Artificial Intelligence in Gifted Education: Challenges and Opportunities from Teachers' Perspectives in Jordan

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Manuscript received September 30, 2025; revised November 19, 2025; accepted January 27, 2026; published June 24, 2026

***Abstract*—A descriptive research method was utilized in this study to examine the challenges and opportunities associated with AI in gifted education. The study included 582 teachers from King Abdullah II Schools for Excellence, which indicated that artificial intelligence is on average used in Jordanian gifted schools. Using factor analysis, three important dimensions of the challenges associated with utilizing artificial intelligence techniques in gifted schools in Jordan were identified. The challenges identified include: the obstacles and personal challenges faced by teachers of gifted students in adopting and employing Artificial Intelligence (AI) in the educational process for gifted students, the lack of support and training in applying artificial intelligence in the absence of resources and technology, and the obstacles and challenges related to using artificial intelligence. This study is significant as it highlights critical issues and provides insights into AI utilization in the context of gifted education in Jordan.**

***Keywords*—artificial intelligence, gifted and talented teachers, challenges and opportunities, gifted education**

I. Introduction

The world has witnessed tremendous development in information and communications technology and in all different areas of life. The most important of these was the field of education. Technology has become a major focus in the educational system, which has greatly contributed to raising the level of educational outcomes and making them more global and dynamic. An important field of information and communications technology that has been developed and used in education is artificial intelligence. As a result of various and advanced "AIEd" technologies [1, 2] modern, non-traditional educational environments have been created, and the future of learning and education will also be shaped by these technologies [3]. Because of its clear positive impact on the personality, abilities, skills and experiences of students in general [4–9].

Students who are gifted and talented are considered a national treasure, and they are responsible for advancing the country's progress, cognitive and technological prosperity, and sustainable development [10]. They also need different, non-traditional educational environments capable of discovering them, challenging their abilities, and demonstrating their different potentials and talents to invest in and develop [11, 12]. It has been shown that "AIEd" technologies is able to contribute to creating an unconventional and influential environment in the education system for gifted and gifted students. Programs that rely on artificial intelligence are modern and flexible, and increase self-learning opportunities for gifted and talented students. It makes them more interactive and motivated in the educational process. It stimulates their aspects of creativity and innovation, raises their levels of achievement by achieving the objectives of widely varying educational programs, and also enhances their communication skills, problem solving, and imagination. It also helps them achieve excellence in extracurricular activities, as "AIEd" technologies provides them with the opportunity to apply what they learn as if it were reality in different fields of life. It fosters a deep understanding of STEM skills, and generally makes learning more fun [6, 13–19].

Although artificial intelligence has spread widely in first world countries, it has become one of the most important pillars of progress in all fields, including the educational field [20, 21]. Now we find that artificial intelligence in developing countries is still lagging behind, and has not even reached the aspirations desired by those societies [22, 23]. The introduction of AI into general education and the education of gifted and creative individuals is a serious step forward [15, 24–26]. These attempts vary from one Arab country to another, as there are many challenges and considerations that prevent achieving significant breakthrough and progress in these fields compared to the developed countries of the world [27, 28].

Jordan is considered a developing countries in the Middle East, which always seeks to be a pioneer and distinguished in various fields of sustainable development UN—Jordan, 2023. At the level of the Jordanian Ministry of Education, it has created a special system for caring for gifted and creative students, one of the first in the region. Which paved the way for their care scientifically, psychologically and socially by creating educational environments that suit their abilities and challenge their potential. It has created many specialized schools: The Jubilee school for talented and gifted students and the King Abdullah II schools for excellence are just some of the schools available for talented and gifted in Jordan. Other schools include the Jubilee Center for Excellence in Education, Innovative centers for talented and gifted individuals, and support spaces. It has also created many programs and initiatives, including identification and detection programs, enrichment programs, the academic acceleration programs, and specialized curricula. Guidance and counseling programs and various competitions [10, 29].

It is also one of the countries in the region that was distinguished by the use and employment of technology in the education sector. The country was the first to introduce computers into schools, computerize school curricula, implement distance education, establish specialized institutions and centers with effective electronic communication networks, and provide various learning

methods and programs. Various electronic services, and the establishment of management and departments specialized in information technology at the level of the Jordanian Ministry of Education and its various directorates [30, 31].

II. Literature Review

In order to provide insight into the barriers and prospects displayed by AI in gifted education in the Arab region, this study selected the most recent previous studies related to its topic, especially studies that were distinguished by their quality. The literature review in this study is organized analytically according to the three aforementioned axes (institutional/technical/human-professional), in addition to a axis specific to the opportunities of artificial intelligence in gifted education (individualization, enrichment, acceleration). This organization helps to identify a clear research gap and develop a more consistent measurement tool for the problem. These studies contributed to clarifying the importance of the problem raised in the current research. In addition, the recommendations of those studies were taken into consideration and invested effectively in directing the course of the current research. Previous studies also contributed to designing research tools and selecting the appropriate sample, in addition to identifying the variables affecting the study and discussing the results and recommendations. Key foundational studies relevant to the current research are reported in [30–36]. The following studies were the closest to the study's subject, as the study of Turki [37] sought to reveal the challenges facing the employment of AI in gifted and talented education and its future prospects. Troush and Al-Hadeq [38] found that students in Gifted Secondary Schools in the Directorate of Sabya Education are encountering obstacles in the use of AI. The study also aimed to show reality of applying AI applications in the enriching programs for talented students in Yanbu and Jeddah schools from the viewpoint of students and enriching program instructors. The results of these studies can be classified into two main categories: studies that focused on institutional/technical barriers (support, infrastructure, policies), and studies that focused on human/professional barriers (competencies, attitudes, beliefs), which supports the adoption of this classification in the current study. At the human and professional level, Yem and Wegerif [39] found that teachers have a positive attitude toward AI-based learning tools, but that their implementation faces challenges due to a lack of technical expertise and experience, as well as infrastructure and budget limitations. This study also utilized the Technology Acceptance Model and the TPACK framework to explain the challenges of AI adoption from the perspective of teachers.

In this context, Tamim [40] reported that the use of Artificial Intelligence (AI) with gifted middle and high school students is associated with clear educational opportunities (such as improving self-directed learning, providing feedback, and expanding cognitive exploration), however it also faces recurring challenges related to technical aspects and privacy. Additionally, the study indicated that effective integration of artificial intelligence requires its systematic integration into the curriculum as well as the provision of professional development to teachers, which is in line with current research trends that examine challenges and opportunities from teachers' perspectives.

The use and employment of technology is the main driver of the digital revolution, and it has become considered one of the most important skills that have been called twenty-first century skills, and represents a major component of the modern entrepreneurial education system. One of the most important fields currently emerging in educational technology is artificial intelligence, which has many Applications in Education (AIEd). With its many components, it has become an effective and influential part of the educational process, and a trend has been observed. Globally, these applications are widely relied upon in most educational fields; this is due to its ease of handling, low cost, and ability to manage, store and transfer a huge amount of information and data, etc. Therefore, we find that the gifted and creative education system includes "students, teachers, and administrators". With the distinctive abilities and capabilities, they possess that make them more qualified and prepared to interact and deal with artificial intelligence applications. Nevertheless, the predominant character of regional literature remains descriptive, with weak analytical differentiation between types of obstacles, which calls for a model that highlights the sources of obstacles and compares them. Based on the above, and in light of the scarcity of studies that dealt with the use and employment of AI techniques in schools and programs for the gifted in Jordan. Supporting this gap, Al-Bawaleez and Turki [41] examine artificial intelligence in gifted schools in Jordan, describing its role, practices, and impact on teaching and learning. Furthermore, the study supports the theme of "opportunities" by emphasizing personalized learning, feedback, and automation, and hints at the theme of "challenges" related to implementation requirements, support, and professional development, which will be examined in greater detail in our research. To enhance the analytical nature of the study, this research adopts an interpretive framework that views the implementation of artificial intelligence in schools as the product of the interaction of three levels: (1) institutional/administrative factors such as policies, support, and incentives; (2) technological factors such as infrastructure, internet access, and the availability of tools and technical support; and (3) human/professional factors related to teachers' competencies, attitudes, and beliefs. Accordingly, the study does not merely describe the challenges and opportunities, but rather classifies and interprets them within these levels. In light of the necessities imposed by the developments of the modern era, which call for the use of artificial intelligence techniques, to produce modern educational solutions and methods, changing traditional educational methods, to create an educational environment that is consistent with the digital revolution, to raise the level of talented and creative people who create development and prosperity in the future. In addition to contributing to the literature on educational technology in general, and artificial intelligence in particular, in schools and programs for gifted and talented in Jordan, this study also intends to contribute to the literature on online education.

Based on the above, the study does not merely present what is stated in the literature, but seeks to analyze it through a clear distinction between the types of obstacles that teachers of the gifted face. Despite the fact that previous studies

provided descriptive insights, they tended to summarize the obstacles and challenges. It is therefore necessary to offer a clear analytical distinction between the types of barriers that gifted-education teachers encounter. A great deal of regional studies research has focused on the perspectives of the local communities, such as in [24, 38], on enrichment programs [28, 35] or on conceptual discussions, without much discussion of underlying challenges. Furthermore, the previous papers developed during the early adoption of AI integration have concentrated on documenting current realities rather than building analytical models that can distinguish between personal, technological, and institutional constraints. In this regard, Zogopoulos *et al.* [42] demonstrated that artificial intelligence can improve education through personalized learning, feedback, and efficiency, but it also raises concerns about privacy, over-reliance, and the diminishing role of the teacher. According to the study, successful integration requires professional training for teachers and clear regulatory frameworks to ensure its equitable and ethical implementation.

From a programmatic perspective, using a four-dimensional framework (impact, content, process, and product), Ecker *et al.* [43] demonstrate that integrating AI-assisted instruction into gifted education programs expands the opportunity for individualization and enables advanced content and interactive learning environments. As a result of this integration, educators are able to overcome traditional limitations and create more dynamic and challenging learning environments that meet the developmental needs of gifted students.

Furthermore, as the field of artificial intelligence continues to develop, there is a growing need for students to explore how different groups of teachers incorporate AI into their classes. A structured analytical lens was used in this study as a rationale for adopting a structured analytical approach. Consistent with this analytical orientation, Ali [44] synthesized a critical review that artificial intelligence is reshaping education by supporting personalized learning, predictive analytics, automated assessment, and interactive learning environments, with tools evolving from rule-based teaching systems to adaptive and generative data-driven solutions. The study also emphasized that the success of this transformation requires addressing fundamental challenges such as digital inequality, data privacy, algorithmic bias, and over-reliance, while highlighting future trends such as human-AI collaboration, explainable intelligence, and immersive learning.

In this study, the main challenge is to answer the following question:

Exploring the opportunities and challenges of AI In gifted education?

Based on the main question, the following sub-questions arise:

1) What is the degree of use of AI techniques in gifted schools in Jordan from the point of view of teachers?
2) What are the most important dimensions of the challenges of using AI techniques in gifted schools in Jordan from the point of view of teachers?
3) What are the most prominent opportunities for applying AI in gifted and creative schools in Jordan from the point of view of teachers?
4) Do the study sample members' estimates of the challenges and opportunities of using AI techniques differ gifted and creative schools in Jordan according to some demographic variables?

III. Materials and Methods

A. Study Design

All This study investigates the challenges and opportunities introduced by AI in gifted education. The researchers used the Descriptive Research method, as it is considered the most appropriate for this purpose. It depends on defining the characteristics of the phenomenon, as well as the relationship between its variables, causes, and trends, are necessary to identify its reality on the ground. A quantitative description is provided by numbers and tables describing its size and degree of interrelationship with other phenomena [45].

B. Population and Sample

582 teachers represent the teaching staff across the King Abduallah II Schools in various cities. In which is shown a flagship network for the education of gifted children. Since these schools operate across multiple governorates with a unified identification system and curriculum for gifted students, the sample is considered representative of teachers working in formal gifted-education settings. Participants in the study were both female and male teachers from the King Abdullah II Schools of Excellence located in the following cities in Jordan: Irbid, Salt, Zarqa, Mafraq, Jerash, Ajloun, Tafilah, Karak, Aqaba, Ma'an, Madaba, Al-Muqablin, and Sahab., who were enrolled in these schools through the 2nd semester two of 2023/2024 academic year, as their number reached (582) Teachers. Of these, 414 teachers completed the study scale, including 220 females (53.1%) and 194 males (46.9%). Table 1 presents the demographic characteristics of the study sample, including gender, scientific specialization, and years of work experience.

Table 1. Demographic characteristics of the study sample

Variable	Category	Frequency (*n*)	Percentage (%)
Gender	Male	194	46.9%
	Female	220	53.1%
Scientific Specialization	Humanities	207	50%
	Scientific disciplines	207	50%
Work Experience	Less than 5 years	69	16.7%
	5–10 years	147	35.5%
	10–15 years	102	24.6%
	More than 15 years	96	23.2%

Regarding scientific specialization, the distribution was balanced, with 207 teachers (50.0%) from the humanities and 207 teachers (50.0%) from scientific disciplines. In terms of work experience, 69 teachers (16.7%) had less than 5 years of experience, 147 teachers (35.5%) had between 5 and 10 years, 102 teachers (24.6%) had between 10 and 15 years, and 96 teachers (23.2%) had more than 15 years of experience.

C. Development and Implementation of the Study Scale

The development of the study scale involved reviewing several scientific studies that met the study's objectives and

goals. The most important of these were [2, 11, 32, 34, 36, 38]. Based on this review, three dimensions were used in this study: In the first dimension, demographic information such as academic qualification and gender was included, and scientific specialization. As part of the second dimension, a main variable was considered, which is the barriers connected with the application of AI in gifted schools. A sample of the forty-eight statements in this dimension is presented below:

- Lack of material and moral incentives for gifted teachers working on artificial intelligence applications.
- There are no artificial intelligence specialists available to provide technical support to gifted teachers.
- There is a lack of Internet access among gifted teachers, as well as the technology they need to utilize artificial intelligence.
- Gifted teachers believe that there is no clear comprehensive strategy for using AI applications in education.
- Gifted teachers believe that the availability, use and employment of AI in education will cause them to be dependent and stereotyped teachers.

According to each dimension, the total score of these statements was measured using a Likert 5-points scale.

D. Validity and Reliability

1) Validity

Refers to the evaluation of the study scale based on its clarity, the clarity of the meanings of its words, as it was reviewed by some experts in the fields of gifted education, curricula and teaching methods, measurement and evaluation. The reviewers modified a number of statements to ensure that the proposed data were suitable for the test. A test-retest method was also employed to ensure that the results of the 2nd and 3rd study tool's dimensions are reliable, in which a sample of the population was subjected to the scale twice within a period of 4 weeks. This study found a correlation coefficient of 0.91, and as such, it is considered acceptable for the purposes of this study.

2) Reliability

The Cronbach-Alpha equation was used to assess the reliability of the scale by determining its internal consistency. Moreover, Cronbach's alpha coefficient was .948, which is an acceptable value. Baumgartner *et al.* [46] concluded, based on this result, that a scale is considered to be stable and valid when the Cronbach's alpha coefficient exceeds 70% assuring the reliability and validity of the data utilized in the study.

IV. Result and Discussion

Researchers in the Arab world have documented concerns and possibilities related to the use of artificial intelligence in special education and gifted education, however the studies have focused on limited samples or a single dimension of practice. As an example, in Saudi Arabia, gifted programs and enrichment centers have reported trading barriers and infrastructure deficiencies. Turki [37] and Al-Ghamdi and Al-Abbasi [47] discussed program level issues and provided practical insights into teachers' classroom realities. Through the use of factor analysis, this study contributes to literature by bringing to light three distinct dimensions - personal, technological, and support related challenges. Furthermore, demographic differences should be identified. As a result, it is intended to contribute a comprehensive, grounded understanding of AI adoption in gifted education. As a means of operationalizing the study's objectives, a large national sample of gifted schools in Jordan was examined to determine teachers' perceptions. The role of AI in gifted education at King Abdullah II Schools for Excellence in Jordan is examined in this study. The study raised a number of questions, which are discussed below in more detail. What is the degree of use of artificial intelligence techniques in gifted schools in Jordan from the teachers' point of view? Accordingly, arithmetic means and SD were calculated as shown in Table 2.

Table 2. Arithmetic means and SD of the degree of use of AI technologies in gifted schools

Item	*N*	Mean	Std. Deviation
Mean all	414	3.5586	0.46784
Valid N (listwise)	414		

From a teacher's standpoint, the use of AI in Jordan's gifted schools was quite average, with an arithmetic mean of (3.55), and a SD of (0.467). These results indicate that teachers have begun to integrate artificial intelligence technologies into gifted education, but the use may not be comprehensive or at its highest levels, perhaps still in its early stages, and needs a lot of development and enhancement. It is also possible that there is a difference in the use of AI by some schools more intensively than others, especially schools located in the capital and nearby governorates for provide financial, technical and technological capabilities. In general, there are ongoing efforts in gifted schools in Jordan to use artificial intelligence, but there is still a large room for expansion and improvement to reach a higher and more comprehensive level of use.

What are the most important dimensions of the challenges of using artificial intelligence techniques in gifted schools in Jordan from the point of view of teachers?

It was found that factor analysis was the most effective method for answering this question. The eigenvalues (>1) of the extracted 3-factors and the variance percentage, along with the cumulative variance percentage for the dimensions were presented in Table 3.

Table 3. Eigenvalues and explained variance of the study scale factors

Factor no.	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	23.94	49.87	49.87	23.94	49.87	49.87	19.49	40.61	40.61
2	8.18	17.06	66.93	8.18	17.06	66.93	6.90	14.37	14.37
3	2.091	4.35	71.29	2.091	4.35	71.29	4.76	9.93	9.93

Table 3 shows that the three factors explained 71.29% of the total variance. The 1st factor represented 23.94% of the

total variance of the factors. This is a high percentage compared to the other dimensions. This is illustrated in Fig. 1, which presents the graphical representation of the latent roots (Eigenvalues).

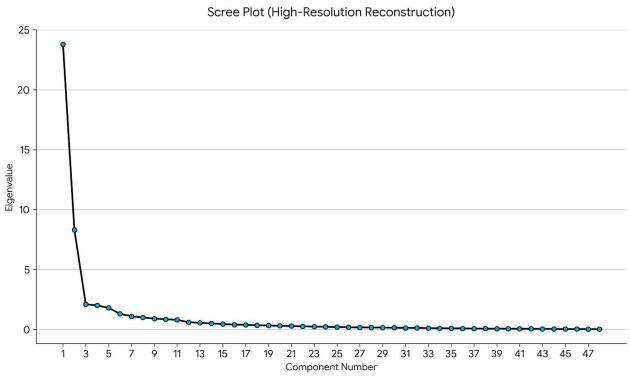

Fig. 1. Graphical representation of latent roots (Eigenvalues).

Table 4. Varimax-Rotated factor loadings for the three factors of AI-related challenges

Dimension no.	Factor no. 1	Factor no. 2	Factor no. 3
Q1			0.605
Q2			0.660
Q4		0.706	
Q5	0.652		
Q7			0.820
Q8			0.604
Q9	0.735		
Q10	0.669		
Q11		0.798	
Q12		0.692	
Q15		0.631	
Q17	0.767		
Q18	0.692		
Q19	0.704		
Q20	0.647		
Q21	0.655		
Q23	0.626		
Q25			0.614
Q27		0.759	
Q28	0.665		
Q30		0.755	
Q32	0.866		
Q33	0.888		
Q34	0.899		
Q35		0.681	
Q36	0.907		
Q37	0.948		
Q38	0.881		
Q39	0.886		
Q40	0.913		
Q41	0.913		
Q42	0.934		
Q43	0.915		
Q44	0.802		
Q45	0.827		
Q46	0.801		
Q47	0.928		
Q48	0.908		

Note: Extraction method: Principal Component Analysis; Rotation method: Varimax with Kaiser normalization

Table 4 provides evidence that the first factor, which explained 23.94%, was strongly saturated with a large group of dimensions, namely (5, 9, 10, 17, 18, 19, 20, 21, 23, 28, 32, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48). In general, these dimensions describe the beliefs, opinions and perceptions of teachers of gifted concerning the use and integration of AI in education. Therefore, this factor: "The obstacles and personal challenges faced by teachers of gifted students in adopting and employing artificial intelligence in the educational process for the gifted". However, this finding is a key factor in understanding how gifted teachers deal with modern technological developments.

Barriers and challenges may be related to a lack of confidence in the effectiveness of AI at this point in time, or a lack of the skills and knowledge necessary to use it effectively. In addition, this finding may reflect resistance to change, where teachers feel uncomfortable or anxious about changing their traditional methods. Time and administrative challenges may also be an influential factor, where gifted teachers find it difficult to allocate the time or resources necessary to explore this rapidly evolving technology. Finally, these barriers may reflect feelings of anxiety or psychological pressure that teachers face as a result of high-performance expectations from gifted students, highlighting the importance of supporting them through training and guidance to assist the application of AI in education for the gifted.

The second factor represents 17.06% of the total variance. It was strongly saturated by a number of dimensions [4, 11, 12, 15, 27, 30, 35].

These dimensions refer to the set of challenges and difficulties that teachers of the gifted face when trying to adopt and apply artificial intelligence in the educational process for the gifted. Therefore, we can call this dimension "Obstacles and challenges related to resources and technology in the use of artificial intelligence". This dimension reflects the multiple difficulties that gifted teachers face in applying AI in the educational process for gifted students. Gifted teachers show great concern about the time and effort required to use and employ AI, as they see that integrating these technologies into education requires a large investment of human and material resources, which may be an additional burden on them in light of daily work pressures.

They also point to the unsuitability of the educational infrastructure of devices and programs to implement AI, such as the lack of applications that support the Arabic language, which negatively affects their ability to achieve the potential benefits of this technology. Old or inappropriate technologies may frustrate teachers and limit their ability to provide a distinguished educational experience for students. In addition, there is difficulty in transporting AI devices and equipment to classrooms, if they are available at all. This process requires careful coordination and logistical planning, which increases the complexity of the effective utilization of this technology in classrooms. Additionally, gifted teachers are concerned about the issue of data protection and privacy when using AI in the educational process.

The 3D factor accounted for 4.35% of the total variance. This work was saturated with a number of dimensions: [1, 2, 7, 8, 25]. These dimensions reflect the existence of a gap in the support provided and training available to teachers of the gifted in the field of employing AI, and we can call this factor "the lack of support and training in the application of artificial intelligence". This deficiency is related to a set of reasons, including the lack of material and moral incentives that encourage teachers of the gifted to adopt and activate artificial intelligence applications, which negatively affects their motivation and interest in this field. In addition, teachers suffer from the lack of appropriate training and qualification

for them before and during service, as well as the weak experience and capabilities of educational supervisors in this field, which leads to a lack of skills and knowledge necessary to apply these technologies effectively. The absence of technicians specializing in artificial intelligence to provide technical support is also considered a major obstacle, as teachers need continuous technical assistance to overcome any technical difficulties they may face.

Based on the findings of the factor analysis, it was concluded that there were three main challenges faced by teachers of gifted students in Jordan when making use of artificial intelligence: personal challenges, technological challenges, and lack of support and training. At this stage, teachers suffer from insufficient trust in the effectiveness of AI in improving the educational process. Many of them feel hesitant and afraid to deal with new technologies, and they believe that adopting artificial intelligence may threaten the traditional educational methods they rely on. These personal challenges indicate the existence of psychological and technical resistance related to their readiness to apply these modern technological tools in teaching gifted students. In addition, teachers face a lack of appropriate infrastructure to apply artificial intelligence in schools in general, including a lack of advanced devices, the unavailability of applications that support the Arabic language, etc. These challenges reflect an urgent need to develop the technological environment and educational infrastructure to support digital innovation in classrooms. In addition to the above, teachers of gifted students suffer from a lack of material and moral incentives that encourage them to adopt artificial intelligence, in addition to the absence of specialized training programs that provide them with the essential abilities to use this technology effectively.

These challenges highlight the gap between the need for professional and technical qualifications, and the support teachers receive to successfully implement AI in gifted education. Finally, these difficulties and challenges represent a great opportunity to improve the educational environment for gifted students in Jordan, as overcoming them can contribute to achieving positive and distinctive results for gifted students by integrating AI technology into the education, as a result, education is enhanced and creative abilities are developed. This result is somewhat intersected with the results of the study of [34, 36].

What are the most prominent opportunities for applying artificial intelligence in gifted and creative schools in Jordan from the point of view of teachers?

As a way of illustrating the importance of artificial intelligence opportunities in Jordanian gifted schools, we calculated the arithmetic means and standard deviations of the teacher's responses on a scale of 15 items.

Table 5 shows that the arithmetic mean of the gifted teachers' responses about the opportunities for applying artificial intelligence in gifted schools in Jordan is 3.74, which indicates a moderately positive evaluation of these opportunities. The standard deviation of 0.62 also reflects a moderate variation in teachers' opinions, meaning that there is a relative variation in their evaluation of the available opportunities. As a result, teachers assess opportunities differently, but in general, the view is positive. These results reflect that gifted teachers in Jordan have a general awareness of the opportunities for progress in applying artificial intelligence in gifted schools, and that it can play an important role in enhancing the educational process and developing students' abilities and talents. However, there are still some reservations or concerns about how to implement it or its potential effects. There is a need to enhance these opportunities and clarify how to apply artificial intelligence more effectively in the gifted schools environment, and this can be enhanced through additional training and support for teachers, and providing appropriate tools and resources. This result is somewhat consistent with both the study [24, 38].

Table 5. Arithmetic means and SD of opportunities for applying AI in gifted schools

Item	*N*	Minimum	Maximum	Mean	Std. Deviation
mean1_15	414	2.27	5.00	3.7436	0.62408
Valid N (listwise)	414				

Do the study sample members' estimates of the challenges and opportunities of using artificial intelligence techniques differ gifted and creative schools in Jordan according to some demographic variables?

Firstly, the study sample members' estimates of the challenges and opportunities resulting from the implementation of artificial intelligence technologies in gifted schools in Jordan are based on the gender variable. It was found that the arithmetic mean and standard deviation for male teachers was 3.80, while the standard deviation for female teachers was 0.372.

Table 6. Mean scores and standard deviations for AI-related challenges and opportunities by gender

Gender	*N*	Mean	Std. Deviation	Std. Error Mean
male	194	3.8027	0.43301	0.03109
female	220	3.3287	0.37206	0.02555

Using the gender variable in Table 6, there appears to be a discrepancy in the arithmetic means and SD of the sample members' perceptions of the challenges and opportunities resulting from implementing artificial intelligence technologies among gifted schools in Jordan. A statistical difference between the arithmetic means was found to be significant using an independent samples test, as shown in Table 7 below.

Table 7. Independent samples t-test for gender differences in AI-related challenges and opportunities

Test Item	Assumption	*F*	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Overall Perception (Mean all)	Levene's Test for Equality of Variances	17.449	0.000							
	t-test (Equal variances assumed)			11.858	404	0.000	0.47402	0.03997	0.39544	0.55260
	t-test (Equal variances not assumed)			11.779	382.275	0.000	0.47402	0.04024	0.39489	0.55314

Based on Table 7, among gifted schools in Jordan, there are statistically significant differences in challenges and opportunities caused by the use of AI technologies in favor of male teachers, as F value reached 17.449 at a significance level of 0.000. Male teachers therefore tend to view the opportunities and challenges of AI more positively than female teachers. This difference may be attributed to several potential factors and variables, including that male teachers are more open to and receptive to technology, due to the availability of training opportunities and personal experiences more than female teachers, and It may be the case that female teachers are more cautious about integrating new technologies into their educational environments due to their concerns regarding the negative impacts on traditional education or their lack of access to resources and support necessary to effectively implement these technologies.

These differences may also be influenced by cultural factors. Secondly: to show the difference in the perceptions of the study sample of the challenges and opportunities resulting from the use of AI technologies among gifted schools in Jordan according to the scientific specializations. The arithmetic mean and SD were extracted. The arithmetic mean for human sciences was 3.769 with a SD of 0.452, while the arithmetic mean for scientific disciplines was 3.348 with a SD of 0.380 Table 8 shows this.

As shown in Table 8, there appears to be a discrepancy between the arithmetic means and SD of the sample members' perceptions of the challenges as well as opportunities resulting from the use of artificial AI technologies by gifted schools in Jordan based on their scientific specializations. Based on the independent samples test, based on the arithmetic means. Table 9 illustrates the significance of the statistical differences.

Table 8. Group statistics of ai challenges and opportunities by scientific specialization

Scientific Specializations	*N*	Mean	Std. Deviation	Std. Error Mean
human sciences	207	3.7690	0.45284	0.03147
scientific disciplines	207	3.3483	0.38056	0.02645

The results identified the existence of statistically significant differences in the challenges and opportunities resulting from the use of AI technologies among gifted schools in Jordan, and they came in favor of human sciences. As a result, teachers in the humanities tend to view AI opportunities and challenges more positively than teachers in the scientific disciplines. This can be referred back to the fact that teachers in the humanities see AI as an opportunity to adopt new technologies in education because they can help improve interaction and communication and between teachers and their students, enhance creativity and innovation, critical thinking, and facilitate assessment processes. Teachers in the sciences often face fewer challenges because they rely on clear and specific technologies, such as mathematical modeling and rigorous analysis, which require specific technical skills that AI may not need to radically improve. Thus, teachers in the humanities see AI as offering greater potential for developing innovative and interactive educational tools.

Table 9. Independent samples test of ai challenges and opportunities by scientific specialization

Test Item	Assumption	*F*	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Overall Perception (mean_all)	Levene's Test for Equality of Variances	19.304	0.000							
	t-test (Equal variances assumed)			10.233	412	0.000	0.42070	0.04111	0.33988	0.50152
	t-test (Equal variances not assumed)			10.233	400.140	0.000	0.42070	0.04111	0.33988	0.50153

Thirdly: To demonstrate the differences in the estimates of the study sample regarding the challenges and opportunities associated with the use of AI technologies in gifted schools in Jordan based on their work experiences. For the purpose of demonstrating the differences between the estimates of the challenges and opportunities resulting from using artificial intelligence technologies in gifted schools in Jordan according to their practical experience variables, an ANOVA analysis was conducted. A statistically significant difference was observed between teachers' estimates of the challenges and opportunities associated with the use of AI technologies in gifted schools in Jordan based on the practical experience variable, which indicated that the value of F reached 118.924, at a significance level of 0.00 as shown in Table 10 below.

Table 10. ANOVA results for AI challenges and opportunities by work experience

Source of Variation	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	42.060	3	14.020	118.924	0.000
Within Groups	48.335	410	0.118		
Total	90.396	413			

Using the Scheffé test, it was determined that teachers' estimates of challenges and opportunities resulting from using artificial intelligence technologies in gifted schools in Jordan differed based on the practical experience variable. This can be seen in Table 11 below.

Table 11. Scheffé post hoc test for ai challenges and opportunities by work experience

Work Experience	*N*	Subset for alpha = 0.05		
		1	2	3
5 to 10 year	147	3.2258		
less than 5 year	69		3.5099	
over 15 year	96		3.5710	
10 to 15 year	102			4.0596
Sig.		1.000	0.676	1.000

According to Table 11 the estimated number of teachers with 5 to 10 years of experience is (3.22), indicating that they were the most affected and the most negative in their estimates. Teachers with less than five experience years had an estimate of (3.50) and more than 15 years had an estimate of (3.57), indicating that their estimates were higher than the previous ones, and are generally moderate. Teachers with 10 to 15 years of experience had an estimate of (4.05), indicating that they were the most positive in their estimates of the challenges and opportunities of using AI in gifted schools in Jordan. This can be attributed to the fact that teachers with 10 to 15 years of experience may be at a stage of experience that combines technical knowledge with practical skills, and may

have received the necessary training and guidance to use these technologies effectively, making them better able to assess the opportunities and challenges associated with AI technologies. While new teachers (< than 5 years) or those with long expertise (>15 years) may be less exposed to these technologies or less adaptable to them.

V. Conclusion and Recommendations

In the age of digital technology, one of the important characteristic of which is the rapid developments in technology. AI has become a vital role in the education of the gifted due to its ability to meet their diverse educational needs in an individual and customized manner. Especially since gifted students are distinguished by their high cognitive abilities, quick learning and deep thinking, and therefore they need educational methods that go beyond the traditional pattern and are in line with their unique capabilities. Here comes the role of AI as a powerful tool that enables the design of unconventional educational programs and provides educational content that suits their level and interests. It also provides additional challenges that enhance their critical and creative thinking. An overview of challenges and opportunities associated with the application of AI in gifted education was presented in this study from the perspective of teachers in general and Jordanian teachers in particular. It showed us that the level of use of AI technologies in gifted schools was average. Despite the great potential of these technologies in improving the educational process, the reality indicates that their application has not yet reached the desired level in Jordan. This reflects a set of challenges that must be addressed to make the most of them. The challenges were limited to three main factors: personal challenges, technological challenges, and support and training challenges. Furthermore, it was found that there is a general positive view of the opportunities that artificial intelligence can provide for gifted education .

Therefore, by addressing the current challenges and taking advantage of the available opportunities, a qualitative shift can be achieved in the way gifted students are taught in Jordan. There should be greater investment in developing the infrastructure and providing the necessary training for teachers that takes into account their needs and differences among them, to ensure maximum benefit from the potential offered by artificial intelligence in enhancing gifted education. Teachers express their appreciation for the potential that these technologies may hold, especially in customizing education according to the needs of gifted students. This positive outlook represents a fertile ground that can be built upon to achieve qualitative leaps in gifted education in Jordan and emerging countries as well. Therefore, the application of AI in education requires raising awareness of its importance and potential among all stakeholders, including teachers, students, and parents.

Organizing awareness campaigns and specialized workshops may contribute to changing the perception of these technologies and promoting their wider use. It is also imperative that teachers receive specialized training in the use of AI in the classroom. Continuous training helps enhance teachers' confidence in their ability to deal with new technologies and contributes to improving educational outcomes. It is also necessary to work on developing and improving the technological infrastructure in gifted schools so that schools are equipped with the latest technologies and tools that facilitate the application of artificial intelligence.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

SA contributed to the literature review, research questions, methodology, results, and discussion. AH contributed to the introduction, methodology, and discussion. YJ contributed to the introduction and literature review. All authors had approved the final version.

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