of AI-based programs in special educational institutions.

Statement of the Problem

AI-based applications are being used in special education worldwide; in Pakistan, there is limited research on their use and on how teachers can employ AI in instruction, and insufficient information on their effectiveness. The government of Punjab has also started encouraging the use of digital technologies, such as artificial intelligence, in governmental schools. However, there is still a lack of research on the application of AI in special education. In the absence of meaningful teacher participation, teachers may fail to adapt AI-based tools to

classroom realities, with implications for instructional planning and implementation. Therefore, teachers' perceptions should be evaluated to enable the positive, contextually relevant use of AI in special education.

Significance of the Study

This research will be valuable for understanding how AI-based applications can be useful for teaching children with mild intellectual disabilities and for assisting special education teachers in incorporating technology into teaching. The findings of this study will contribute to positive changes in teachers' attitudes toward the usefulness and practicality of AI tools in classroom teaching. The research will guide school administrators and policymakers, drawing on teachers' experience and views. It will also contribute to the scarcity of literature on teachers' perceptions of AI's use in special education in Pakistan.

Research Objectives

The following objectives of the study to:

1. examine special education teachers' perceptions of how effective AI-based applications are for teaching children with mild intellectual disabilities.
2. explore teachers' views on the use of AI-based applications in classrooms for children with mild intellectual disabilities.
3. identify the challenges teachers face when using AI-based applications in institutions.
4. determine whether teachers' perceptions of AI-based application effectiveness differ across demographic characteristics.

Research Questions

The following were the research questions:

1. How do special education teachers perceive the effectiveness of AI-based applications for teaching children with mild intellectual disabilities?
2. What are the teachers' perceptions regarding the use of AI-based applications in classrooms for children with mild intellectual disabilities?
3. What challenges do teachers encounter in the institutional use of AI-based applications?
4. Do teachers' perceptions of the effectiveness of AI-based applications differ according to their demographic characteristics?

Literature Review

Children with mild intellectual disability show below-average intellectual functioning and limitations in adaptive behavior that affect learning and daily skills. They usually have problems with attention, memory, language development, problem-solving, and independent functioning, and they disrupt the academic progress (Elshani et al., 2020; Schalock et al., 2021). The said learners need to be taught systematically in the special-educational setting, with simplified content, repetition, and continuous feedback that matches their pace of learning (Dichaba et al., 2024). Nevertheless, many conventional teaching methods are characterized by a lack of differentiation and standard teaching, which makes them less efficient at meeting the needs of children with a mild intellectual disability and limits their ability to retain and generalize information.

Technology is also a significant issue in special education instruction, ranging from simple assistive devices to high-tech digital and intelligent technologies. The initial technologies were mostly concerned with access and compensations, such as visual aids and simple computer-based applications aimed at minimizing learning barriers. These tools, developed over the years as interactive online applications, support personalized, adaptive learning for learners with varying needs (Alnahdi, 2014). Technology-based instruction for children with intellectual disabilities has several advantages. It presents information in a graphic, systematic, and monotonous manner, which facilitates memorization and comprehension (Alexopoulou et al., 2021). Previous research has also shown that digital tools can increase student engagement and motivation, as they enable students to learn at a pace, they feel comfortable with and provide immediate feedback as they are being taught (Bouck et al., 2014). Moreover, technology enables the personalization of instructions by allowing the material to be modified in accordance with learners' abilities, which is often challenging with

traditional teaching techniques alone (Drigas and Ioannidou, 2013). Despite these benefits, educators encounter significant difficulties in implementing educational technologies, including a lack of training opportunities, technical support, and infrastructure, and the inability to align digital technologies with curriculum objectives (Ertmer and Ottenbreit-Leftwich, 2010). Technology use in special education is not just as a being conditioned on its teaching potential but it also requires the willingness and institutional support of the teachers.

Application of Artificial Intelligence in education can be described as the application of intelligent systems to alter the learning process depending on the capability of the learners, performance and pace at which they acquire knowledge. In contrast to the traditional educational apps that deliver the same content and order to everyone, AI-based ones embrace adaptive learning, customizing activities, altering the difficulty of tasks, and giving real-time and data-driven feedback (Holmes et al., 2022). The mentioned characteristics can be especially useful in special education when children with mild intellectual disabilities demonstrate various cognitive profiles and learning requirements. AI enables individual learner-focused instructions by adapting tasks to their abilities, monitoring their progress, and identifying errors, eliminating frustration and encouraging active learning over time (Almufareh et al., 2023). In addition to this, AI systems also generate performance information that is meant to guide the teachers in monitoring the students' progress and make sound teaching decisions (Zawacki-Richter et al., 2021). Despite these benefits, AI application in education is associated with certain ethical and access challenges, including data privacy, informed consent, the transparency of the algorithm, and unequal access to technology. These problems need to be tackled to provide responsible, inclusive, and equitable utilization of AI-based educational applications in special education settings (Miao and Holmes, 2021).

Adaptive learning applications, intelligent tutoring systems, game-based learning applications, and AI-assisted assistive technologies are AI-based applications targeting children with mild intellectual disabilities (MID) and customizes teaching based on the performance and the learning pace of a child. According to recent reports, these applications contribute to the increase in such important cognitive functions as attention, working memory, and problem-solving, in addition, these applications help improve academic abilities in such areas as early literacy, numeracy, and concept recognition, through constant practice and instantaneous feedback (Saxena, 2024: Liu and Sun, 2024: Jiao, 2025). The use of AI-based tools has also demonstrated beneficial outcomes in terms of functional and everyday living skills, especially in cases when the learning tasks are divided into small, easy to manage steps and supported with visual and interactive presentations (Almufareh et al., 2023: Perry et al., 2024). They are progressively applied to school environments, where they are incorporated into individualized or small-group learning by teachers, as well as to home environments, where they are supported by parents to ensure further practice and the generalization of skills (Wang et al., 2024: Boncillo, 2025 & Ansari and Qamari, 2025). Recent experimental and quasi-experimental research has shown that AI interventions cause significant improvements in academic and learning performance of children with mild intellectual disability, especially with individualized and adaptive training (Alsolami, 2025; Li and Zeng 2025; Perry et al., 2024).

Teachers are the key figures in the effective use of AI-based applications in special education, as they are the primary decision-makers who select, adapt, and integrate them into classroom instruction. Teachers and their beliefs, attitudes, and confidence are used as the strongest predictors of the possibility of adopting and successfully applying AI technologies in working with children with mild intellectual disabilities (Schalock et al., 2021; Almufareh et al., 2023). Favorable opinions about AI are often linked to the level of knowledge of teachers regarding the effects of such applications on personalized learning, automatic feedback, and decreased teaching load. However, the shortage of confidence, a shortage of previous experience, and uncertainty concerning the functionality of the AI can become obstacles to

adoption. According to recent studies, the area of continuous training and professional development is essential for teachers to acquire skills to use AI-based applications in special education in an ethical and meaningful way (Drigas and Karyotaki, 2022; Holmes et al., 2022). The teachers' practical classroom experience also indicates that effective implementation is not solely dependent on technology but also on institutional and technical support, as well as curriculum alignment, underscoring the need for teacher-centered perspectives when evaluating the effectiveness of AI-based instructional tools.

Teachers' perceptions of effectiveness are professional judgments about an instructional tool's ability to help students learn, be engaged, and practice in the classroom, rather than the end result, objectively measured by tests. Another area of educational research is actively studied through the lens of teachers' views on tangible changes in engagement, the acquisition of particular skills, and the comfort level in incorporating the tool into everyday teaching. Most recent research indicates that special education teachers are more inclined to be positive about the use of AI apps when informed that students feel more motivated, learn at their own pace, receive feedback, and observe improvements in cognitive or academic skills (Drigas and Ioannidou, 2022; Almufareh et al., 2023). Teachers appreciate the ease of use, the minimal need for technical support, and the alignment with curriculum objectives, as these factors directly contribute to classroom applicability (Holmes et al., 2022). However, there is a clear disparity between the perceived benefits and the real challenges as they come out in the literature. Although teachers attribute the possibilities of using the AI-based applications, they also refer to the number of problems, among them being the absence of training, a shortage of infrastructure, limited time, and the lack of support in their institutions, which restrict their application. These results reveal that the performance of teachers is influenced by the situation and other organizational variables, but not the performance of students only.

Aspects such as usability, classroom applicability, and implementation barriers are key factors influencing teachers' willingness to use AI-based applications in special education institutions. Surveys since 2020 show that special education teachers value AI tools that are simple to use, require minimal technical skills, and enable students with mild intellectual disabilities to engage in online learning activities without teacher support (Almufareh et al., 2023; Drigas and Karyotaki, 2022). The applications of AI are better suited to classroom use because they are easy to navigate, have clearly defined instructions, and adapt to varying levels of the task. Nevertheless, educators tend to complain about difficulties when such applications are not integrated into current curricula or usual classroom practices and cannot be incorporated into teaching regularly (Liu et al., 2022). The issue of infrastructure barriers is also significant, especially in developing settings, where access to tablets is restricted, internet connectivity can be unstable, and technical support is not available on the ground, hindering successful implementation (Holmes, 2023). Moreover, teachers' lack of confidence in AI-based applications is also associated with a lack of institutional support, unclear policies, and limited access to professional training, even when they see the advantages of such applications in helping students learn (Holmes et al., 2022). These results demonstrate that the perceived effectiveness of AI tools is strongly correlated with their instructional usefulness, as well as with their usability, fit within the school context, and support system.

The current AI-based application studies conducted in special education have paid significant attention to the student outcomes (academic performance, cognitive performance, engagement, etc.) as the measure of the success of AI-based applications in special education (Drigas and Ioannidou, 2021; Holmes et al., 2022), which has been relatively silent regarding the topic of teacher perspectives. The gap in research is captured in this trend as the researchers do not talk about the teachers. Most studies to date have been conducted in developed countries. The present study indicates a clear lack of evidence from developing countries, where infrastructure, training opportunities, and institutional support differ substantially (Zawacki-Richter et al., 2023). There is a paucity of empirical research that

elucidates explicitly the perspectives of special education teachers working with children with mild intellectual disabilities, as numerous studies amalgamate intellectual disability with broader disability categories, thereby diminishing the specificity of their findings (Schalock et al., 2021; Almufareh et al., 2023). This problem indicates a lack of evidence in the field of disability. Literature demonstrates that there is a gap in the methodology because the lack of large-scale, survey-based research that specifically investigates the perception of teachers regarding the effectiveness, usability, and practical challenges of AI-based applications is identified, and quantitative evidence is required to inform policy, training, and implementation decisions in the special education context (Su & Zhong, 2022).

Methodology

The research design used in the study was a quantitative survey research design where the researchers investigated the perceptions of special education teachers about the effectiveness of AI-based applications to teach children with mild intellectual disabilities. The survey research design was selected because it is suitable for gathering information on attitudes, experiences, and perceived difficulties with using AI-based applications in classrooms and for systematically exploring them (Prasetya et al, 2024: Yim & Wegerif, 2024).

Population and Sample

The study population consisted of government special education teachers working in special educational institutions for children with intellectual disabilities in the Province of Punjab, Pakistan. These teachers are directly involved in teaching children with mild intellectual disabilities and were well aware of the use of AI apps in instructional practice. Simple random sampling was used to select the sample (N=110) teachers from 3 divisions (Sahiwal, Multan & Bahawalpur) of the Punjab province of Pakistan.

Research Instrument for Data Collection

The tool for this survey research was questionnaire which had 20 items based on a 5-point Likert scale. It contained two parts, Section A included demographic data, and Section B measured the perceptions of teachers toward the effectiveness of instruction, usability, classroom use, and the difficulties related to using AI-based applications. Web based questionnaire was created using Google Forms and data was collected electronically. Special education teachers employed in special education schools in the Sahiwal, Bahawalpur and Multan divisions of Punjab were sent by email and WhatsApp the questionnaire. All the research ethical protocols were kept in mind. The participants held the information about the aims of the research and were assured that the data would be used exclusively in the research. The responses obtained were analyzed by using the relevant statistics.

Validity of the Instrument

To achieve content validity, questionnaire items were constructed after a review of the literature on the topic and aligned with the study's objectives. The preliminary version was reviewed by a panel of subject specialists in special education and educational technology to assess the relevance of the items, their clarity, and their appropriateness to the target population, in accordance with accepted content validation practices. It was revised based on expert opinions, and the improved tool was subjected to pilot testing to ensure it was clear and suitable.

Reliability of the Instrument

Cronbach was used as an evaluation of internal consistency of the questionnaire. The pre-test of the data collection was carried out before the actual data collection, and findings revealed that the overall instrument was very reliable (0.96). The subscales exhibited an adequate level of internal consistency as Cronbach alpha coefficients of effectiveness, usability, and challenges were .88, .94, and .93 respectively. An alpha value of 0.70 or above was considered acceptable for this study.

Data Analysis

The analysis of data was done using the Statistical Package of the Social Sciences (SPSS). The summary of the perceptions of the teachers was in the form of descriptive statistics, such as mean, standard deviation, frequency, and percentage.

The inferential analysis was done using independent-samples t-test and one-way ANOVA to investigate the difference in perceptions among the demographic groups in accordance with the objectives of the study.

Ethical Consideration

The research problem was explained to the participants and they were assured that they would not disclose the information about the study and that the information would be used solely in the research. Respondents were involved to participation on a voluntary basis and informed consent was taken.

Demographic Distribution

Frequencies and percentages were used to summarize demographic features of the respondents, such as their gender, teaching experience, academic qualification, and training background. This distribution provided an overview of the sample profile for subsequent analysis.

Table 1

Demographic information of the respondents

Variables		F	%	N
Gender	Male	35	31.8	110
	Female	75	68.2	
Designation	JSET (MCC Field)	81	73.6	02
	SSET (MCC Field)	29	26.4	
BPS	16	77	70.0	02
	17	33	30.0	
Education	M.A Special Education	60	54.5	03
	M.Ed. Special Education	15	13.6	
	M.Phil. Special Education	35	31.8	
Age	26-30	27	24.5	05
	31-35	41	37.3	
	36-40	26	23.6	
	41-45	13	11.8	
	46-50	3	2.7	
Experience	0-5	8	7.3	05
	6-10	69	62.7	
	11-15	19	17.3	
	16-20	8	7.3	
	21-25	6	5.5	
Division	Sahiwal	25	22.7	03
	Bahawalpur	55	50.0	
	Multan	30	27.3	

Inferential statistics

Inferential statistics were used to examine differences in teachers' perceptions across demographic variables. An independent-samples t-test and one-way ANOVA were applied for this purpose.

Table 2
To examine special education teachers' perceptions of the effectiveness of AI-based applications for teaching children with mild intellectual disabilities.

Items	N	SD	D	N	A	SA	Mean	St. Dev
AI-based applications help improve my teaching of children with mild intellectual disabilities.	110	10.0	2.7	5.5	39.1	42.7	4.02	1.226
AI-based applications support individualized instruction for students with different learning needs.	110	3.6	2.7	4.5	47.3	41.8	4.21	0.930
Using AI-based applications increases students' engagement during lessons.	110	4.5	4.5	4.5	51.8	34.5	4.07	0.993
AI-based applications help students understand learning concepts more easily.	110	5.5	6.4	6.4	40.9	40.9	4.05	1.107
AI-based applications support students' attention and focus during classroom activities.	110	6.4	7.3	7.3	39.1	40.0	3.99	1.161
AI-based applications are helpful in managing classroom activities.	110	3.6	3.6	2.7	60.0	30.0	4.09	0.894
AI-based applications support repetition and practice for students who need extra help.	110	2.7	6.4	5.5	41.8	43.6	4.17	0.985
AI-based applications can be considered effective training instruments for children with mild intellectual disabilities.	110	4.5	3.6	6.4	50.0	35.5	4.08	0.987

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Table 3
To explore teachers' views regarding the usability of AI-based applications in classrooms for children with mild intellectual disabilities.

Items	N	SD	D	N	A	SA	Mean	St. Dev
I consider AI-based applications simple to learn how to use.	110	2.7	3.6	5.5	41.8	46.4	4.25	0.923
AI-based applications are suitable for use during regular classroom teaching.	110	2.7	6.4	3.6	42.7	44.5	4.20	0.975
The AI-based applications are easy to understand and follow the instructions.	110	3.6	5.5	2.7	45.5	42.7	4.18	0.988
Applications based on AI could be incorporated into lesson plans without difficulties.	110	2.7	5.5	3.6	51.8	36.4	4.14	0.923
AI-based applications are appropriate for the cognitive level of children with mild intellectual disabilities.	110	2.7	6.4	4.5	36.4	50.0	4.25	0.997

I am comfortable with the AI-based application in the classroom.	110	2.7	3.6	6.4	49.1	38.2	4.16	0.904

Table 4
To identify the challenges teachers, face when using AI-based applications in special education institutions.

Items	N	SD	D	N	A	SA	Mean	St. Dev
I have also been well-trained on how to use AI-based applications effectively.	110	2.7	2.7	5.5	42.7	46.4	4.27	0.898
Professional training is deficient, which inhibits my efficient application of AI-based applications.	110	2.7	8.2	3.6	41.8	43.6	4.15	1.015
Limited access to technological resources (e.g., devices, internet) affects the use of AI-based applications.	110	2.7	3.6	4.5	58.2	30.9	4.11	0.860
It is challenging to apply AI-based applications in my school because of the lack of institutional support.	110	2.7	6.4	8.2	37.3	45.5	4.16	1.009
Technical problems often interfere with the use of AI apps in the classroom.	110	2.7	10.0	4.5	60.9	21.8	3.89	0.952
Additional guidance and support are needed to improve the use of AI-based applications in special education.	110	8.2	6.4	5.5	43.6	36.4	3.94	1.191

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Q. 4. To determine whether teachers' perceptions of AI-based application effectiveness differ across demographic characteristics.

Table 5
Gender-based differences in effectiveness, usability, and implementation challenges

Variable	Gender	N	M	SD	t	df	p	Cohen's d
Effectiveness	Male	35	4.35	0.38	3.23	107.60	.002	0.76
	Female	75	3.96	0.88				
Usability	Male	35	4.29	0.64	0.79	108	.434	0.85
	Female	75	4.15	0.93				
Implementation challenges	Male	35	4.28	0.64	1.57	108	.120	0.86
	Female	75	4.00	0.95				

Table 5 presents the gender-based difference in the perception of teachers on the effectiveness, usability and implementation challenges of AI-based application. The independent-samples t-test showed a statistically significant difference in gender with regard to effectiveness that was seen to have male teachers higher in perceived effectiveness than the female teachers t (107.60) = 3.23, p =. 002, where men teachers were higher in perceived effectiveness (M = 4.35, SD = 0.38). The effect size was significant (Cohen d = 0.76), which means that practical difference is significant. In contrast, no statistically significant gender differences were found for usability, t (108) = 0.79, p = .434, or implementation challenges, t (108) = 1.57, p = .120. Although male teachers reported slightly higher mean scores than female teachers on both usability and implementation challenges, there were no statistically significant differences, despite large effect sizes (Cohen's d = 0.85 and

0.86, respectively). The outcomes indicate that gender dissimilarity was only apparent in perceived effectiveness, whereas usability perceptions and implementation difficulties showed no gender variations.

Table 6
Differences by designation (JSET vs. SSET) in effectiveness, usability, and implementation challenges

Variable	Designation	N	M	SD	t	df	p	Cohen's d
Effectiveness	JSET (MC)	81	4.08	0.87	−0.19	101.97	.849	0.78
	SSET (MC)	29	4.10	0.40				
Usability	JSET (MC)	81	4.21	0.96	0.31	101.89	.759	0.86
	SSET (MC)	29	4.17	0.44				
Implementation challenges	JSET (MC)	81	4.08	0.95	−0.29	80.00	.770	0.87
	SSET (MC)	29	4.12	0.59				

Table 6 presents differences in teachers' perceptions of effectiveness, usability, and implementation challenges based on designation (JSET vs. SSET). The independent-samples t-test showed no statistically significant differences between JSET and SSET teachers for effectiveness, t (101.97) = -0.19, p = .849, usability, t (101.89) = 0.31, p = .759, or implementation challenges, t (80.00) = -0.29, p = .770. Mean scores for both groups were very similar across all variables, indicating comparable perceptions regardless of designation. The observed differences though statistically non-significant had large effect sizes (Cohen d 0.78-0.87). Overall, the findings suggest that designation (JSET vs. SSET) did not meaningfully influence teachers' perceptions of the effectiveness, usability, or implementation challenges of AI-based applications.

Table 7
Differences by BPS Level (16 vs. 17) in Effectiveness, Usability, and Implementation Challenges

Variable	BPS	n	M	SD	t	df	p	Cohen's d
Effectiveness	16	77	4.06	0.89	−0.76	107.85	.449	0.78
	17	33	4.15	0.39				
Usability	16	77	4.18	0.97	−0.53	106.68	.600	0.85
	17	33	4.25	0.46				
Implementation challenges	16	77	4.06	0.97	−0.71	98.21	.477	0.87
	17	33	4.16	0.56				

Table 7 shows differences in teachers' perceptions of effectiveness, usability, and implementation challenges based on BPS level (16 vs. 17). The independent-samples t-test indicated no statistically significant differences between BPS-16 and BPS-17 respondents for effectiveness, t (107.85) = -0.76, p = .449, usability, t (106.68) = -0.53, p = .600, or implementation challenges, t (98.21) = -0.71, p = .477. Although teachers at BPS-17 reported slightly higher mean scores than those at BPS-16 across all three variables, these differences were not statistically meaningful. Effect size estimates were large, ranging from 0.78 to 0.87; however, the non-significant p-values indicate that BPS level did not have a meaningful influence on teachers' perceptions. The results indicate that the teachers of BPS-16 and BPS-17 showed that the perceptions of the effectiveness, usability, and implementation issues of AI-based applications were similar.

Table 8
Comparison of study variables across age groups

Variable	df	F	p	η^2
Effectiveness	4, 105	0.47	.756	.02
Usability	4, 105	2.40	.054	.08
Implementation Challenges	4, 105	2.38	.056	.08

Table 8 shows the effectiveness, usability, and implementation challenges comparison by various age groups using one-way ANOVA. The findings were no statistically significant difference of age groups on effectiveness, F (4, 105) = 0.47, p =.756, usability, F (4, 105) = 2.40, p =.054, or implementation challenges, F (4, 105) = 2.38, p =.056. Even though the effect size of the effectiveness was small (η^2= 0.02), that of usability and implementation challenges fell in the middle range (0.08). Non-significant p values however mean that there was no significant effect of age on the perception of teachers towards these variables. These results indicate that educators of various ages indicated similar views on the usefulness, applicability, and challenges of AI-based applications.

Table 9
Comparison of study variables across educational level

Variable	df	F	p	η^2
Effectiveness	2, 107	2.05	.133	.04
Usability	2, 107	0.93	.398	.02
Implementation Challenges	2, 107	0.28	.756	.01

Table 9 presents the comparison of effectiveness, usability, and implementation challenges across diversified levels of educational level by use of one-way ANOVA. The findings showed no statistically significant differences according to the level of education in terms of effectiveness, F (2, 107) = 2.05, p =.133, usability, F (2, 107) = 0.93, p =.398, or implementation challenge, F (2, 107) = 0.28, p =.756. The effect sizes of all variables (ranging between.01 and.04) were small indicating little impact in practice. On the whole, these results reveal that the educational level of teachers did not have a significant impact on their views on the effectiveness, usability or implementation difficulties of AI-based applications.

Table 10
Comparison of study variables across divisions

Variable	F(2, 107)	p	η^2	Significant Division Differences (LSD)
Effectiveness	2.71	.071	.05	Multan > Sahiwal (p = .024)
Usability	2.40	.096	.04	Multan > Sahiwal (p = .037)
Implementation Challenges	3.08	.050	.06	Multan > Sahiwal (p = .024); Multan > Bahawalpur (p = .042)

Table 10 presents the analysis of the study's variables. The variables division showed that there were no statistically significant differences in effectiveness, usability, or implementation issues across the conventional alpha level. To be effective, the one-way ANOVA presented a non-significant, yet marginal, value, F (2, 107) = 2.71, p = .071, and a small-to-medium effect size (η^2 = .05). Nonetheless, a post hoc LSD test showed that Multan teachers have significantly higher effectiveness than Sahiwal teachers (p = .024). Similarly, regarding usability, the overall difference across divisions was not statistically significant, F (2, 107) = 2.40, p = .096, with a small

effect size (η^2 = .04); however, the LSD results indicated that teachers in Multan had higher usability perceptions than those in Sahiwal (p = .037). However, the issues related to implementation were statistically significant, F (2, 107) = 3.08, p = .050, with a medium effect size (η^2 = .06). When the post hoc analysis was done, it was found that Multan teachers experienced many more implementation difficulties than Sahiwal (p = .024) and Bahawalpur (p = .042). Overall, group differences were insignificant; however, post hoc tests revealed division-specific variations, with teachers in Multan reporting higher perceptions across various study variables.

Findings

The sample included 110 special education teachers; most of them were women (68.2%). The majority of the respondents were junior special education teachers (73.6%), BPS-16 (70.0%), and master's degree holders in special education (54.5%). The greatest percentage of teachers were aged between 31 and 35 years (37.3%), and the highest number of them had 6-10 years of teaching experience (62.7%). Participants were recruited from the Bahawalpur (50.0%), Multan (27.3%), and Sahiwal (22.7%) divisions.

Teachers also presented a generally positive view of the effectiveness of AI-based applications in teaching children with mild intellectual disabilities. The effectiveness items yielded a range of mean scores between 3.99 and 4.21, indicating agreement that AI applications help provide individualized instruction, increase student engagement, improve understanding of learning concepts, and support classroom management and repetition practice.

Teachers, on the same note, also indicated high levels of agreement with the use of AI-based applications. The mean usability scores ranged from 4.14 to 4.25, indicating that the applications were perceived as easy to learn, easy to use, appropriate for the classroom setting, and at the cognitive level of children with mild intellectual disabilities.

Even though the teacher said that they had positive feelings about the role of technology and its usefulness, moderate barriers to implementation were mentioned. The means scores of 3.89 to 4.27 demonstrated the issues related to the lack of professional training, poor technological facilities, the lack of institutional support, and technical barriers when using it in the classroom. These findings indicate that the successful implementation of AI-based applications can be affected by structural barriers and training barriers.

The analysis according to gender revealed that the mean difference between perceptions of effectiveness was statistically significant and that male teachers presented higher scores than female teachers ($p < .05$). However, there were no statistically significant differences in gender with regard to usability or implementation problems, and hence, no gender differences were found as to perceptions of these problems.

There was no statistically significant difference between the perceptions of effectiveness, usability, and implementation challenges between the junior and senior special education teachers ($p > .05$). Likewise, there was no major difference in perception between BPS-16 and BPS-17 teachers in any study variable.

The comparison between age groups revealed no significant differences in effectiveness, usability, or implementation issues ($p > .05$). The moderate effect sizes of the usability and implementation challenge scores suggest some practical differences among age groups, despite their lack of statistical significance.

Educational qualifications (M.A., M.Ed., and M.Phil.) did not produce statistically significant differences in any of the study variables, and the effects of educational background on teachers' perceptions were small, suggesting insignificant impacts of educational achievement on perceptions.

The division-wise analysis showed no statistically significant differences in effectiveness or usability across divisions. But the implementation issues had a marginally significant difference with a moderate effect size. The post hoc analysis showed that Multan teachers had much greater implementation challenges than those in Sahiwal and Bahawalpur.

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Conclusion

The present study examined special education teachers' perceptions regarding the effectiveness, usability, and implementation challenges of AI-based applications for teaching children with mild intellectual disabilities. The results showed that teachers usually found AI-based applications to be effective learning tools that support individualized learning, improve student engagement, and help students better understand learning concepts. The findings generally showed widespread acceptance of AI-based applications in special education classrooms. Teachers also reported a positive perception of the usability of AI-based applications. The applications were deemed user-friendly, easy to learn, and suitable for daily classroom instruction. The teachers also thought that these apps should be used at the cognitive level for mildly intellectually challenged kids so that usability doesn't deter their use in class. Although the study reported positive results regarding perceptions of effectiveness and usability, there were several challenges during implementation. Some of the issues pointed out by teachers included a lack of professional training, insufficient technology resources, a lack of institutional support, and technical challenges when using the technology in the classroom. Such obstacles mean that to be successful in integrating AI-based applications, not only teachers but also adequate infrastructure and administration are needed. The inferential test indicated that the demographic characteristics, such as designation, the level of BPS, age, and education level showed no statistically significant difference in the perception of teachers. However, it seemed that gender variance in effectiveness perceptions was great. Moreover, the variations in the implementing issues in the various divisions implied the varying access to resources and support facilities across the regions. To sum up, the paper shows that AI-oriented applications can have significant potential to support the teaching and learning of children with mild intellectual disabilities. Nevertheless, the implementation process needs to be effective and sustainable through addressing training needs, enhancing technological infrastructure, and augmenting institutional support systems. Such results can support educational policy and inform teacher training programs and other future efforts that may involve extending AI-based technologies into the special education environment.

Discussion

This research found that special education teachers consider AI-based applications effective instructional methods for children with mild intellectual disabilities. According to the teachers, such applications support personalized learning, increase students' interest, and help them master learning concepts through repetition and practice. Similar findings were also documented in the recent studies, where teachers admitted that AI-based and electronic devices have a positive impact in addressing all types of learning needs and help building cognition in special education facilities (Shaheen and Zanoon, 2025; Almarzouq et al., 2025). The views of teachers regarding AI applications were also favourable. The applications were found to be very easy to use, learn and classrooms could be used. This finding corresponds to the earlier research findings indicating that teachers are more willing to utilize the educational technologies when they are simple to operate and do not interfere with the classroom activities, which is more noticeable in terms of special education, as the instructional time and the needs of learners require simple and convenient technologies (Starks and Reich, 2023; Xia et al., 2023). Despite the positive perception of effectiveness and usability, teachers claimed that there were serious implementation issues. The areas identified as primary obstacles include the lack of professional training, access to technology, and institutional support, as well as technical complications. This trend is related to the previous research that found the structural and infrastructural constraints of implementing AI and digital technologies in special education are frequent obstacles to the successful application of such technologies, even when the educators hold a positive attitude towards these technologies (Alnaim and Al-Otaibi, 2025; Starks and Reich, 2023). The results indicate that although AI-based applications are commonly viewed as useful and applicable in special education classrooms, their effective use requires sufficient training,

technological infrastructure, and institutional backing. To integrate AI-based applications with children with mild intellectual disabilities, it is necessary to address these challenges and ensure effective, sustainable integration.

Recommendations

1. The special education teachers should be trained to use AI-based applications in classroom instructions by being subjected to regular professional training.
2. The leadership in the education sector ought to ensure that there is a proper supply of technology services, such as equipment and fast internet connections, in the institutions of special education.
3. To ensure the implementation of AI-based applications into the routine teaching process, school administrations should offer institutional and technical assistance in the form of constant support.
4. The applications based on AI should be introduced systematically into the special education curriculum according to the learning objectives and individual education plan.

Implications

This study has important implications on the policy, practice and research of special education. The positive perceptions of the usefulness and applicability of AI-based applications among teachers mean that it is possible to use the technologies in special education classrooms to organize personalized learning and provide a more favorable environment. However, the fact that there are implementation challenges proves the critical role of concerted efforts of the authorities and the institutions involved in the education sector to offer adequate training and technological resources and administrative support. To make sure that AI-based educational tools are fairly distributed among the divisions, there is a need to consider regional disparities in implementation. Moreover, the small scale of the majority of demographic variables implies that AI-based applications can be generalized and will slice across the population of teachers, improving their use on a system-wide scale. These implications identify the relevance of strategic planning, capacity building, and evidence-based decision making to support sustainable adoption of AI-based applications in education institutions.

Limitations

This paper has some limitations. First, the information was gathered using a self-reported questionnaire, which can be biased by responses and may not be fully representative of classroom practices. Secondly, the research was conducted only among special education instructors in the selected divisions, which could limit the study's applicability in other regions or teaching contexts. Third, the study focused on teachers' perceptions rather than students' cognitive outcomes; thus, the results fail to establish a cause-and-effect relationship between AI-based applications and learning performance.

Future Research

A future study can use an experimental or longitudinal research design to examine the short- and long-term effects of AI-based applications on the thinking skills of children with mild mental disabilities. It is also suggested that further studies with larger, more diverse samples across regions and educational settings be conducted to increase the generalizability of the results.

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