Learning disabilities teachers' perceptions of employing artificial intelligence applications in teaching their students

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Article Info

ABSTRACT

This study explores the learning disabilities teachers' perceptions of employing artificial intelligence (AI) applications in teaching their students in Saudi Arabia. A quantitative approach was utilized, distributing a questionnaire to 108 teachers of students with learning disabilities. Findings indicate a moderate level of AI application use, with tools like virtual reality (VR) and speech recognition being more commonly recognized and valued. However, other applications, such as Thinkster Math, remain underutilized, revealing gaps in effective AI integration. The study recommends targeted strategies to overcome barriers such as insufficient teacher training, lack of digital infrastructure, and the need for culturally responsive AI tools. Key solutions include developing professional development programs, improving access to technology, and providing financial incentives to encourage wider adoption. By addressing these challenges and implementing these recommendations, Saudi Arabia can enhance its special education landscape, enabling teachers to leverage AI as a transformative tool and fostering a more inclusive and adaptive learning environment for students with learning disabilities. This study underscores the need for continuous research and feedback to refine AI tools, ensuring they meet educational goals and improve student outcomes.

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1. INTRODUCTION

Thanks to the digital revolution, the world has witnessed tremendous progress in various fields, including agriculture, industry, technology, science, and the military. Among its most prominent tools are artificial intelligence (AI) applications, defined as the ability of a computer-controlled device to perform tasks in a way that is simple for humans [1]. AI also simulates human intelligence in the process of inference, thinking, planning, learning, and decision-making [2].

As a result, AI has become a field for relieving pressure on humans, as these applications can perform alternative tasks for humans that require strenuous physical and mental effort [3]. What was impossible yesterday has become a reality today through AI systems, such as facial recognition, diagnosing some diseases, predicting epileptic seizures, detecting financial fraud in banks, and detecting war mines using robots [4]. It also went beyond that by enabling people to enter some virtual worlds designed in professional ways, such as visiting international hotel rooms, castles, fortresses, and forests in which predatory animals abound, or exploring the depths of the seas [5]. Therefore, many countries have sought to introduce the culture of AI into their societies; by promoting it through finding scientific competencies, various applications in the field of AI, and finding the digital citizen who can deal with it efficiently [6]. The matter

became more urgent when this huge technological revolution removed geographical barriers and the different languages of humans, as this technology became under the control of humans and they have the ability to access and control it with the touch of their fingers [7].

There is no doubt that education is the best way for nations to advance, and that the strongest human investment is through quality education outcomes. Whenever these outcomes are of high quality, society rises and all its sectors flourish. Therefore, investing in AI in education is a matter of great importance in the modern era. Advanced technology and the development of AI have brought about a radical transformation in the field of education, as teachers and learners can now benefit from the benefits of this technology in improving the processes of teaching and learning.

Just as AI plays an effective role in general education, the use of AI in the field of special education has a vital role, as advanced technology contributes to improving the learning experience and personal development of individuals with disabilities by helping them customize education, provide individual support, and enhance communication and interaction; which enhances their growth opportunities and helps them realize their potential to the maximum extent possible. In Saudi Arabia, the rapid advancement of technology in various sectors, including education, presents both opportunities and challenges for educators working with special needs students. A strong body of research highlights the potential of AI to enhance educational practices, particularly for students with learning disabilities, by providing personalized learning experiences and adaptive teaching resources [8]. In this context, study by Tsouktakou et al. [9] demonstrated the effectiveness of employing AI applications to support students with visual impairments, whereas study by Caldwell-Marin et al. [10] highlighted the positive impact of a robot-based interactive chat program in enhancing expressive language skills among individuals with mild intellectual disabilities. Additionally, McCarthy et al. [11] has found that practicing Braille using AI was highly effective, while Tamim [12] have confirmed the effectiveness of an educational program based on AI in developing spatial thinking skills among gifted secondary school students.

This paper will focus on teachers of students with learning disabilities. It is well recognized that when compared to their classmates without disabilities, students with learning disabilities perform worse academically. Despite having intelligence that is either normal or above average, they struggle with certain learning processes, including comprehension, reasoning, perception, focus, reading, writing, spelling, pronunciation, doing math operations, and skills associated with each of the aforementioned processes [13]. Therefore, the use of AI applications with students with learning disabilities will play a crucial role in enhancing their educational experience, as the study by Korosidou [14] demonstrated how well augmented reality technology works to help students become more adept at connecting letter sounds to drawings, and Kellems et al. [15] confirmed the effectiveness of augmented reality technology in developing the skills of solving mathematical problems for people with learning disabilities. Lastly, study by Yang [16] indicated the importance of applying augmented reality to support and improve reading difficulties among students.

Garg and Sharma [17] studied the role of AI applications in teaching students with special needs in India, conducting interviews with both teachers and students. The results showed that AI has a positive impact in facilitating life and education for students with disabilities, as well as helping teachers be more effective in their teaching methods and ensuring fair participation for all students. However, the study also identified key problems faced by students with special needs, including challenges related to their educational abilities and rejection by both regular students and teachers.

It is also important to note that these modern technologies can provide creative solutions to educational problems, and present content in an easy, accessible and creative way. Services can also be provided in a way that stimulates the mind to think [18]. These applications also help the learner to learn independently and exchange roles between the teacher and the learner, so that the teacher directs the educational process. They also provide flexibility when presenting content and adapting it to the student's needs [19]. This is one of the basics that educators demand when teaching students with learning disabilities.

In the context of Saudi Arabia, the perception of AI applications among teachers is crucial for successful implementation in classrooms. Many teachers exhibit a lack of familiarity with AI technologies and their benefits, which can hinder the integration of these tools in special education [18]. The findings of the pervious study suggest that while educators recognize the potential of AI in enhancing learning for students with disabilities, their reservations regarding technical complexities and insufficient training must be addressed. Moreover, studies reveal that cultural and contextual factors significantly shape teachers' attitudes toward technology use [17], [18]. In the Saudi educational landscape, where traditional teaching methods have long been predominant, embracing AI presents unique challenges. This body of literature indicates that educators often feel apprehensive about transitioning to technology-driven approaches due to concerns about its efficacy and impacts on their teaching roles [20]. Understanding these perceptions within the cultural context of Saudi Arabia is essential to developing effective training programs and policies.

Despite substantial research underscoring the importance of AI in education, many teachers still find it unclear how to effectively implement, utilize, and benefit from AI to enhance teaching quality [5], [7].

Therefore, this study aims to explore the perspectives of teachers working with students who have learning disabilities regarding the use of AI applications in their educational practices. It specifically examines the current application of AI in the education of students with learning challenges, reflecting the experiences of their educators while identifying barriers to implementation. The researcher will conclude with recommendations and solutions designed to improve the integration of AI in teaching students with learning disabilities. This study is particularly relevant given the emphasis on the need for AI in special education, as these applications can provide tailored support based on individual student needs and challenges, in line with the demands of today's digital generation. Furthermore, noting a lack of existing literature on this topic, this study is essential to investigate the use of AI applications in teaching students with learning disabilities from the perspective of their teachers in the Kingdom of Saudi Arabia. Thus, this paper answer two scientific questions:

i)   What is the level of reality of using AI applications in teaching students with learning disabilities from their teacher's perspective?

ii)   What are the most important challenges facing teachers of students with learning disabilities in deploying AI applications in their education?

2.   METHOD

This study examines the important issue of using AI to support students with learning disabilities, specifically from the viewpoint of their teachers. The researcher employs a quantitative descriptive-analytical approach to enable a thorough investigation of this phenomenon. This method ensures a detailed and accurate understanding of how AI is applied in educational settings for these students.

2.1. The participants

The study participants included all teachers of students with learning disabilities in Dammam, Saudi Arabia, selected using a convenience sampling method, totaling 108 teachers. The researcher distributed questionnaires to these participants and gathered their responses once completed. Upon reviewing the collected questionnaires, it was confirmed that all were valid for further analysis.

2.2. Study tool

To achieve the purposes of the study, the researcher relied on the questionnaire, which will be used to collect data related to the practical aspect of the study. This source stemmed from the responses of the study sample in a quantitative manner, which expresses the opinions of the respondents, in order to reach and discuss the results of the study. The study is based on the questionnaire to collect data and it is consisted of two sections. Section 1 is about the reality of using AI applications in teaching students with learning disabilities from their teacher's perspective, and it contains the statements from (1-18) and it symbolize by (D1). Section 2 is about challenges facing teachers of students with learning disabilities in deploying AI applications in their education and it contains the statements from (1-13) and it symbolize by (D2).

2.3. Validity of the study tool

It is very important that the study tool used in the study measures what it was designed for and that this tool is suitable for achieving the objectives of the study through some simple steps by the researcher. This is called the validity of the study tool. In light of the ongoing investigation, the researcher prepared the measurement tool in its initial form and disseminated it to eight of special education major and educational experts to identify the extent to which these academic experts interact with the items of the measurement tool. The experts also took a number of corrective measures on the study tool to produce it in its final form. The modifications were summarized in either deletion or addition or modification and linguistic formulation. After that, the data collection tool came out in its final form, consisting of 31 items that fit to measure the reality of using AI applications in teaching students with learning disabilities from teacher's perspective.

The study assessed the internal construct validity of the data collection tool using the Pearson correlation coefficient test. Statements with a correlation value above 0.30 were deemed acceptable, indicating good discrimination significance [21], [22]. Additionally, statistical significance levels between 0.01 and 0.05 were used to identify distinguishing statements, as detailed in Table 1. The table shows that the Pearson correlation test revealed that all statements were significantly related to their dimensions, with values exceeding 0.30 and significant at the 0.01 level, which is considered acceptable [20]. A total of 31 statements were included, each aligning with the study's dimensions. These statements collectively measured the primary variables of the study.

Table 1. The correlation coefficient of each statement scores with the dimension total score

	D1		D2
1	0.910**	1	0.794**
2	0.885**	2	0.872**
3	0.894**	3	0.805**
4	0.908**	4	0.734**
5	0.847**	5	0.852**
6	0.806**	6	0.867**
7	0.844**	7	0.784**
8	0.811**	8	0.789**
9	0.844**	9	0.838**
10	0.877**	10	0.881**
11	0.903**	11	0.884**
12	0.908**	12	0.807**
13	0.914**	13	0.873**
14	0.922**		
15	0.855**		
16	0.868**		
17	0.833**		
18	0.874**		

** significant at level of (0.01)

2.4. Reliability

To assess the reliability of the instrument in the study, the researcher employed Cronbach's alpha coefficient, as depicted in Table 2. The obtained Cronbach's alpha values for all variables of the scale exceeded the acceptable threshold of 0.70 [23], indicating satisfactory internal consistency. The overall reliability coefficient for the questionnaire ranged from 0.962 to 0.981, and all statements scored value of reliability (0.967) with values approaching 1.00, as illustrated in Table 2.

Table 2. Cronbach's alpha coefficient for all the dimensions and total score of the scale

Variables	Statements	Cronbach alpha
D1 (dimension)	1-18	0.981
D2 (dimension)	1-13	0.962
Overall statements (total scale)	1-31	0.967

2.5. Data analysis techniques

To answer the study questions which were formulated to examine the perceptions of the reality of using AI applications in teaching students with learning disabilities from their teacher's perspective, SPSS program version–22 was used to analyze and answer the questions of the study and appropriate statistical techniques were used in data analysis: i) The internal construct validity of the study tool was extracted through the use of the Pearson correlation coefficient test; ii) The stability of the study tool was verified through the Cronbach alpha test, which shows the consistency of the responses of the study sample members; iii) The study questions were answered by extracting the means values, which show the level of the study sample's responses on the questionnaire items, and the standard deviations were extracted to identify the extent of the responses' dispersion from their means values; and iv) The research type scale included five Likert scale: 5 (always), 4 (often), 3 (sometimes), 2 (rarely), and 1 (never). To determine relative importance, class intervals were calculated using (1) and (2).

$$\text{Class interval} = \frac{\text{Maximum class} - \text{Minimum class}}{\text{Number of level}} \tag{1}$$

$$\text{Class interval} \frac{5-1}{3} = \frac{5}{3} = 1.33 \tag{2}$$

This value means the length of category and the scoring levels were: low level from 1.00-2.33, medium level from 2.34–3.67, and the high level from 3.68–5.00.

3. RESULTS AND DISCUSSION

In this section, we present the findings of the research along with a thorough discussion that contextualizes these results within the broader framework of existing literature. The exploration of learning disabilities teachers' perceptions of employing AI applications in their teaching practices is critical for

understanding the current landscape of special education in Saudi Arabia. By analyzing the collected data, we aim to illuminate how these educators perceive the benefits and challenges associated with integrating AI into their classrooms, as well as the implications for their teaching methodologies and student outcomes. This comprehensive discussion will not only highlight the key themes and patterns identified in the results but also relate them to theoretical frameworks and prior studies, thereby contributing valuable insights into the effective implementation of technology in supporting students with learning disabilities.

3.1. Question number one

The study calculated the mean values and standard deviations to assess the current use of AI applications in teaching students with learning disabilities. This evaluation was based on the perspectives of their teachers. The results are presented in Table 3.

The participant's responses, as in Table 3, showed that the mean value of the level of reality of using AI applications in teaching students with learning disabilities from their teacher's perspective was (2.51), which is medium. Statement 7 "virtual reality (VR) to add visual and audio stimuli to traditional content for students with learning disabilities," ranked first with a mean of (2.87), and a standard deviation of (1.13), which is a level of medium, and statement 10 "speech recognition program for students with writing difficulties to convert sounds into words," ranked second with mean of (2.84), and standard deviation of (1.10), which is of a medium level. Statement 16 "applying Thinkster Math to teach students difficulties in mathematics according to their abilities," ranked last with a mean of (2.21) and a standard deviation of (1.13), which is of a low level.

Table 3. The level of reality of using AI applications in teaching students with learning disabilities from their teacher's perspective in descending order

No	D1 statements	Mean	Std. deviation	Rank	Level
7	VR to add visual and audio stimuli to traditional content for students with learning disabilities	2.87	1.13	1	Medium
10	Speech recognition program for students with writing difficulties to convert sounds into words	2.84	1.10	2	Medium
9	Speech making program for students with linguistic difficulties to convert written words into spoken sound	2.83	1.12	3	Medium
5	VR technology to clarify difficult abstract concepts for students with learning disabilities	2.75	1.09	4	Medium
6	VR technology to provide educational experiences for students with learning disabilities that are difficult to obtain in real life	2.75	1.13	4	Medium
8	VR in converting content into three dimensions	2.72	1.12	6	Medium
11	Adaptive learning to meet the individual educational needs of students with learning disabilities	2.49	1.11	7	Medium
12	Adaptive learning to develop spelling training activities for students with spelling difficulties	2.46	1.08	8	Medium
14	Smart chatbots to repeat scientific subjects for students with learning disabilities more than once	2.45	1.03	9	Medium
13	Smart chatbots to respond to inquiries from students with learning disabilities	2.43	1.03	10	Medium
2	Intelligent education systems in identifying the strengths and weaknesses of students with learning disabilities	2.39	1.09	11	Medium
1	Intelligent education systems to determine the baseline for students with learning disabilities	2.38	1.06	12	Medium
4	Intelligent education systems for making educational decisions for students with learning disabilities	2.38	1.09	12	Medium
3	Intelligent education systems to choose the appropriate teaching strategy for each student with learning disabilities according to her abilities	2.35	1.04	14	Medium
17	The expert system generates questions appropriate to the abilities of students with learning disabilities	2.32	1.17	15	Low
15	Brainly platform works with students with learning disabilities to ask questions about homework	2.31	1.17	16	Low
18	The expert system helps to solve problems faced by students with learning disabilities	2.28	1.12	17	Low
16	Applying Thinkster Math to teach students difficulties in mathematics according to their abilities	2.21	1.13	18	Low
Total		2.51	0.96		Medium

The results of this study offer significant insights into the perception and use of AI applications in the education of students with learning disabilities within the context of Saudi Arabia. The overall mean score of 2.51, indicating a medium level of AI application from the teachers' perspective, suggests that while there is some integration of AI in supporting students with learning disabilities, its adoption remains

moderate. This finding aligns with the broader global discourse on AI in special education, where its potential is acknowledged, but widespread implementation faces various challenges [24]. Furthermore, the findings reflect unique cultural and educational dynamics within Saudi society, where there is increasing interest in leveraging technology for inclusive education, yet practical barriers to widespread adoption remain [8].

The highest ranking was observed for the use of VR to add visual and auditory stimuli to traditional content, with a mean of 2.87. Previous research supports the use of VR in enhancing learning experiences for students with disabilities, as it provides immersive environments that can aid comprehension and engagement [25]. Within the Saudi context, such tools are seen as particularly valuable due to their potential to enrich learning experiences that are often restricted to conventional instructional approaches. The Saudi Vision 2030 initiative has emphasized the enhancement of digital capabilities within education, which aligns with the increasing interest in integrating VR into teaching practices [6], [26]. However, the medium level of perceived use reported in this study suggests that while the potential of VR is recognized, there may be constraints that we may discover in the second research question.

Similarly, speech recognition programs to aid students with writing difficulties and speech-making programs for students with linguistic challenges were rated with means of 2.84 and 2.83, respectively. The use of speech-to-text tools is supported by global research as a beneficial approach for students with dysgraphia or other writing impairments, allowing them to articulate their thoughts more freely without the barrier of writing difficulties [27]. Within the Saudi educational landscape, speech recognition technology aligns well with the goal of fostering inclusive education by enabling greater participation of students with learning disabilities [6], [8]. However, the medium level of perceived effectiveness suggests practical challenges, such as the availability of Arabic-language AI tools, software limitations, and the need for customization to support students' individual needs in a culturally appropriate manner [18].

The moderate overall level of AI application use, as observed in the study, suggests a need for further support and resources to facilitate the effective integration of these technologies into teaching practices. Previous literature emphasizes that professional development and training for teachers are critical for the successful adoption of AI in educational settings [28]. This is particularly relevant in Saudi Arabia, where the digital transformation of education is a priority, yet educators require adequate training and support to implement AI applications effectively in classrooms [29]. Moreover, enhancing access to technology, ensuring alignment with pedagogical goals, and developing culturally and linguistically appropriate AI applications are essential for maximizing the benefits of AI in special education [6], [30].

Interestingly, Thinkster Math, an AI-based application for teaching students with mathematical difficulties, received the lowest ranking, with a mean score of 2.21. This indicates a low level of perceived use or benefit in supporting mathematics learning for students with disabilities. One explanation for this result could be related to cultural and educational factors specific to Saudi Arabia. Mathematics education often requires culturally contextualized content and adaptive, personalized learning experiences, which may not be fully addressed by generic AI-based programs [31]. Teachers may find it challenging to align the content and pacing of AI tools like Thinkster Math with the needs of students, particularly when teaching diverse learning styles and abilities in mathematics [32]. Moreover, there may be limitations in how well such programs are localized for the Saudi curriculum and learning context, as well as potential language barriers and differences in pedagogical approaches that are unique to the region.

In the context of Saudi Arabia, where there is a growing emphasis on digital transformation in education, the findings highlight a recognition among educators of the potential of AI. However, the moderate level of application suggests that challenges exist in fully integrating these technologies into the educational environment for students with learning disabilities. The educational system may benefit from increased training and resources to enhance the use of AI in teaching, ultimately aiming for more tailored and effective support for students with learning disabilities.

3.2. Question number tow

The study analyzed the mean values and standard deviations to pinpoint the main challenges teachers face when educating students with learning disabilities. These challenges are related to implementing AI applications in the classroom. The results are detailed in Table 4. This research highlights key challenges teachers face when integrating AI applications into the education of students with learning disabilities in Saudi Arabia. Based on Table 4, which shows the most important challenges facing teachers of students with learning disabilities in deploying AI applications, participants reported an overall challenge level of 3.37, indicating significant obstacles to AI adoption. Addressing these challenges is essential to enhance the effectiveness of special education.

Table 4. The level of most important challenges facing teachers of students with learning disabilities in deploying AI applications in their education

No	D2 statements	Mean	Std. deviation	Rank	Importance level
1	Lack of training to qualified teachers to use AI applications	3.69	1.06	1	High
4	Lack of availability of the necessary digital infrastructure, such as technical equipment and communication networks, in all public education schools	3.68	1.14	2	High
3	The high cost of AI applications	3.58	1.09	3	Medium
8	Weak financial and moral incentives provided to the teachers of learning disabilities students who use AI applications	3.49	1.18	4	Medium
2	The large teaching load on the learning disabilities teacher	3.35	1.26	5	Medium
13	The disapproval of some learning disabilities teachers to change, innovation, and learning to use AI applications in teaching	3.33	1.26	6	Medium
9	Possibility of losing data stored on AI applications	3.31	1.20	7	Medium
5	Difficulty in using AI applications with students with learning disabilities due to the type of the disability	3.30	1.25	8	Medium
11	Parents adhered to the basic of strategies used in educating their daughters	3.28	1.24	9	Medium
12	Some parents of students with learning disabilities fear that there will be negative effects on their daughters when wearing smart glasses or gloves for AI applications	3.24	1.26	10	Medium
7	Sstudents with learning disabilities are used to traditional teaching strategies in the general classroom, which may affect their acceptance of using AI applications in the resource room	3.21	1.30	11	Medium
10	Small display screens, which negatively affects some students with learning disabilities in cases that require enlargement and clarity of font	3.21	1.22	11	Medium
6	Using AI applications in teaching students with learning disabilities takes a longer time, causing a loss of class time	3.19	1.24	13	Medium
Total		3.37	1.00		Medium

The foremost challenge identified by the study is the "lack of training for qualified teachers to use AI applications," with a mean score of 3.69 and a standard deviation of 1.06. This is consistent with previous research [17], [18], [28], [29], which highlights the critical need for professional development and skill-building among educators. In Saudi Arabia, as AI increasingly becomes a part of the educational landscape, teachers' proficiency in using these technologies is paramount. Without adequate training, teachers struggle to harness AI's potential to support students with learning disabilities effectively, thereby limiting the positive impact these technologies can have on learning outcomes. Karsenti [33] argued that for AI tools to be fully effective in special education, educators must possess not only technical skills but also an understanding of how to integrate these tools into pedagogical practices meaningfully.

Another significant challenge identified is the "lack of availability of necessary digital infrastructure," including technical equipment and reliable communication networks in public education schools. This challenge ranked second, with a mean score of 3.68 and a standard deviation of 1.14, indicating a high level of concern. Adequate infrastructure is essential for the successful implementation of AI in classrooms, and the digital divide can significantly hinder AI adoption in education [29]. The infrastructure gap in Saudi schools not only limits the availability of AI technologies but also restricts teachers' ability to offer personalized and adaptive learning experiences for students with learning disabilities. Therefore, the absence of robust technological infrastructure can exacerbate existing educational inequalities [34].

Interestingly, the study found that the challenge related to "using AI applications in teaching students with learning disabilities takes a longer time, causing a loss of class time," received the lowest ranking, with a mean score of 3.19 and a standard deviation of 1.24. Although rated as a medium concern, this challenge raises practical issues regarding time management and the implementation of AI tools. Educators may find that integrating AI into lessons extends instructional time, potentially disrupting classroom flow and pacing. This finding underscores the necessity for efficient AI tools that can be seamlessly embedded into educational practices without detracting from instructional time or content delivery [19].

Overall, these findings highlight the multifaceted challenges associated with deploying AI to teach students with learning disabilities in Saudi Arabia. While there is clear recognition of AI's potential benefits for enhancing personalized learning and providing support to students with special needs, barriers such as insufficient teacher training, inadequate digital infrastructure, and classroom time management remain significant. To overcome these obstacles, a comprehensive approach is required at both policy and implementation levels. This includes developing targeted professional development programs for teachers, investing in digital infrastructure, and designing efficient AI applications that align with classroom practices and are sensitive to time constraints.

Tackling these challenges aligns with the literature's emphasis on context-specific strategies to integrate AI into special education [17], [27]. Overcoming these barriers can help Saudi Arabia build an inclusive, technologically advanced educational system. This will ensure that students with learning disabilities receive the personalized support they need to succeed.

4. CONCLUSION

This study highlights the promising role of AI in enhancing education for students with learning disabilities in Saudi Arabia. While tools like VR and speech recognition are gaining traction among educators, others remain underutilized, underscoring the need for targeted professional development, improved digital infrastructure, and updated educational policies. Equipping teachers with the skills and resources to integrate AI effectively is crucial for creating inclusive, adaptive learning environments that meet the unique needs of these students.

To fully realize the potential of AI in special education, culturally and linguistically tailored applications must be developed in collaboration with local educators and stakeholders. Encouraging community engagement and parental involvement can further promote acceptance and informed use of AI tools. Ongoing research and feedback mechanisms are essential to ensure these technologies remain effective, relevant, and aligned with educational goals. By embracing these recommendations, Saudi Arabia can build a more inclusive, innovative education system that empowers both students and educators.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization	I : **I**nvestigation	Vi : **Vi**sualization
M : **M**ethodology	R : **R**esources	Su : **Su**pervision
So : **So**ftware	D : **D**ata Curation	P : **P**roject administration
Va : **Va**lidation	O : Writing - **O**riginal Draft	Fu : **Fu**nding acquisition
Fo : **Fo**rmal analysis	E : Writing - Review & **E**diting	

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

INFORMED CONSENT

We confirm that informed consent was obtained from all individuals who participated in this study.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Institutional Review Board (IRB) at Imam Abdulrahman bin Faisal University.

DATA AVAILABILITY

The data supporting the findings of this study are available upon reasonable request from the corresponding author [MA]. Due to confidentiality considerations and the potential risk to participant privacy, the dataset is not publicly accessible.

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