A Systematic literature review of artificial intelligence in special education

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Abstract

This study explores the landscape of Artificial Intelligence (AI) in special education, focusing on Arabic-language literature. Employing a systematic review approach, the research aims to identify trends and applications in the integration of AI technologies to support individuals with special needs. The study, found that most of the studies included was conducted between 2020 and 2023, selected 15 articles through rigorous screening, employing the PRISMA Statement approach. The research questions address prevalent topics in Arabic AI in special education articles, the integration of AI technologies in aiding special needs students, and the types of disabilities featured in the selected studies.Results indicate a predominant focus on autism in the selected studies, aligning with the perceived effectiveness of AI for students facing challenges in structured learning environments and social interactions. The paper acknowledges limitations, including the relatively small number of studies and the need for more

extensive research encompassing diverse settings, participants, and disabilities.In conclusion, while the existing studies offer valuable insights, a more comprehensive and diverse body of research is essential to draw overarching conclusions about the efficacy of AI in special education. This would enable educators and researchers to address the nuanced challenges and opportunities associated with implementing AI across various educational contexts and with different participant groups.

Keywords: Artificial Intelligence (AI), Special education, Systematic review

مراجعة نظامية للأدب حول الذكاء الاصطناعي في التربية الخاصة

الملخص:

تستكشف هذه الدراسة المشهد الحالي للذكاء الاصطناعي في التربية الخاصة ، مع التركيز على الأدب العربي. باستخدام منهج المراجعة النظامية، تهدف البحث إلى تحديد الاتجاهات والتطبيقات في دمج تقنيات الذكاء الاصطناعي لدعم الأفراد ذوي الاحتياجات الخاصة. وجدة الدراسة ان معظم الدراسات طبقة بين عامين ٢٠٢٠ و ٢٠٢٣، باختيار ١٥ مقالًا من خلال فحص دقيق، باستخدام منهجية بيان PRISMA . تتناول أسئلة البحث المواضيع السائدة في الأدب العربي حول الذكاء الاصطناعي في التربية الخاصة ، ودمج تقنيات الذكاء الاصطناعي في مساعدة الطلاب ذوي الاحتياجات الخاصة، وأنواع الإعاقات المشار إليها في الدراسات المختارة. تشير النتائج إلى تركيز سائد على التوحد في الدراسات المختارة، متماشيًا مع الفعالية المتصورة للذكاء الاصطناعي في مساعدة الطلاب الذين يواجهون تحديات في بيئات التعلم المنظمة والتفاعلات الاجتماعية. تقر الورقة بالقيود، بما في ذلك العدد النسبي الصغير نسبيًا من الدراسات

والحاجة إلى بحوث أكثر توسعًا تغطي بيئات متنوعة ومشاركين وإعاقات. في الختام، على الرغم من أن الدراسات الحالية تقدم رؤى قيمة، فإن جسم بحث شامل ومتنوع أكثر أهمية لاستخلاص استنتاجات شاملة حول فعالية الذكاء الاصطناعي في التربية الخاصة . سيمكن هذا المنهج المعلمين والباحثين من معالجة التحديات والفرص المعقدة المرتبطة بتنفيذ الذكاء الاصطناعي عبر سياقات تعليمية مختلفة ومع مجموعات مشاركين مختلفة.

كلمات مفتاحية: الذكاء الاصطناعي(AI) ، التربية الخاصة ، المراجعة النظامية

Introduction

Artificial Intelligence (AI) has significant promise in transforming the landscape of special education, offering innovative solutions to address the diverse needs of individuals with disabilities. AI technologies encompass a range of applications, including chatbots, intelligent tutoring programs, augmented reality, and other innovative tools designed to cater to the unique requirements of learners with special needs. The rationale for incorporating AI in special education lies in its capacity to offer personalized, adaptive, and interactive learning experiences tailored to individual learning styles and disabilities. Such technologies have the potential to mitigate barriers and provide more inclusive and effective educational interventions for students with diverse needs.

Facilitating this technological evolution in special education, AI applications have not only been instrumental in enhancing learning experiences and outcomes (Khan et al., 2020; Kim et al., 2021 Weragama & Reye, 2014) but have also extended their impact

to supporting the professional development of educators (Gunawan et al., 2021; Lampos et al., 2021). However, despite these advancements, the landscape of AI in special education research is marked by a comparative scatter and lack of organizational cohesion, especially when juxtaposed with more consolidated areas within educational technology, such as universal and blended learning.

Holmes et al. (2021) note that the effects of artificial intelligence on education are still unknown, and further study is required to determine whether and how these new technologies improve education. It is difficult to introduce or integrate unfamiliar technologies into colleges and universities (Hussin, 2018). To the best of the author's knowledge, no review addresses the use of AI in Arabic-language special education (SpEd). The study's justification is that, at the time, there were no reviews of the most recent developments in artificial intelligence (AI), a crucial area in the special education field. It could be beneficial to identify the research on AI in special education, given the topic's popularity, and help determine the number of studies that have been done on the subject. Therefore, additional review studies are required to arrange the literature, particularly that which is written in Arabic, identify research trends in artificial intelligence (AI) in special education in Arabic-language articles, and recommend future directions for research. For this purpose, the research questions were as follows:

What are the most common topics in Arabic articles about AI in special education?

How have these AI technologies been integrated into supporting students with special needs?

What disability types feature in the selected studies?

Research Problem: The research problem addresses the lack of comprehensive reviews and research on the integration of Artificial Intelligence (AI) in special education within the Arabic-language literature. Despite the growing interest and potential of AI in special education, there is a dearth of organized and cohesive studies, especially within the Arabic-speaking context. This gap impedes the understanding of the effectiveness, challenges, and trends associated with AI integration in supporting individuals with disabilities.

Research Goals: The research aims to address several objectives:

1. Identify prevalent topics in Arabic-language literature related to AI in special education.
2. Explore how AI technologies have been integrated to support students with special needs.
3. Investigate the types of disabilities featured in the selected studies.

Research Importance: The significance of the research lies in its potential to:

1. Fill a crucial gap in the literature by providing a systematic review of AI in special education within Arabic-language literature.
2. Offer insights into AI technologies' current state, trends, and applications in supporting individuals with disabilities.
3. Inform educators, researchers, policymakers, and stakeholders about the opportunities and challenges associated with AI integration in special education.

4. Guide future research efforts to address the identified gaps and enhance the effectiveness of AI interventions for diverse learners.

Definitions of Keywords:

Artificial Intelligence (AI): AI is the simulation of human intelligence processes by machines, typically computer systems. These processes include learning (acquiring information and rules for using it), reasoning (using rules to reach approximate or definite conclusions), and self-correction. AI technologies aim to replicate cognitive functions such as problem-solving, perception, learning, and decision-making.

Special Education: Special education refers to the education of students with disabilities, learning differences, or other special needs. It involves individually planned and systematically monitored arrangements of teaching procedures, adapted equipment, and materials designed to meet the unique needs of students with disabilities. Special education aims to provide equal educational opportunities and promote the academic, social, emotional, and vocational development of students with special needs.

Artificial Intelligence in Special Education

Artificial Intelligence (AI) plays a crucial role in special education by enhancing teaching methods, aiding skill development, and improving the quality of education for students with special needs. AI technologies have been successful in recent decades, particularly between 2001 and 2010, offering new forms of interaction and tools to benefit children with special educational needs (Roberto, etal .,2023; Marino etal., 2023). AI applications in special education focus on cognitive and affective skill

development, often utilizing software-based methods in school settings with learners from diverse backgrounds(Hopcan etal.,2023). These technologies are seen as disruptive, with the potential to significantly change special education practices, impacting areas such as writing assistance and teacher preparation (Neeharika and Riyazuddin 2023). Overall, AI in special education aims to provide inclusive and effective educational experiences for students with special needs, leveraging technical models like ANN and SVM for improved outcomes (Neeharika and Riyazuddin 2023)

Examples of Ai in Special Education

Artificial Intelligence (AI) has significantly impacted the field of special needs education by introducing various innovative solutions to support students with disabilities. Examples of AI applications in this area include: 1. **Data-Driven Classification Systems**: AI technologies have been utilized to classify autism spectrum disorder (ASD) patients and typically developing (TD) participants, enhancing the understanding and support for students with ASD (Neeharika and Riyazuddin 2023). 2. **Collaborative Support Systems**: ICT-based collaborative systems have been developed to support children with developmental disabilities. These systems enable teachers, parents, and supporters to share information instantaneously, ensuring immediate and tailored support for the students(Al Hosni et al.,2023). 3. **E-Learning Platforms**: During the COVID-19 pandemic, AI-enhanced e-learning platforms were recognized for their potential to support online learning for students with special needs, facilitating educational engagement, social connections, and knowledge exchange (Kirongo et al., 2022). 4. **AI-Enabled Assistive Technologies (AT)**: AI has been instrumental in matching the

unique needs of learners with disabilities to appropriate assistive technologies, thereby supporting innovation and learning in special education settings (Marino et al., 2023). 5. **Educational Robotics**: For children with Special Educational Needs (SEN), educational robotics have been used to maintain attention and increase participation in the educational process, demonstrating AI's role in creating engaging learning environments (Vouglanis, 2023). 6. **Sign Language Communicators**: AI tools have been developed to assist deaf students by converting speech to sign language and vice versa, facilitating effective communication and learning in the classroom (Mouti & Rihawi, 2023). 7. **Assistive Technologies in Classrooms**: Various AI-driven assistive technologies, including augmented reality and virtual reality, have been introduced to support special education, enabling teachers to focus on developing the full potential of all students (Narot & Kiettikunwong, 2023). 8. **Emotion Recognition Systems**: AI systems designed to monitor the emotional state of students with special needs help teachers and psychologists to better understand and respond to the emotional needs of these students, ensuring a supportive learning environment (Andrunyk & Yaloveha, 2020). These examples illustrate the diverse and impactful ways in which AI is being leveraged to support students with special needs, offering personalized, accessible, and efficient educational experiences.

t's crucial to emphasize that although Artificial Intelligence (AI) holds great potential in aiding special education, it should serve as a supplementary resource rather than a substitute for human educators and support personnel. Teachers need to carefully integrate AI tools into their practices to prevent any interference

with essential teaching methods, particularly the vital interactions between teachers and students.

Method

This study used the systematic review method to reveal the research trends in AI in special education. According to the Cochrane Handbook (Higgins et al., 2019), it is difficult to keep track of the ever-increasing number of studies. In this context, systematic reviews enable readers to access up-to-date and complete information on all available research evidence. Higgins et al. (2019) also add that a systematic review can identify gaps, limitations, deficiencies, and any lack of evidence in the literature, presenting the state of research that might be useful for future research. This study aims to reveal the research trends in AI in Special Education.

To our knowledge, there has been no existing review conducted to examine trends in AI in Special Education. This review adopted the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach (Page et al., 2021) and proceeded in three steps: (i) article selection, (ii) article screening and inclusion, and (iii) data coding, extraction, and analysis.
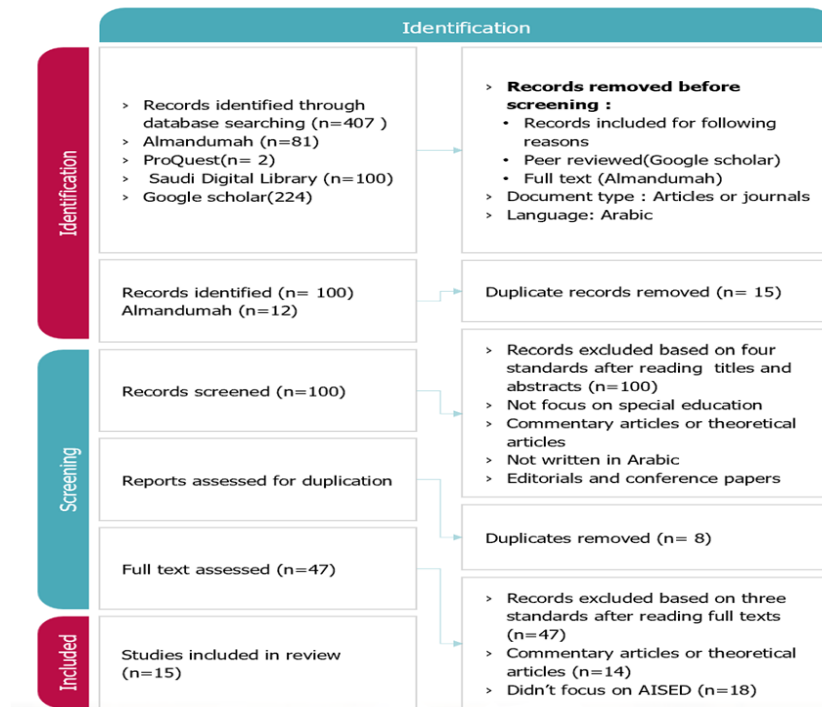
Fig. 1. Flow chart of article selection.

Article identification

Only articles relevant to AISEd (Artificial intelligence in special education) were selected for this review. To identify relevant published articles, three of the author's colleagues collaboratively discussed and developed the criteria described in Fig.1. Based on the previous studies (Nigam et al., 2021), the search query [("AI" or "artificial intelligence") and "Special education"] was used to include papers with these terms in the titles, keywords, or abstracts published in any year. The search was executed in Almandumah, ProQuest, Saudi Digital Library (SDL), and Google Scholar. The query returned 407 initial articles: 81 in Almandumah, 2 in ProQuest, 100 in Saudi Digital Library, and ٢٢٤

in Google Scholar. The investigation covered only peer-reviewed journal articles published in Arabic. The inclusion and exclusion criteria varied slightly for each database due to the unique characteristics and functions of the search engines (as shown in Fig.1). Additionally, the articles selected from Almandumah were limited to full-text publications, and those from SDL were limited to studies in the area of educational research. After applying the criteria, 100 publications were selected for further screening.

Table 1

Presenting and Reviewing the Results of Literature Analysis.

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
1	Effectiveness of a program based on Chatbots on improving expressive language disorders in people with mild intellectual disabilities. Matar, Asmaa Ibrahim Muhammad Saleh, Ahmed Saeed Abdulaziz Ibrahim) m.	Chatbots	Egypt	Mild intellectual disabilities	The purpose of the study was to determine how well a chatbot-based program could help mildly intellectually disabled individuals with their expressive language disorders. The study showed that the chatbot-based program worked well to improve expressive language disorders in people with mild intellectual disabilities and how long the effects

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
	participant 2021				lasted during the follow-up period (one month after graduation).
2	Factors Associated with Application of Artificial Intelligence (AI) on Students with Autism Spectrum Disorder Education in the Light of some Demographic Variables as Perceived by Specialists Dr. Reda Ebrahim Mohamed Elashram 2023	Didn't use Artificial Intelligence (AI)	Saudi Arabia	Autism	The purpose of this study was to determine the variables related to the use of artificial intelligence (AI) in the education of students with autism spectrum disorders from the perspective of subject matter experts. The findings indicated that the following, in decreasing order, are the primary associating factors: the facilities needed for AI application; the propensity to use AI; awareness of AI characteristics; and an understanding of the advantages of AI. Additionally, based on the

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
					research variables, the results showed that specialists' awareness of the research factors varied. More experienced specialists are using artificial intelligence in beneficial ways.
3	The Reality of Employing Artificial Intelligence Applications and its challenges in The Habilitation of Children with Special Needs (Autism Spectrum Disorder - Intellectual Disability) from The Point of View of Teachers and Specialists Mohamed Saeed Sayed	Not used	Egypt	Autism Spectrum Disorder - Intellectual Disability	From the perspective of teachers and specialists, this research attempts to shed light on the realities and difficulties of using artificial intelligence applications in the habilitation of children with special needs (autism spectrum disorder - intellectual disability), as well as the attitudes of teachers regarding the use of AI. Result: Artificial intelligence

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
	Agwa Nahed Mounir Gad Makary 2023				applications are of an average degree. The challenges associated with using only artificial intelligence applications are ranked as follows: technical and physical challenges, challenges in the educational field, challenges related to security and privacy, and challenges in the social field. All of these challenges were significant. Teachers' and specialists' attitudes toward the value of using artificial intelligence applications were largely positive. Teachers and specialists were also largely positive about using artificial intelligence applications for training and education.

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
4	The reality of using artificial intelligence applications in special education schools in Jeddah from the teachers' point of view Samia Fadel Alghamdi leena Ahmad Alfarani 2020	Didn't use	Saudi Arabia	Didn't mention blind students	From the perspective of female teachers at Al-Nur Institute in the Jeddah governorate, the study aimed to identify the perceptions of female teachers at the special education schools using artificial intelligence in educational applications. The study found that while knowledge and skill levels about using AI and the significance of using it for education both obtained degrees (strongly agree), there were barriers to using AI for education and attitudes toward it obtained degrees (agree), and there was no difference

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
					in either category between the groups.
5	The effectiveness of artificial intelligence-based interventions in improving cognitive skills among intellectually disabled students in government inclusion centers

Fakhro, Abdel Nasser Abdel Rahim

Ahmed, Tariq Abdel Majeed Kamel) m. participant

2023 | Various educational applications and games and Clicker 7 software | Qatar | Mild intellectual disabilities | The purpose of the study was to confirm whether or not students with mild intellectual disabilities in government inclusion centers could improve their cognitive abilities through an AI-based training program.

Findings: The post-measurement of the cognitive skills test showed statistically significant differences between the control and experimental groups, with the experimental group scoring higher. |
| 6 | Educational applications of artificial intelligence for children with disabilities | No | UAE | Children with disabilities | The study evaluates how artificial intelligence (AI) is currently used in the UAE to support people with |

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
	"People of Determination" In the United Arab Emirates, from teachers' perspective

Maryam Ali Saeed Alyammahi
2023 | | | | disabilities in education. It primarily focuses on the challenges educators see and identifying differences in how these applications are used depending on the courses teachers teach, their years of experience, and their areas of specialization.

An important challenge that was found was lack of applications designed for particular categories of disability. Based on participant specialization, the study discovered statistically significant differences in participant responses, favoring teachers with experience in visual impairment. These specialists expressed more |

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
					optimism regarding the use of AI educational applications for individuals with disabilities.
					The course and years of experience variables, however, showed no statistically significant differences, indicating that teachers' perceptions of the practicality of using AI applications with this student population were not significantly influenced by these factors.
7	Digital learning using artificial intelligence applications for students with visual impairment Ibrahim Abdel Hadi	No	Egypt	Visual impairment	The current study intends to enable digital learning for visually impaired students in Egyptian government schools through the use of artificial intelligence

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
	Mohamed Abdel Latif 2020				applications. The study discovered that the behavioral and emotional components of digital learning are most important to students with visual impairments, followed by the skill and cognitive components. According to the study, some government schools should set up an artificial intelligence unit to support these students' digital self-learning and help them with the difficulties they face in the classroom. This shows that to improve the educational experience for visually impaired students, artificial intelligence tools should be included and emphasize

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
					skills development and include emotional, behavioral, and cognitive components.
8	Teachers' attitudes towards using chatbots to teach students with disabilities in Madinah Omaima Mahfouz Al-Shanqeeti 2022	No	Saudi Arabia	Students with disabilities	The study sought the opinions of educators regarding the use of interactive chatbots in the instruction of students with disabilities in Madinah. According to the study, teachers are using interactive chatbots at a medium level when instructing students with disabilities. When using interactive chatbots to teach students with disabilities, teachers reported encountering only mild difficulties. The suggested fixes for these problems were given an average rating. Significantly, the findings showed no

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
					statistically significant attitudes differences among teachers according to gender, type of disability, academic background, length of schooling, or training courses.
9	A Smart E-Learning Environment Design and Effectiveness on Developing Digital Scientific Research Applications for Secondary Stage Talented Female Students Dr. Sayed Shaaban Abd-ul Aliem & Dr. Ghadeer Ali Al-Mehammadi 2021	A smart electronic learning environment that allows for the selection of appropriate artificial intelligence techniques according to the student's inclinations and needs.	Saudi Arabia	Talented female students	The study's objective is to create an online learning environment and evaluate how well it supports digital scientific research by gifted female secondary students while taking into account their various learning preferences. The study's findings indicated that, among female students, there were statistically significant differences in mean scores (at the 0.05 significance level) between post-tests and the application

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
					of observation cards based on learning styles, with a preference for post-application. The results indicate that, for gifted female students, secondary school curricula should include digital scientific research applications. Furthermore, with an emphasis on the academic future of gifted female students, the education system should be in line with smart environments and developmental plans for programs that cater to them as well as Saudi scientific enrichment programs.
10	Requirements for Employing Smart Glasses Technology Based on	No	Egypt	Visual impairments	The goal of the current study is to determine what conditions must be met in so people

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
	Artificial Intelligence for Developing Skills and Fundamental Concepts Among Individuals with Visual Impairments in General Education Obeida Khalufa Al-Omari 2021				with visual impairments enrolled in general education can acquire skills and basic concepts using artificial intelligence-based Smart Glasses technology. According to the study, visually impaired people in education have a favorable opinion of the potential of smart glasses technology to improve skills acquisition and learning. It also draws attention to the important issues that must be resolved to successfully execute the plan. No statistically significant variations in the responses according to the

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
					research variables (qualification, experience, and training courses) were discovered at the 0.05 level, which suggests that regardless of the participants' credentials, degrees of experience, or training programs, their opinions and attitudes regarding the conditions for using Smart Glasses technology were the same.
11	The effect of a training program using a jacket designed with artificial intelligence technology to predict the level of skill performance of motorically disabled fencers. Mahrosa	A jacket designed with artificial intelligence technology	Egypt	Motorically disabled	The goal of the research is to increase the performance of physically challenged fencers. Result: Students with physical disabilities performed noticeably better, and the suggested program using artificial intelligence jackets

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
	Mohamed Ali Israa Adel Kamel Muhammad 2021				had a beneficial effect.
12	Educational applications of artificial intelligence for people with special needs in middle school integration schools from the point of view of their teachers in Riyadh City. Reem Muidh Khashnan Alqahtani Dr. Ashjan Ali Abdulaziz Al-Sudais ٢٠٢٢	No	Saudi Arabia	People with special needs	The study sought to determine which educational programs, from the perspective of their Riyadh City instructors, related to artificial intelligence were used in integration schools at the Intermediate stage to serve individuals with special needs. The study emphasizes the importance of augmented reality technologies in special education applications and the difficulties in obtaining devices. It suggests concentrating on creating apps specifically designed to meet

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
					the needs of this group.
13	Requirements for Using Artificial Intelligence Applications to Teach Social and Academic Skills to Children with Autism Spectrum Disorder Yasser Abdel Hamid Mahmoud Ahmed ٢٠٢٣	No	Not mentioned	Children with Autism Spectrum Disorder	The purpose of the study was to determine the prerequisites for teaching academic and social skills to children with autism spectrum disorder (ASD) by using artificial intelligence applications. The study also sought to determine how the requirements for utilizing artificial intelligence applications to teach social and academic skills to children with ASD varied, as perceived by experts, based on various variables (e.g., job specialty, educational background, and years of experience). A. A consensus was reached among the

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
					experts regarding the critical importance of every requirement listed in the questionnaire, including the technical material, parents, teachers, and children with autism spectrum disorder (ASD). B. Statistically, based on their occupation or area of expertise, the experts' evaluations of the requirements did not differ significantly. C. Based on their educational backgrounds, the experts' evaluations showed statistically significant differences. The opinions of those with master's and doctoral degrees regarding the specified

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
					requirements varied. D. Expert assessments of the unique needs of kids with ASD and the technical material requirements based on years of experience did not show any statistically significant differences. But there were discrepancies in the evaluations of parent and teacher requirements, particularly among experts with 15 to 20 years of experience.
14	Teacher attitudes towards employing artificial intelligence applications to confront learning	No	Saudi Arabia	Students with learning disabilities	The purpose of this study was to find out how Aseer Region teachers felt about applying artificial intelligence (AI) applications to help students with

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article Result
	difficulties in the Asir region in the Kingdom of Saudi Arabia. Bandar bin Abdullah bin Dhaif Allah Al-Shehri 2022				learning disabilities. The findings indicated that teachers exhibited a high degree of emotional and behavioral preference toward using these applications, as well as a medium to high level of awareness regarding AI's potential to address learning disabilities. On the other hand, there was also broad consensus regarding the challenges and barriers associated with using these apps.
15	Challenges Facing Applying Artificial Intelligence in the Education of the Gifted	No	Jordan	Gifted	The aim of this study was to determine the difficulties in implementing artificial intelligence (AI)

ID	Title, name, year	AI technology	Country	Type of disability	Aim of the article / Result
	and their Future Prospects Jehad. Abed R.M. Turkey 2023				programs in the education of gifted students. The study found that there was only a moderate degree of success using AI techniques to teach gifted students, with respondents citing a number of difficulties in putting AI programs into practice for participants. The respondents did, however, suggest improvements for AI programs, including creating and refining AI-based learning environments for talented educators, training gifted students with educational robots, and incorporating AI into strategic planning for schools.

Article screening and inclusion

Screening and inclusion procedures were used to select articles for the main analysis. First, 15 duplicated articles were eliminated using the duplication detection function of EndNote. Two of the authors' colleagues then examined the titles and abstracts of the articles to identify empirical reviews of best practices and perceptions and attitudes studies related to AISEd published in journals, thus excluding conceptual papers, commentaries, editorials, and conference papers. A further 30 articles were excluded based on these criteria. When the two colleagues disagreed on paper identification, another colleague assessed the paper and made a final decision. The full texts of the remaining articles were read and 8 duplicates that were not detected by EndNote were removed, leaving 47 articles. Another 14 commentaries or theoretical articles and 1٨ studies that did not focus on AISEd were also eliminated at this stage. Ultimately, 15 articles were retained (see Table 1).

Coding and analysis

Higgins et al. (2019) recommended that a systematic review should be conducted by a research team of at least two researchers to avoid errors. Thus, for this research, articles were coded separately by two researchers and both code sets were compared. Cohen's Kappa coefficient value was calculated to measure interrater reliability. Cohen's Kappa was 0.90, which can be interpreted as almost perfect agreement (0.81-1.00)(Mchugh,2012). Disagreements were resolved by discussion until an agreement was reached. The emerged topics are displayed using frequency tables. Table 1presents a summary of the analysis carried out on the

selected studies. Then selected papers were analyzed through inductive and deductive processes including reading and re-reading the data to answer the research questions:

What are the most common topics in Arabic articles about AI in special education?

How have these AI technologies been integrated into supporting students with special needs?

What disability type features in the selected studies?

Results and discussion

All 15 studies included in this compilation were published between 2020 and 2023. A predominant subset of these investigations, accounting for seven studies, assumed a prospective orientation and did not incorporate Artificial Intelligence (AI) methodologies. In contrast, a minority comprising four out of the 15 studies explicitly integrated AI technologies. The primary role ascribed to AI within these four studies was to augment and refine skills among the targeted population. Examining the distribution of studies across various disability categories reveals a limited representation, with three studies on autism and two studies each focusing on mild intellectual disability, giftedness, and visual impairments. Singular studies were dedicated to learning disabilities, motorically disabled individuals, and the blind. Additionally, three studies adopted a broad terminology, referencing individuals as "people with disabilities" without specifying a particular disability type.
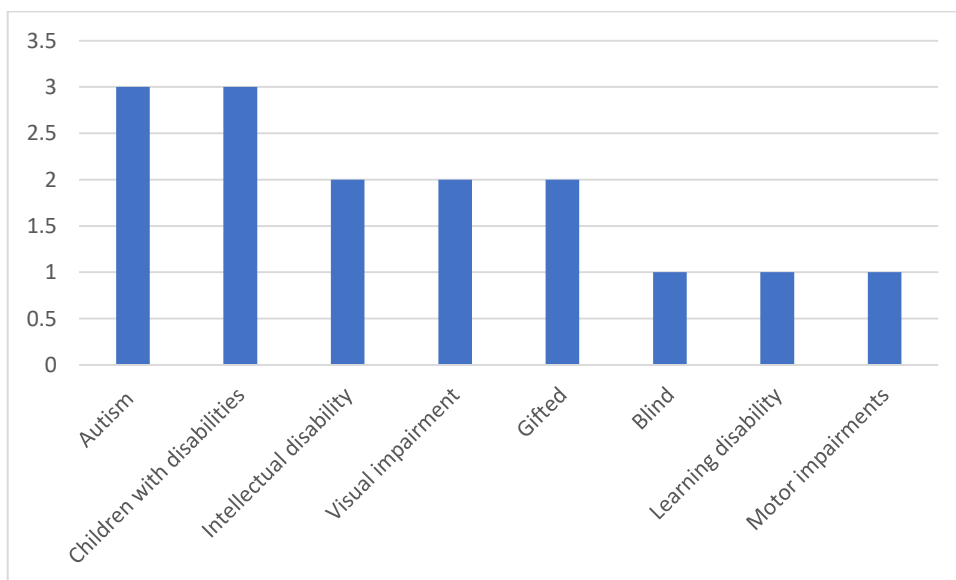
Fig. 2.Disablitiy type

Table 2

Types of disabilities

ID	Types of disabilities	Number of studies
١	Autism	3
٢	Children with disabilities	3
٣	Intellectual disability	2
٤	Visual impairment	2
٥	Gifted	2
٦	Blind	1

٧	Learning disability	1
٨	Motor impairments	1

Regarding disability types (as seen in Fig2 and table 2), the predominant emphasis in the conducted studies was on autism. This alignment with the findings of Hopcan et al. (2022) is noteworthy, as they identified 10 studies on autism in their review of 29 studies. The focus on autism aligns with researchers' perceptions of AI's particular effectiveness for students who experience anxiety in structured learning environments, grapple with social interaction, and seek greater independence (Hedges et al., 2018).

The 15 studies mention the effectiveness and challenges of implementing artificial intelligence (AI) in diverse educational contexts for individuals with special needs. These include utilizing AI programs, chatbots, and intelligent tutoring systems to enhance language skills in those with mild intellectual disabilities, exploring the factors influencing the use of AI in autism spectrum disorder education, assessing the reality and challenges of employing AI in the habilitation of children with special needs, and designing smart e-learning environments for talented students. Additionally, studies delve into teachers' attitudes toward AI usage, the application of AI in addressing learning difficulties, and identifying challenges and prospects of AI in educating gifted students. These diverse studies contribute valuable insights into the potential, obstacles, and perceptions surrounding the integration of AI technologies in special education.

On the other hand, it is difficult to determine whether the implemented AI works in different settings and with different participants. The difficulty in determining the effectiveness of implemented AI across various settings and with different participants arises from the inherent complexities associated with the diversity of educational environments, types of disabilities, and AI applications. The studies presented highlight a range of challenges and considerations in this regard.

First, the regions vary widely: for example, UAE, Qatar, Egypt, and Saudi Arabia each have their own set of contextual factors. These contextual differences can impact the implementation and reception of AI applications. Hopkins and Polat (2022) advocate for exploring and implementing AI in various contexts, highlighting the need for such studies beyond the predominantly U.S.-focused literature they encountered in their review of AI in special education. Moreover, the studies involve participants with distinct types of disabilities, including mild intellectual disabilities, autism spectrum disorder, visual impairments, and motor disabilities. Each disability presents specific challenges and necessitates tailored approaches (Zhai, X., & Panjwani-Charania, S. (2023). What proves effective for one group may not necessarily generalize to others, emphasizing the need for specialized and adaptable AI interventions. Further, the variety of AI applications employed across the studies, such as chatbots, intelligent tutoring programs, and augmented reality technologies, adds another dimension to the challenge. Different AI technologies may have varying impacts on distinct skills and educational outcomes, making it challenging to draw broad conclusions about their effectiveness.

AI applications tailored for specific disabilities may not enhance student learning (Xia, Q., Chiu, et al., 2022). The advancement of AI technologies within the educational realm has been slower compared to other fields (Brown et al., 2020; Nicolae & Nicolae, 2018). Teachers commonly resort to off-the-shelf technologies for instructional purposes, but these may not always align optimally with their intended educational objectives. To address this gap, researchers are urged to undertake a nuanced approach, customizing AI applications for each specific disability and ensuring that they are attuned to the diverse learning needs of students. By leveraging more sophisticated AI technologies, researchers can enhance the adaptability and effectiveness of these applications, ultimately leading to improved educational outcomes for both students and teachers. This tailored approach acknowledges the unique challenges associated with various disabilities, promoting a more inclusive and responsive integration of AI in educational settings.

In essence, the difficulty lies in navigating the intricate interplay of contextual, participant-specific, and technological factors that influence the success of AI implementations. To enhance the generalizability of findings, future research should continue to explore these complexities, incorporating a broad spectrum of settings, participants, and AI applications to provide a comprehensive understanding of the effectiveness of AI in special education.
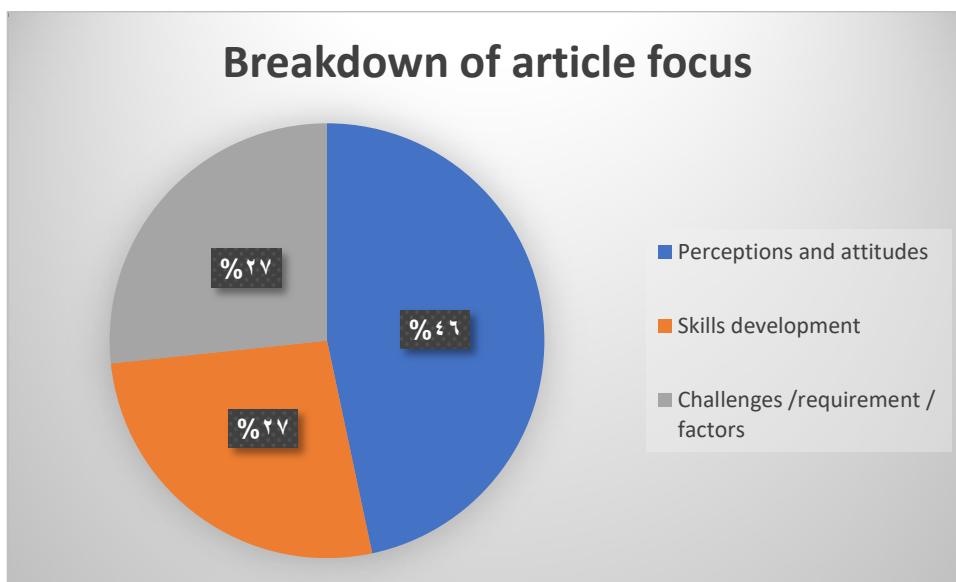
Breakdown of article focus

Fig. 3. Article Focus

Table 3

Focus of the article

Focus of the article	Number articles	Percentage
Perceptions and attitudes	7	46%
Skills development	4	27%
Challenges /requirement / factors	4	27%

Most of the studies under consideration focus on exploring the perspectives and attitudes held by teachers and specialists in the field(seen in fig3 and table3). This observation aligns with the assertion made by Alrusaiyes (2014), who noted that Middle Eastern studies over the past years have predominantly concentrated on investigating the attitudes and perceptions of educators. This concurrence resonates with the characterization of disability research in the Middle East as articulated by Levin, O'Donnell, and Kratochwill (2003), who characterized it as a developmental stage. According to Levin et al., educational research typically progresses through four stages: the initial stage involves formulating initial ideas, pilot work, and observations amenable to qualitative and correlation methods. The second stage comprises controlled classroom experiments or observational studies utilizing quasi-experimental, single-subject, mixed-method, and qualitative approaches. The third stage involves synthesizing insights from previous stages to design interventions and substantiate their effectiveness in natural settings. The final stage entails identifying factors that contribute to the adoption of effective practices. As indicated by Levin et al. (2003), the current state of research in Saudi Arabia suggests that it is primarily situated in the first stage, emphasizing preliminary ideas and observations. Consequently, there is a compelling need for research in the Middle East to progress beyond this initial stage and evolve towards intervention research, classroom experiments, and endeavors assessing effectiveness. The meta-analysis conducted herein underscores the scarcity of published research on

disabilities, particularly about research concerning artificial intelligence implementation, within the Middle Eastern context.

Limitations and conclusion

The use of AI in special education is relatively new, and the number of research studies in this area is limited (Hinojo-Lucena et al., 2019). Thus, the number of studies provided in this paper is relatively small, and this limitation impacts the breadth and generalizability of conclusions that can be drawn about the effectiveness of AI in special education across diverse settings and with various participants. A larger sample size and more extensive representation of studies would enhance the robustness of findings and allow for a more comprehensive understanding of the nuanced dynamics involved. The limited number of studies means that the insights gained from these specific cases may not capture the full spectrum of challenges and successes in implementing AI across different educational contexts and disabilities. Educational systems vary significantly worldwide, and the small number of studies referred to here may not adequately represent the diversity of approaches, resources, and infrastructures in different countries and regions. Furthermore, the specific types of disabilities and educational settings explored in the provided studies are not exhaustive. For instance, there is a focus on autism spectrum disorder, mild intellectual disabilities, visual impairments, and motor disabilities, but there are many other types of special needs that could benefit from AI interventions. A larger body of research would allow for a more comprehensive examination of the applicability of AI across a wider array of disabilities. Moreover, the studies predominantly focus on the perspectives of teachers, specialists, and experts. While this is valuable, a more extensive collection of studies could include the perspectives of students,

parents, and administrators, providing a more holistic understanding of the impact and challenges of AI in special education.

In summary, while the provided studies offer valuable insights, a larger and more diverse body of research is needed to draw overarching conclusions about the efficacy of AI in special education. This would enable researchers and educators to better address the nuanced challenges and opportunities associated with implementing AI across various educational settings and with different participant groups.

References:

Abdel Hamid, Y. (2023). Requirements for using artificial intelligence applications in teaching social and academic skills to children with autism spectrum disorder. Fayoum University Journal of Educational and Psychological Sciences, 17(5), 594-652.

Abdul Latif, Ibrahim Abdul Hadi Muhammad. (2020) Mechanisms for achieving digital learning using artificial intelligence applications for students with visual disabilities. Arab Journal of Disability and Gifted Sciences, 14, 487-542.

Abu Al-Atta, Mahrousa Ali Hassan, and Kamel, Israa Adel.. (2021) The effect of a training program using a jacket designed with artificial intelligence technology to predict the level of skill performance of physically disabled fencers. The Fourth International Scientific Conference: Strategic Innovation and the Sports Industry, Volume 2, New Administrative Capital: Tanta University - Faculty of Education, 707-743.

Al Hosni, B., Naidu, V. R., & Al Mandhari, S. (2023). Support for students with Special needs during and after the COVID-19 pandemic through E-learning: A Case Study. In *SHS Web of Conferences* (Vol. 156, p. 06004). EDP Sciences.

Al Shehri, Dr. B. B. A. B. Z. A., & Dr. Bandar bin Abdullah bin Dhaif Allah. (2023). Teacher attitudes towards employing artificial intelligence applications in confronting learning difficulties in the Asir region, the Kingdom of Saudi Arabia. Journal of Reading and Knowledge, 23(261), 357-398.

Al-Ghamdi, Samia Fadel, and Al-Farani, Lina bint Ahmed bin Khalil. (2020). The reality of using artificial intelligence applications in special education schools in Jeddah from the

teachers' point of view and the trend towards it. International Journal of Educational and Psychological Studies, vol. 8, no. 1, 57-76.

Al-Omari, Obaida Khalifa. (2021). Requirements for employing Glass Smart technology based on artificial intelligence to develop the basic skills and concepts of people with visual disabilities in general education. Research Journal, 5, Part 1, 133-105.

Alrusaiyes, R. F. (2014). Perspectives toward transition program for females with intellectual disability in the Kingdom of Saudi Arabia. University of Northern Colorado

Al-Shanqiti, Umaima bint Mahfouz. (2022. (Teachers' attitudes towards using interactive chatbots in teaching students with disabilities in Medina. Arab Journal of Disability and Giftedness Sciences, 23, 51-80.

Al-Yamahi, Maryam Ali Saeed. (2023.) Educational applications of artificial intelligence for children with disabilities in the United Arab Emirates from the point of view of their teachers. Arab Journal of Specific Education, 26, 217-250.

Andrunyk, V., & Yaloveha, O. (2020, September). Information system for monitoring the emotional state of a student with special needs using AI. In *2020 IEEE 15th International Conference on Computer Sciences and Information Technologies (CSIT)* (Vol. 1, pp. 66-69). IEEE.

Ashram, Reda Ibrahim Muhammad. (2023) Factors associated with employing artificial intelligence in educating people with autism spectrum disorder in light of some demographic variables as perceived by specialists. Journal of Scientific Research in Education, 1 vol. 24, 30-69.

Brown, M., McCormack, M., Reeves, J., Brook, D. C., Grajek, S., Alexander, B., & Weber, N. (2020). 2020 Educause Horizon Report Teaching and Learning Edition (pp. 2–58). EDUCAUSE.

Fakhro, Abdel Nasser Abdel Rahim, and Ahmed, Tariq Abdel Majeed Kamel. (2023.) The effectiveness of a training program based on artificial intelligence applications to improve the cognitive skills of students with mental disabilities in government integration centers. Arab Journal of Measurement and Evaluation, v8, no. 4, 66-84.

Gunawan, K. D. H., Liliasari, L., Kaniawati, I., & Setiawan, W. (2021). Implementation of competency enhancement program for science teachers assisted by artificial
intelligence in designing HOTS-based integrated science learning. *Jurnal Penelitian dan Pembelajaran IPA, 7*(1), 55–65.

Hedges, S. H., Odom, S. L., Hume, K., & Sam, A. (2018). Technology use as a support tool by secondary students with autism. Autism, 22(1), 70–79.

Higgins, J. P., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (eds.). (2019). Cochrane handbook for systematic reviews of interventions. John Wiley & Sons.

Hinojo-Lucena, F. J., Aznar-Díaz, I., Cáceres-Reche, M. P., & Romero-Rodríguez, J. M. (2019). Artificial intelligence in higher education: A bibliometric study on its impact in the scientific literature. Education Sciences, 9(1), 1–9.

Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S. B., ... & Koedinger, K. R. (2021). Ethics of AI

in education: Towards a community-wide framework. *International Journal of Artificial Intelligence in Education*, 1-23.

Hopcan, S., Polat, E., Ozturk, M. E., & Ozturk, L. (2022). Artificial intelligence in special education: a systematic review. *Interactive Learning Environments*, 1-19.

Hopcan, S., Polat, E., Ozturk, M. E., & Ozturk, L. (2023). Artificial intelligence in special education: a systematic review. Interactive Learning Environments, 31(10), 7335-7353.

Hussin, A. A. (2018). Education 4.0 made simple: Ideas for teaching. *International Journal of Education and Literacy Studies, 6*(3), 92–98.

Khan, Z. F., & Alotaibi, S. R. (2020). Design and Implementation of a computerized user authentication system for e-learning. *International Journal of Emerging Technologoes in Learning, 15*(9), 4–18.

Kim, H. S., Kim, N. Y., & Cha, Y. (2021). Is it beneficial to use AI chatbots to improve learners' speaking performance? *Journal of ASIA TEFL, 18*(1), 161–178.

Kirongo, A. C., Huka, G., Bundi, D., Kitaria, D., & Muchiri, G. (2022). Implementation of AI-Based assistive technologies for learners with physical disabilities in areas of innovation and special schools: a practical design thinking approach. *African Journal of Science, Technology and Social Sciences*, *1*(2), 73-76.

Lampos, V., Mintz, J., & Qu, X. (2021). An artificial intelligence approach for selecting effective teacher communication strategies in autism education.

NPJ   Science   of Learning, 6(1).

Levin, J.R., O'Donnell, A.M., & Kratochwill, T.R. (2003). Educational/psychological intervention research. In W. Reynolds & G. Miller (Eds.), Handbook of psychology, Vol.7: Educational psychology (pp. 557-581). Hoboken, NJ: John Wiley & Sons.

Makari, Nahid Mounir Gad, and Ajwa, Muhammad Saeed Sayed. (2023.) The reality of employing artificial intelligence applications and its challenges in rehabilitating children with special needs "autism spectrum disorder - mental disability" from the point of view of teachers and specialists. Journal of Scientific Research in Education, v24,no.1,70- 149.

Marino, M. T., Vasquez, E., Dieker, L., Basham, J., & Blackorby, J. (2023). The future of artificial intelligence in special education technology. Journal of Special Education Technology, 38(3), 404-416.

Marino, M. T., Vasquez, E., Dieker, L., Basham, J., & Blackorby, J. (2023). The future of artificial intelligence in special education technology. *Journal of Special Education Technology*, *38*(3), 404-416.

Matar, Asmaa Ibrahim Muhammad, and Saleh, Ahmed Saeed Abdulaziz Ibrahim.. (2021). The effectiveness of a program based on interactive chatbots in improving expressive language disorders among people with mild mental disabilities. Journal of the College of Education, v128, no.32, p.669-702.

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. Biochemia Medica: Biochemia Medica, 22(3), 276–282.

Mouti, S., & Rihawi, S. (2023). Special needs classroom assessment using a sign language communicator (CASC) based on artificial intelligence (AI) techniques. *International Journal of e-Collaboration (IJeC)*, *19*(1), 1-15.

Narot, P., & Kiettikunwong, N. (2023). The Advent of Assistive Technology and Instructions for Restructuring Schools for Special Education Need Students. In *Interdisciplinary Perspectives on Special and Inclusive Education in a Volatile, Uncertain, Complex & Ambiguous (Vuca) World* (pp. 247-258). Emerald Publishing Limited.

Neeharika, C. H., & Riyazuddin, Y. M. (2023, January). Artificial Intelligence in Children with Special Need Education. In 2023 International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT) (pp. 519-523). IEEE.

Neeharika, C. H., & Riyazuddin, Y. M. (2023, January). Artificial Intelligence in Children with Special Need Education. In *2023 International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT)* (pp. 519-523). IEEE.

Nigam, A., Pasricha, R., Singh, T., & Churi, P. (2021). A systematic review on AI-based proctoring systems: Past, present and future. *Education and Information Technologies, 26*(5), 6421–6445.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J.,Grimshaw, J. M., Hrobjartsson, ´A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E.,McDonald, S., … Moher, D. (2021). The PRISMA 2020

statement: An updated guideline for reporting systematic reviews. BMJ, 372, n71.

Qahtani, Reem bint Muayd bin Khashnan, and Al-Sudais, Ashjan bint Ali bin Abdulaziz. (2022). Educational applications of artificial intelligence for people with special needs in middle school integration schools from the point of view of their teachers in Riyadh (unpublished master's thesis). Imam Muhammad bin Saud Islamic University, Riyadh.

Roberto, Araya., Walter, Scheidel. (2023). AI in Education. Crossroads, 29(3):63-65.

Standen, P. J., Brown, D. J., Taheri, M., Galvez Trigo, M. J., Boulton, H., Burton, A., ... & Hortal, E. (2020). An evaluation of an adaptive learning system based on multimodal affect recognition for learners with intellectual disabilities. *British Journal of Educational Technology*, *51*(5), 1748-1765.

Turki, & Jihad Abd Rabbo Muhammad. (2023). Challenges facing the application of artificial intelligence in gifted education and its future prospects. Educational Journal of the Faculty of Education in Sohag, 110(110), 1-37.

Vouglanis, T. (2023). The use of robotics in the education of students with special educational needs. *World Journal of Advanced Research and Reviews*, *19*(01), 464-471.

Weragama, D., & Reye, J. (2014). Analysing student programs in the PHP intelligent tutoring system. *International Journal of Artificial Intelligence in Education,* *24*(2), 162–188

Xia, Q., Chiu, T. K., Zhou, X., Chai, C. S., & Cheng, M. (2022). Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 100118.

Younis, Sayed Shaaban Abdel Aleem, and Al Mahmadi, Ghadeer Ali. (2021) Designing a smart electronic learning environment and its effectiveness in developing digital scientific research skills among gifted female students in the secondary stage. Journal of Educational Research, 9, 1-46.

Zhai, X., & Panjwani-Charania, S. (2023). AI for Students with Learning Disabilities: A Systematic Review.