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# The Level of Science and Mathematics Teachers' Employment of Artificial Intelligence Applications in the Educational Process

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## Abstract

The study aimed to identify the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process in Jordan from their point of view. The study followed the descriptive method to achieve the objectives of the study. A questionnaire consisting of 22 items was developed, and the study sample consisted of 358 male and female teachers. The results showed that the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process was moderate. It also showed that there are statistically significant differences between genders in favor of female teachers at the level of employing artificial intelligence applications; there were no differences due to specialization. The study recommended shedding light on new services and applications provided by artificial intelligence in teaching and learning, publishing them, and introducing teachers to them through teaching methods and educational activities.

## Introduction

Artificial intelligence, with its various uses and applications, as an applied science, has become the backbone of daily life, affecting the human race in its present and future. It has become an indispensable reality in light of the tremendous technical development which the world is witnessing. Rather, it is a tangible reality today and what this development can represent in terms of complete dependence in the life of humanity on the computer in the smallest details of daily life through the information revolution and technical trends. In addition, it is an implicit reference to cultural communication and technical communication between people in various parts of the world. Artificial intelligence has an important role in many fields, such as the modern educational and educational process, and it represents an urgent necessity whose applications cannot be dispensed with (Karsenti, 2019). There has been increased interest in researching the possibility of harnessing artificial intelligence to support the educational process, enhance learning environments, and work on developing teaching methods and transforming them from indoctrination to creativity (Farzaneh et al., 2019). Artificial intelligence and its applications have a role in improving and developing all areas of life, through the development of computer systems to operate with superior efficiency similar to the competence of an expert human being (Mahmoud, 2020). Artificial intelligence can also contribute to the development of science and mathematics curricula by continuously updating lessons

and presenting them to students in a manner commensurate with their needs and abilities through artificial intelligence (Al-Qutaish, 2022).

The most important characteristics of artificial intelligence applications in science and mathematics are great speed, high accuracy, and long working periods. It is also characterized by high efficiency in data management, the ability to extrapolate, extrapolate and deduce, deal with conflicting data, and symbolically represent information. In addition, it can learn, acquire knowledge, and apply it procedurally (Topal et al., 2021). Artificial intelligence applications can make the learning environment a smart environment by helping to analyze students' learning behavior and provide them with appropriate support. They allow students to participate and interact and provide them with an ideal learning environment. They also provide analysis and support to help teachers improve their teaching methods and real-time assessment of the impact of learning activities on student engagement and academic outcomes (Zarrouki & Falata, 2020). Al-Atl and Al-Anzi (2021) added that the use of artificial intelligence applications in education helps to improve the student's leadership level by teaching them. He can follow the interactive and educational steps explaining the scientific material, practicing tests, and knowing the correct answers. This, in turn, leads to assessing himself and knowing his level and increasing the creative and imaginative ability of the student, using graphic and photographic programs in highlighting the scientific material.

In the same context, robots have been employed in STEM education (meaning the integration of science, mathematics, engineering, and technology). Countries, including Jordan, have begun to adopt this education, which includes technology, and part of it is the applications of artificial intelligence and robotics (Al-Kanaan, 2021). This interest shows the need to employ artificial intelligence applications in teaching science and mathematics. In this context, many studies have emphasized the employment of artificial intelligence applications in education in general and the teaching of science and mathematics in particular, such as Mahmoud's (2020) study, which emphasized the need to employ artificial intelligence applications in educational institutions, raise awareness of the positive effects of artificial intelligence, and train teachers on it. Murphy (2019) also confirmed the interest of teachers in employing applications that take advantage of the capabilities of artificial intelligence in education.

Artificial intelligence offers us many capabilities that we need to employ with the digital generation that is indispensable to technology. Preparing for the future requires employing artificial intelligence applications in teaching scientific subjects (Aldosari, 2020). It is time to get our teachers ready for it; science and mathematics are among the subjects that have their place in the educational system and are of particular importance among other subjects. It is imperative to diversify the methods of presenting them to suit the learner. Hence, there is a deer need to carry out this study to identify the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process from their point of view.

## Review of Literature

The literature on the topic of the current study has been reviewed. Al-Roumi and Al-Qahtani (2023) conducted a study aimed at determining the skills of employing artificial intelligence applications in improving learning

outcomes for secondary school students in Saudi Arabia. The study used the descriptive approach, and a questionnaire was applied to a sample of 414 male and female managers. It concluded that the high role of the skills of employing artificial intelligence applications in improving student learning outcomes and the weakness of applied reality in secondary schools. Man (2021) also examined the opportunities and challenges faced by educational leadership based on artificial intelligence in the field of education in China by classifying the advanced global progress of artificial intelligence in education and analyzing the latest theoretical and practical results of artificial intelligence in education. The results showed that the opportunities brought by artificial intelligence in education are greater than the challenges. The study found that this significantly affects the direction and pace of global education reform. Thus, education should follow the trend of updating educational goals and implications promptly. Al-Atl and Al-Anzi (2021) identified the importance of artificial intelligence technology in the educational process and the challenges facing its use in education in the State of Kuwait. The descriptive approach was used, and the study sample consisted of 229 male and female students, to whom a questionnaire was applied. The results showed that artificial intelligence technology has importance in the educational process. It allows students to learn at any time and anywhere in the world and provides flexibility in presenting scientific material to suit students' abilities and students and teachers with feedback. It also concluded some challenges, including the lack of specialists and experts in artificial intelligence technology and its employment in the educational process.

Tyson and Sauers (2021) conducted a study in the US state of Georgia to examine the experiences of school leaders in adopting and implementing artificial intelligence systems in their schools. To achieve this goal, the study adopted the qualitative case study methodology by interviewing seven individuals who have adopted artificial intelligence programs in their schools. The results showed that the prevalence of Artificial intelligence applications among school leaders depends on the clarity of the adoption and implementation of Artificial intelligence applications. The results also indicated that school leaders actively participated in the training related to the adoption and implementation of artificial intelligence. Al-Kanaan’s (2021) study explored the level of awareness of employing artificial intelligence applications in science education among female science teachers before serving in Saudi Arabia. The descriptive survey method was used, and a questionnaire was applied to a sample of (43) female teachers. The study revealed a low level of pre-service science teachers' awareness of employing artificial intelligence applications in science education as a whole. Al-Awfi and Al-Rahili (2021) aimed to identify the possibility of employing artificial intelligence applications in developing innovative abilities in teaching mathematics among secondary school students in Saudi Arabia. To collect data, a questionnaire was prepared and applied to (150) female teachers. The study concluded that mathematics teachers have a medium level of knowledge of artificial intelligence applications in developing innovative capabilities. The results also showed that there was no difference due to the variable of educational qualification and years of experience.

Al-Ghamdi and Al-Frani (2021) revealed the reality of special education teachers’ use of educational applications of artificial intelligence and the trend towards them from the teachers’ point of view at Al-Noor Institute in Jeddah Governorate. The descriptive approach was used, and a questionnaire was applied to (27) female teachers. The results showed that the domain of the importance of using educational applications of artificial intelligence received a strongly agreed degree. Murphy (2019) showed three types of applications based on artificial

intelligence: intelligent teaching systems that provide adaptive and personalized learning for students, automatic correction of essay exams, and early warning systems for students academically.

**Statement of the Problem**

Artificial intelligence applications in education contribute to planning, evaluation, training, education, and acquiring skills in various fields, which contributes to learners achieving academic excellence (Incerti, 2020). Numerous studies have confirmed that the concept of artificial intelligence and its applications in education are among the modern trends that top the list of research and scientific interests in all countries. Many international conferences have been held on artificial intelligence and its application in the educational process (Chassignol et al., 2018). Studies, such as Incerti (2020) Sangapu (2018), and Khanlari (2014) recommended studying teachers' perceptions of employing artificial intelligence and its applications in education. From this standpoint, this study identified the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process in Jordan by answering the following questions:

1- What is the degree of science and mathematics teachers' employment of artificial intelligence applications in the educational process from their point of view?

2- Are there statistically significant differences ($\alpha \leq 0.05$) between the means of the study sample's responses of the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process due to the variables of gender and specialization?

**Objectives of the Study**

The current study aimed to identify the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process from their point of view. It also revealed differences between the mean of the study sample's estimates of the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process due to the variables of gender and specialization.

**Significance of the Study**

The study is a response to what educators call for the need to develop science and mathematics education in the light of scientific and technical progress on an ongoing basis. At the theoretical level, the study gained its significance by addressing an important research area represented in the employment of artificial intelligence in science and mathematics education. This research may contribute to shedding light on how artificial intelligence can be used in education. It may also enrich the Arab library in general and the local one in particular in terms of providing a theoretical framework dealing with the subject of artificial intelligence to benefit researchers in conducting other studies. At the applied level, it is hoped that the study will direct the attention of specialists and decision-makers in the Ministry of Education to the necessity of adopting the use of educational applications of artificial intelligence within its plans. This would contribute to developing teaching strategies used in schools in general and the teaching of science and mathematics in particular.

**Key Terms of the Study**

*Artificial intelligence applications:* These are "A set of methods and systems capable of performing various tasks that simulate the capabilities of human intelligence, such as thinking, analysis, learning, and problem-solving. They include smart systems, interactive chatbots, augmented and virtual reality applications, and the Internet of things in educational situations that contribute to increasing Effectiveness and learning" (Al-Qahtani & Al-Dayel, 2021, p. 178).

*Mathematics or science teachers:* Teachers who specialize in mathematics or science and teach students in the basic or secondary stages in the governmental schools of the Mafraq District.

**Delimitations of the Study**

The study was limited to the topic of employing artificial intelligence applications in education. Also, the study was limited to Kasaba Al-Mafraq government schools. In addition, it was implemented in the academic year 2022/2023. Finally, it was applied to a sample of mathematics and science teachers in Kasaba Al-Mafraq schools.

## Methods

The descriptive approach was used as it suits the nature and objectives of this study.

**Population and Sample of the Study**

The study population consisted of all teachers of mathematics and science in Kasbah Al-Mafraq government schools, numbered (341) mathematics teachers and (286) science teachers in the academic year 2022/2023. A random sample was selected, consisting of (187) male and female mathematics teachers and (171) science teachers. Table 1 shows the distribution of the study sample according to their demographic variables.

Table 1. Description of the Study Sample according to Variables

| Variable | Group | Freq. | % | Total |
|---|---|---|---|---|
| Gender | Male | 167 | %46.6 | 358 |
| | Female | 192 | %53.4 | |
| Specialization | Mathematics | 187 | %52.2 | 358 |
| | Science | 171 | %47.8 | |

**Study Tool**

A questionnaire was built according to a five-point Likert scale, and it consisted in its initial form of (24) items after reviewing the relevant theoretical literature and previous studies.

**Validity**

The study tool was presented to 13 specialists and experts in artificial intelligence and educational and educational technology. They were asked to express their opinions and observations about the correctness of the paragraphs of the tool. Based on their observations and opinions, some items were amended and deleted so that the final form consisted of (22) items.

**Reliability**

To ensure the reliability of the tool, the test-retest method was used by applying the study tool and re-applying it after two weeks to a group outside the study sample consisting of (36) male and female teachers. Then, the reliability coefficient was calculated using the internal consistency method according to the Cronbach alpha equation. It scored (0.91), which is a high coefficient and indicates the questionnaire's reliability.

**Data Analysis**

The study used some statistical methods commensurate with the tool's nature: means, standard deviations, two-way analysis of variance (ANOVA), and Cronbach alpha coefficient. To judge the means of the respondents' responses to the items, a five-point Likert scale was adopted in the correction, and the mean values were determined as follows: less than (2.33) low, (2.34-3.67) medium, (3.68-5) high.

## Results and Discussion

**Results and discussion of the first research question: What is the degree of science and mathematics teachers' employment of artificial intelligence applications in the educational process from their point of view?**

To answer this question, the means and standard deviations were extracted for each item of the study tool, as shown in Table 2.

Table 2. Means and Standard Deviations for Items of the Level of Science and Mathematics Teachers' Employment of Artificial Intelligence Applications in the Educational Process, arranged in Descending Order

| Rank | No. | Item | Mean | Standard deviation | Level |
|---|---|---|---|---|---|
| 1 | 14 | I develop the skills of some types of thinking using artificial intelligence techniques, such as critical, creative, reflective, and imaginative thinking. | 4.09 | 0.96 | High |
| 2 | 1 | I use written, image, and voice search engines that work with artificial intelligence technology. | 3.99 | 0.94 | High |
| 3 | 10 | I use artificial intelligence translation apps like Google Translate. | 3.97 | 0.97 | High |

| Rank | No. | Item | Mean | Standard deviation | Level |
|---|---|---|---|---|---|
| 4 | 2 | I motivate students by designing interactive activities with specific goals, such as games and simulations. | 3.89 | 0.912 | High |
| 5 | 11 | I use the Internet of Things technology to help me complete my scientific tasks faster. | 3.85 | 0.97 | High |
| 6 | 5 | I add a kind of vitality and attractiveness when presenting the educational material by employing artificial intelligence applications. | 3.81 | 1.05 | High |
| 7 | 20 | I interact with Chabot. | 3.74 | 1.03 | High |
| 8 | 16 | I use artificial intelligence applications to determine the subjects that students prefer. | 3.66 | 0.95 | Medium |
| 9 | 19 | I employ virtual reality applications in education. | 3.65 | 0.990 | Medium |
| 10 | 7 | I generate questions according to students' levels using expert systems. | 3.63 | 0.96 | Medium |
| 11 | 18 | I analyze exam results using artificial intelligence applications to choose the best type of evaluation. | 3.62 | 1.12 | Medium |
| 12 | 15 | I create a system that allows students to interact with the academic content. | 3.60 | 1.03 | Medium |
| 13 | 17 | I use artificial intelligence applications to determine the most effective methods in the learning process. | 3.51 | 0.95 | Medium |
| 14 | 13 | I develop students' scientific research skills by adopting artificial intelligence techniques. | 3.50 | 1.11 | Medium |
| 15 | 12 | I employ personal assistants in the mobile phone to search for information such as Siri and Bixby. | 3.36 | 1.32 | Medium |
| 16 | 6 | I provide feedback to students using artificial intelligence applications. | 3.13 | 0.84 | Medium |
| 17 | 21 | I create lessons with smart digital content using artificial intelligence. | 3.08 | 0.95 | Medium |
| 18 | 4 | I encourage interaction between me and the students, and the students themselves using collaborative learning frameworks suitable for Artificial intelligence applications. | 3.03 | 0.93 | Medium |
| 19 | 3 | I provide realistic examples of the content of the lesson by employing augmented reality technology. | 3.01 | 0.86 | Medium |
| 20 | 9 | I prepare educational activities using artificial intelligence technology that take into account individual differences among students. | 2.97 | 099 | Medium |
| 21 | 22 | I spread the culture of artificial intelligence among students. | 2.88 | 1.02 | Medium |
| 22 | 8 | I enrich the programs to students using artificial | 2.81 | 1.05 | Medium |

| Rank | No. | Item | Mean | Standard deviation | Level |
|---|---|---|---|---|---|
| | | intelligence techniques based on a STEM approach. | | | |
| | | Total | 3.49 | 0.79 | High |

The results in Table 2 show that the average level of science and mathematics teachers' employment of artificial intelligence applications in the educational process at the macro level came to a moderate degree with a mean of (3.49) and a standard deviation (0.79). Item (14) “I develop the skills of some types of thinking using artificial intelligence techniques, such as critical, creative, reflective and imaginative thinking” ranked first with a mean of (4.09), a standard deviation of (0.96), and a high degree. The rest of the most employed items of artificial intelligence applications in the educational process that came with a high degree talk about the use of written, image, and audio search engines and translation applications that work with artificial intelligence technology. They also included motivating students to design interactive activities with specific goals, such as games and simulations using the Internet of Things technology that added attraction when presenting the educational material by employing artificial intelligence applications and interacting with interactive Chabot. This result may be due to the respondents realizing that artificial intelligence techniques are among the tools that stimulate creativity, imagination, and thinking in particular. Also, these technologies depend in their design, implementation, and applications on creative, innovative, and reflective thinking. In addition, by following up on the experiences of others in using these technologies, the respondents formed a desire to use them, especially with the consequent success stories that the respondents would like to write for the benefit of individuals and society.

Moreover, the study sample believes that the impact of artificial intelligence techniques is direct and clear in developing students' thinking skills, due to the correlation of the performance of these technologies with mathematics, algorithms, and the like. Item (8) “I enrich the programs to students using artificial intelligence techniques according to the STEM approach” ranked last, with a mean of (2.81), a standard deviation of (1.05), and a moderate degree. The least employed items of artificial intelligence applications in the educational process were moderate. They included spreading the culture of artificial intelligence among students and preparing educational activities using artificial intelligence technology that takes into account individual differences among students while providing realistic examples using augmented reality technology. Also, they included encouragement for interaction between the teacher and students and students themselves, preparing lessons with smart digital content using artificial intelligence, providing feedback to students using artificial intelligence applications, and employing personal assistants on mobile phones to search for information. This result may be attributed to the fact that the STEM approach is still new to them in the educational field. Especially, since this approach requires a lot of financial resources, in addition to the lack of capabilities through which this approach can be applied due to its many requirements and the relative newness of these technologies in the educational field. In addition, the result may be due to the lack of technical and qualified cadres who are aware of the implications of these technologies. In addition, the simplicity of their information and knowledge of these technologies in a way does not help them to overcome and solve any problem that may arise in these technologies and their uses, which requires reviewing successive developments in this field, whether courses, conferences, or seminars.

Artificial intelligence applications may not be available at present, and it can also be said that it is due to the absence of a department specialized in artificial intelligence in the ministry, and the scarcity of sources in Arabic that dealt with this subject and on which it can be relied upon. This result is consistent with that of Al-Awfi and Al-Rehaili (2021), who showed that female mathematics teachers have an average level of knowledge of artificial intelligence applications. Additionally, Al-Atl and Al-Anzi (2021) showed that artificial intelligence technology is important in the educational process, as it allows learning for students at any time and anywhere in the world and provides flexibility in presenting scientific material in a way that suits students' capabilities and students and teachers alike with feedback. However, the result is inconsistent with that of Al-Roumi and Al-Qahtani (2023), who showed the weakness of the reality of employing artificial intelligence applications in secondary schools, and that of Al-Kanaan (2021), who revealed the low level of pre-service science teachers' awareness of employing artificial intelligence applications in science education as a whole. Moreover, Al-Ghamdi and Al-Frani (2021 showed that the domain of the importance of using educational applications for artificial intelligence obtained a strongly agreed degree.

**Results and discussion of the second research question: Are there statistically significant differences ($\alpha \leq 0.05$) between the means of the study sample's responses of the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process due to the variables of gender and specialization?**

To answer this question, the means and standard deviations of the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process were extracted according to the variables of gender and specialization. Table 3 depicts the results.

Table 3. Means and Standard Deviations of the Level of Science and Mathematics Teachers' Employment of Artificial Intelligence Applications in the Educational Process according to the Variables of Gender and Specialization

| Variable | Group | Mean | Standard deviation |
|---|---|---|---|
| Gender | Male | 3.42 | 0.95 |
| | Female | 3.69 | 0.88 |
| Specialization | Mathematics | 3.58 | 0.82 |
| | Science | 3.63 | 0.86 |

Table 3 shows apparent differences between the means of the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process according to the variables of gender and specialization. To find out if these differences were statistically significant, two-way analysis of variance (ANOVA) was used. Table 4 shows the results.

Table 4. Two-way Analysis of Variance (ANOVA)

| Source | Sum of squares | df | Mean of squares | f | Sig. |
|---|---|---|---|---|---|
| Gender | 4.308 | 1 | 4.308 | 6.267 | 0.013* |
| Specialization | 1.589 | 1 | 1.589 | 1.156 | 0.316 |
| Error | 244,572 | 356 | 687 | | |
| Total | 1858.127 | 358 | | | |

*Statistically significant ($\alpha \leq 0.05$)

Table 4 shows that there were statistically significant differences at the significance level ($\alpha \leq 0.05$) between the means of the study sample's responses of the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process, due to the gender variable. The value of f was (6.267), and the significance level was (0.013). The differences came in favor of female teachers. This result may be because female mathematics and science teachers, in light of the contemporary changes and the information and technology revolution, have become passionate about learning and searching for technical applications. They benefit from those technological tools based on artificial intelligence in acquiring skills and knowledge in a variety of ways according to their needs in a manner consistent with the digital age in which we live. They also have positive attitudes toward employing artificial intelligence applications in education. This result means that teachers realize the importance and usefulness of these applications in the educational process. It is also evident from Table 4 that there were no statistically significant differences at the significance level of ($\alpha \leq 0.05$) between the means of the study sample's responses of the level of science and mathematics teachers' employment of artificial intelligence applications in the educational process due to the variable of specialization. The value of f was (1.156), and the significance level scored (0.316). This result may be due to the novelty of artificial intelligence and the lack of its applications that can be employed in science and mathematics education. Also, the applications of artificial intelligence were not addressed in the program for preparing new teachers for both majors. Likewise, pre-service science and mathematics teachers during university studies did not see faculty members employing artificial intelligence applications in their lectures.

## Recommendations

In light of the results of this study, the researchers recommended shedding light on the new services and applications provided by artificial intelligence in the field of teaching and learning, publishing them, and introducing them to teachers through teaching methods and educational activities. Also, there is a need for science and mathematics teachers, especially males, to pay attention to the use of artificial intelligence applications in teaching and learning because of its importance in developing teaching methods. In addition, teachers should be made aware of the need to exploit artificial intelligence techniques according to the STEM approach. Moreover, the study recommended the inclusion of artificial intelligence and its applications in teaching science and mathematics in the program for preparing new teachers. Finally, the researchers recommend conducting a study to detect the effectiveness of a training program for developing the performance of mathematics or science teachers using artificial intelligence applications.

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