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# The Effectiveness Of Educational Robots In Enhancing Ninth-Grade Students' Motivation To Learn Physics In Jordan

**Rana Mohamed Amro[1], Khaleel Al-Said[2]**
[1,2]Department of Educational Technology, Faculty of Arts and Educational Sciences, Middle East University, Amman, Jordan

***Abstract*** *:*
*The study aimed to investigate the effectiveness of educational robots in enhancing the motivation of ninth-grade students in Jordan to learn physics. To achieve this goal, the quasi-experimental design was employed. A scale was developed to measure the use of educational robots in promoting motivation toward learning physics. After verifying the validity and reliability of the scale, it was applied to both the control and experimental groups, which consisted of a total of 60 students, with 30 students in each group, during the first semester of the academic year 2024/2025. , he results revealed statistically significant differences ($\alpha$ = 0.05) between the mean scores on the motivation scale in favor of the experimental group, which are attributed to the use of educational robots. The findings also indicated a high level of effectiveness based on the Eta squared value ($\eta^2$ = 0.90), demonstrating a strong effect of using educational robots on students' motivation to learn physics. Based on these results, the study recommends the use of educational robots as an effective instructional tool in teaching physics to ninth-grade students.*

***Keywords***: *Educational robots, motivation to learn physics.*

## INTRODUCTION

With the accelerating pace of technological development, it has become necessary to constantly re-evaluate and update educational methods. This development has led to a radical change in the educational process, which requires keeping up with everything new and working to include it within the educational process. This contributes to building a flexible educational system capable of keeping pace with rapid changes, with the aim of enhancing the concept of lifelong learning, and motivating students to adapt to an era Constantly evolving and renewing, modern technology has made education more enjoyable and effective, particularly through technologies related to artificial intelligence and other modern technologies. These technologies improve the quality of education and open up new horizons that align with educational goals that seek to advance the educational process.

Physics is a dynamic scientific subject linked to technological developments. It is among the most important sciences whose teaching methods require innovation and modernity, as teachers play a vital role in achieving educational outcomes for students. Some studies also indicate that about 25% of the differences in student performance are due to the quality and effectiveness of the teaching methods adopted by teachers. Some of these methods may lack modernity and are not in line with the technological era, which negatively affects students' beliefs and educational decisions during direct teaching. This deficiency may reduce learners' motivation (Dogan et al, 2020).

Artificial Intelligence (AI) is one of the most prominent modern technological revolutions that the world is witnessing, as it has become an essential element in many sectors such as medicine, engineering, and education, which requires educational institutions and others to strive to keep pace with this technological revolution and integrate applications. Artificial intelligence (AI) is being applied in various fields, leading to increased interest and research to promote the culture of AI and its application at all educational levels (Al-Mahdi, 2021). AI is one of the most prominent digital developments that has proven effective in solving problems, thanks to machine learning techniques and knowledge acquisition in the fields of scientific and applied research. It has also contributed to the development of systems smart, innovative computing solutions, and

modern technical methods derived from the digital world integrated with artificial intelligence (Al-Hadi, 2021). Among the most important modern technological tools emerging in the era of artificial intelligence are educational robots, designed to simulate human capabilities and integrate them into the educational process. This innovation opens new doors. Experts are developing the interaction between robots and the educational process, making it a rapidly growing trend in educational institutions (Polishuk & Verner, 2017). Educational robots are modern, innovative tools that contribute to enriching and enhancing a variety of student skills, such as self-efficacy, problem-solving, and collaborative and collaborative work. They can also be used Educational robots translate between different languages using artificial intelligence applications, enhancing students' research and innovation capabilities (Lin & Chen, 2022). Robots are a modern innovation that has influenced the era of technology, although the use of machines in manufacturing dates back to before the 20th century. Robots began to take their modern form in the early 20th century It witnessed its first stages of development in 1951. Since then, its uses have diversified, as it developed into industrial robots in 1968, then entered the medical field in 1980, and was also employed by space exploration agencies to send it on spacecraft instead of sending astronauts, which reflects the rapid technological progress in the modern era (Gautam, 2023).

Robotics is based on a set of advanced educational theories, such as project-based learning, constructivism, collaboration, and experimentation. Educational robotics provides a rich cognitive environment that motivates students to build their knowledge and develop real-world skills such as critical thinking, problem-solving, and teamwork. It is also designed educational robots support curricula in innovative ways, facilitate and simplify complex scientific concepts, and enhance logical thinking for data analysis (Hassan, 2024).

Al-Hawrani (2024) pointed to a number of educational robots that could be used in classrooms educational, such as LEGO MINDSTORMS robots, a programmable set produced by LEGO, is designed to engage children and foster their love of science, mathematics, engineering, and programming. LEGO MINDSTORMS robots are used in homes and classrooms, allowing children to learn in a hands-on and creative way. Advanced technological challenges are also held in large-scale competitive tournaments, contributing to the development of their skills technology and their talents. There's also the VEX GO robotics group, which seeks to connect students' knowledge of technology, science, and mathematics by designing engaging educational robots that engage students. It also focuses on providing an integrated approach that can serve as a reference for teachers and students, and organizes periodic competitions to encourage the use of educational robots in various fields. Mahmoud (2021) added that there are several types of educational robots that can be activated inside classrooms and programmed in an interesting and fun way, including the Moot robot, which is one of the educational robots that came with the aim of enhancing graphic programming, and which is provided by Macke Block, which is one of the companies that works on manufacturing robots, and providing mechanical parts and special programming solutions in the movement of the educational robot educational robots, as indicated by Brazi (2024), contribute to the development of various types of thinking, including creative and innovative thinking associated with higher-order thinking skills. They also help spread the culture of using robots in various educational fields, opening new horizons for making learning more active and interactive. Robots are distinguished with its bright colors and attractive designs, it is an effective tool for motivating learners, regardless of their age. It is used to develop mental and creative abilities and promotes the concept of sustainable learning that keeps pace with future changes in education (Tran, 2022). In light of this, we can understand that the introduction of educational robots into today's teaching and learning process may contribute to the development of students' higher-order thinking skills and place the learner at the center of the teaching and learning process. This is what future technology seeks to achieve, as robots bridge the gap between theory and practice, enabling learners to apply the theories contained in

curricula in easier and more effective ways educational robotics represents a fundamental pillar in the development of the contemporary educational process, as it provides an educational environment rich in interactive and creative activities that cover diverse scientific fields such as science, mathematics, engineering, and programming. Through these activities, students may be able to apply their theoretical knowledge practically and improve their problem-solving and critical thinking skills. Robotics also contributes to preparing students for the future there is an increasing reliance on technology, as it introduces students to the principles of robotics and encourages innovation and creativity in this field. Moreover, the use of robots in education makes the educational process more fun and exciting, which enhances students' motivation to learn (Al-Atoum, 2020).

The American Science Teachers Association (NAST) emphasizes that a fundamental aspect of the learning process is the development of a student's skills and knowledge over time. The ideas a student acquires deepen across the various stages of learning, leading to the emergence of integrated links between academic subjects. Learning progression represents the series of educational steps a student goes through as they strive for academic development. However, these skills are not applied uniformly it is not for all students, but it is an effective framework for improving their learning skills. Science education also provides a comprehensive framework that describes the evolution of various scientific and engineering practices and concepts over time (Willard, 2020). In light of the above, with the continuous progress in the educational process, it has become necessary to integrate teachers within the framework of future technology, educational robots have added a fundamental element to this development, as they are a powerful support tool for teachers in the educational process. Motivation has a strong relationship with learning and learner behavior. It is the primary driver of learners' behavior and increases their expended energy, making them more attentive and focused, and striving harder to understand all intended objectives, especially those related to the subject it is present in the physics subject and the available curriculum, which is characterized by rigidity, thus improving their academic performance and raising their level of achievement (Al-Atoum et al., 2021). The factors and environment surrounding the learner are among the things that influence their motivation. Therefore, learners' motivation varies from one person to another based on their performance and knowledge. Studies have been classified as:(Talib, 2018; Khalil, 2019; and Al-Saeed, 2023), motives according to the factors that affect the learner are divided into the following types: Innate motives: These are the motives that exist in all living beings, including humans, such as the motive to drink or eat, and internal motives: These are the motives that stem from the person himself, as he seeks to achieve the goal for his own satisfaction, and physiological or biological motives these are motives related to an individual's basic needs, such as food and drink. Psychological motives are secondary motives that appear through a person's desire to obtain something or achieve a goal or objective. External motives are motives that a person obtains from external factors, such as reinforcement and the giving of gifts Motivation is one of the basic factors that enhance an individual's ability to achieve and learn, as it directs his attention towards certain activities and affects his behavior, which motivates him to work and persevere continuously. Educators view motivation as an important factor that helps students practice cognitive activities that go beyond the scope of school work and affect their daily lives. Motivation is considered the driving force that helps an individual control himself and determine plans.

A court to achieve its goals and find appropriate solutions, by thinking about solutions to the problems it faces. Highly motivated individuals are characterized by their ability to develop logical visions for facing future challenges (Habib, 2022). Studies and research have shown that motivation contributes to achieving effective learning and mental focus, and it is one of the most important factors that enhance students' interest in learning and knowledge, and push them towards innovation and creativity, are time management and information management are considered factors that enhance students' focus, which helps them complete tasks completely and

on time the orientation towards learning helps enhance students' motivation to acquire knowledge, by integrating learning into diverse activities and situations, which encourage challenge and perseverance towards acquiring knowledge the ability to solve problems creatively and come up with innovative and original ideas that have never been proposed before, which drives learners to innovate and gives them a sense of satisfaction with the interaction they achieve while solving complex problems (Majid and Abdullah, 2019).

Motivation is one of the most important factors that direct learners' behavior toward achieving their goals. It enhances their energy and effort, increasing their desire to understand the required topics, which positively impacts their performance their academic performance, as the teacher plays a vital role in guiding and directing learners towards their goals, and contributes to preparing a creative generation capable of facing challenges and solving problems. This is achieved by following procedures that enhance learners' motivation, such as linking learning within classrooms to real life and integrating it with acquired knowledge motivation enhances learners' ability to explore knowledge and ask questions during educational activities. Therefore, motivation is a catalyst that drives learners to seek answers to their questions, enhancing their exploration skills (Shaheen et al., 2022). Motivation represents a fundamental axis of educational behavior within the classroom environment, as it is considered the spark that It initiates the teaching and learning process, contributes to improving the learner's self-perception, and enhances their ability to cope with diverse learning situations. Motivation also helps the learner identify their own motivations, enabling them to direct their behavior in line with their desires and inclinations (Sarhan, 2023). This can be demonstrated by the fact that motivation has a significant impact on individuals' desire to learn, as it drives them to the search for knowledge and the discovery of new learning. Technology plays a crucial role in enhancing motivation and improving the quality of the educational process. By providing diverse and easy-to-use educational resources, technology helps spark curiosity in learners and encourages them to explore and collaborate.

Many studies have addressed the topic of educational robots, with Al-Alauna's study seeking to Al-Shamali (Alawneh, Al-Shamali, 2024) sought to reveal the extent of the use of artificial intelligence in science teaching and its relationship to increasing students' motivation to learn in public schools in Nablus Governorate. The study aimed to determine whether there was a difference in teachers' responses regarding their attitudes toward the degree of use of artificial intelligence in science teaching in these schools. The study relied on the descriptive survey approach it was applied to a sample of (136) teachers from public schools in the Nablus Governorate. The study relied on a scale that included the use of artificial intelligence and increased student motivation. The results showed that the use of artificial intelligence in teaching science increased students' motivation and enthusiasm for learning. Daher's study (2022) also aimed to identify the impact of employing educational robots on student motivation students learning mathematics. Two groups of seventh-grade students participated in this research: a robotics class (32 students) and a regular class (33 students). Data were collected using two methods: questionnaires and interviews. Qualitative results showed that students in the robotics class described their experience with robot-based learning of the rectangle topic in terms of interest, mastery, and self-efficacy, doing so significantly more than students in the regular classroom. Quantitative results indicated that seventh-grade students' motivation to learn mathematics in the robotics class differed significantly, favoring the robotics class, across three dimensions: interest, mastery, and self-efficacy.

Al-Masry et al. (2023) developed a science unit for third-grade students to investigate its impact, based on the STEAM approach, on developing mental motivation and academic achievement among students third grade in the capital, Amman, Jordan. The study relied on the quasi-experimental approach, as the study sample consisted of (60) male and female students who were divided into two groups: control and experimental. The study tool included a measure of mental

motivation and an achievement test for the science subject. The results indicated a positive impact of the curriculum STEAM in developing mental motivation and academic achievement. The results also showed a correlation between mental motivation and achievement the current study aimed to identify the effectiveness of an educational robot in developing the motivation of ninth-grade students to learn physics in Jordan. This study differs from all previous studies in terms of its objective the study, where the study of Alawneh and Al-Shamali (2024) aimed to reveal the extent of using artificial intelligence in teaching science and its relationship to increasing students' motivation towards learning in public schools in Nablus Governorate, and the study of Daher (2022) aimed to identify the effect of employing educational robots on students' motivation to learn mathematics, and the study of Al-Masry et al. (2023) aimed to "identify the impact of a STEAM-based study unit in third-grade science on developing motivation the study adopted a quasi-experimental approach. This approach is consistent with studies by Daher (2022; Al-Masry et al., 2023), which adopted a quasi-experimental approach, and differs from Alawneh and Al-Shamali (2024), which adopted a descriptive approach the study adopted a motivation scale approach. This approach is consistent with the study by Al-Masry et al. (2023; Alawneh, Al-Shamali, 2024), which used a motivation scale. It differs from Daher's study (2022), which used a questionnaire and interview. In this respect, the current study stands out from previous studies, in the researcher's opinion, that addressed the effectiveness of an educational robot in developing the motivation of ninth-grade students to learn physics in Jordan.

**The study problem**

The study problem emerged from the researcher's observation, during her work in the educational field, that the educational process lacks effective use of technological tools in educational activities in science in general and physics in particular. This requires interaction and integration with students to break the rigidity of the subject content.

All scientific disciplines. This deficiency and lack of technology integration may be a reason for teachers' inability to diversify teaching methods, raise students' academic achievement, and develop their higher-order thinking skills. The results of the Trends In International Mathematics and Science Study (TIMSS) in both the 2015 and 2019 cycles showed a decline in Jordanian student performance, with the average being below average Internationally, the average percentage of correct answers reached (57%), which indicates the presence of a defect that may be attributed to the teaching methods practiced by mathematics and science teachers, or the lack of continuous training for teachers on modern teaching methods, which requires those in charge of the educational system to move towards improving the performance of science and mathematics teachers (Al-Sharaa, 2023). By reviewing local and international research priorities and previous studies, such as those by (Ammar, 2021; Abu Musa and Al-Takhayneh, 2021; Al-Nawaiseh, 2024), it becomes clear that there is a growing interest in using educational robots at various educational levels, and adopting modern technologies in teaching mathematics and science. However, there is a lack of research examining the effectiveness of educational robots in teaching science in general and physics in particular. Given this technological and research gap, and in line with global trends toward integrating technology into education, and because physics is one of the subjects that plays a significant role in developing students' intellectual abilities,

Which contributes to understanding environmental and social challenges and encouraging students to participate in solving societal problems. Based on the researcher's experience as a teacher and coordinator of the science subject and dealing with a number of science and mathematics teachers, and her in-depth knowledge of the field of educational smart robots, it became clear that the educational process needs to employ modern technology, including educational robots, as this approach aims to develop the teaching style Traditional education has become more modern and interactive, which may contribute to increasing students' motivation and developing their cognitive and thinking skills, such as critical thinking, problem-solving, and

programming Based on this study sought to determine the effectiveness of educational robots in enhancing achievement and motivation among ninth-grade students in Jordan.

**Study objectives**

The study aimed to identify the effectiveness of an educational robot in developing ninth-grade students' motivation to learn physics.

**Study Questions**

The current study sought to answer its question: What is the effectiveness of an educational robot in developing ninth-grade students' motivation to learn physics?

**Study Hypotheses**

The study tested the following hypothesis: There is no statistically significant difference at the significance level ($\alpha = 0.05$) between the mean scores of the experimental group and the control group on the motivation scale for learning physics attributable to the teaching method (educational robot, traditional method).

**Significance of the Study**

The theoretical significance of this study lies in providing new practical and research insights for those interested in using educational robots. It highlights their effectiveness in developing student motivation, and clarifies for teachers and supervisors the nature of educational robots and their positive impact on student motivation.

In addition, the study highlights the importance of collaborative and cooperative work among students, especially in physics, through various educational activities that can be implemented using educational robots. The practical significance of the study is that it seeks to utilize its results in

The use of educational robots to improve ninth-grade students' achievement and develop their practical and intellectual skills is achieved through enrichment activities in physics and encouraging students to use educational robots.

**Study Limitations**

The study was bound by the following limitations:

**Objective Boundary:** The study focused on the concepts, ideas, and skills included in Unit Two, "Forces and Motion: Newton's Applications of Forces and Motion," from the ninth-grade physics textbook.

**Spatial Boundary**: The study was conducted at Al-Qayrawan Model Schools, located in the Marka District, Amman.

**Temporal limit:** The study was conducted during the first semester of the 2024/2025 academic year.

**Human limit:** The study was limited to a sample of ninth-grade students at the Qairawan Model Schools in Marka District.

The generalizability of the results of this study depends on the psychometric properties of the Motivation to Learn scalePhysics.

The validity and reliability of the tools are essential factors that ensure the accuracy and objectivity of the results. This leads to new findings on the importance of using educational robots. The results depend largely on the accuracy of ninth-grade students' responses and their cooperation in completing the study tools.

**Study terminology**

The study's terms were defined as follows:

Educational robot: Jarrah (2022, p. 187) defined it as "a mechanically operated tool capable of executing a set of tasks and commands pre-coded using a computer. It can sense its surrounding work environment and make intelligent decisions that appear to be based on artificial intelligence."It is procedurally defined in this study as: a technological tool containing sensors and sensors that are programmed using computer programs to execute various commands in a practical and creative way, through the use of the Mbot1 robot, which is programmed using

Macke block software through which scientific experiments may be simulated and students are clarified the physics concepts related to the unit of forces and motion.

**Motivation**: Shaheen et al. (2022, p. 650) defined it as "an internal drive that drives the learner to exert maximum effort in educational situations with the goal of achieving their educational goals." In this study, it is operationally defined as: the internal energy and desire that motivates ninth-grade students to exert effort and acquire knowledge in innovative ways. It was measured using the Motivation to Learn Scale Physics, which was developed specifically for this study, was driven by their interest and enjoyment in using the educational robot.

## METHOD AND PROCEDURES

### Study Approach

To achieve the study objectives, an experimental approach with a quasi-experimental design was used, a scientific approach that is appropriate for the purposes of this study.

### Study Subjects

The study sample consisted of (60) ninth grade students from Al-Qayrawan Model Schools in the capital, Amman, affiliated with the Marka District Education Directorate, during the first semester of the 2024/2025 academic year. The school was chosen intentionally due to the cooperation of the school administration and its teachers, and the facilities provided by the school to the researcher.

The two study groups were randomly selected from the school's classes through a lottery. Class A was chosen to be the control group, with 30 students, who studied physics using the traditional method. Class B was chosen to be the experimental group, with 30 students, who studied physics using the educational robot.

### Physics Learning Motivation Scale

A scale was developed to measure ninth-grade students' motivation to learn physics. This scale was based on theoretical literature and previous studies related to the topic, such as the studies of Al-Ghamdi & Issa, 2022; Al-Qafazi & Al-Otaibi, 2022; Al-Shamali & Alawneh, 2024. The opinions of some educators specializing in this field were also sought.

### Content Validity of the Scale

To ensure the content validity of the Motivation Towards Educational Robots scale, the scale was presented in its initial form, consisting of (25) items, to a committee of (22) judges with experience and expertise in the fields of curricula and teaching methods, measurement and evaluation, educational technology, and physics. The judges were asked to provide their opinions. Regarding the clarity of the paragraphs, their scientific and linguistic soundness, and their suitability for the level of ninth-grade students, in addition to suggestions for deletion, modification, or addition. After reviewing the comments received from the referees, which included the addition of an artificial intelligence axis related to educational robotics, and included Also, to allocate some paragraphs to physics, its concepts, and the student's engagement with it, the necessary modifications were made, with paragraphs that achieved an agreement rate of 80% or more being retained. Based on this, the scale settled on its final form of 25 paragraphs, with each paragraph assigned a weight based on a five-point Likert scale. Three items were used weights were used to suit the students' needs (agree, neutral, disagree). To verify the validity of the construct, the scale was administered to a pilot sample independent of the main study sample and from the study population/Marka District. The sample consisted of 35 students. A correlation coefficient was then calculated Pearson correlation coefficients were used between each item in the scale and the scale as a whole, to verify the consistency of the items and their compatibility with the overall objective of the measurement. Table (1) shows the values of the correlation coefficients of the scale items with the scale as a whole.

**Table (1) Values of the correlation coefficients of the items with the scale as a whole**

| Paragraph number | Correlation coefficient with the total score | Paragraph number | Correlation coefficient with the domain |
|---|---|---|---|
| 1 | **0.63 | 14 | **0.79 |
| 2 | **0.56 | 15 | **0.73 |
| 3 | **0.42 | 16 | **0.75 |
| 4 | **0.66 | 17 | **0.73 |
| 5 | **0.59 | 18 | **0.62 |
| 6 | **0.44 | 19 | **0.69 |
| 7 | **0.62 | 20 | **0.76 |
| 8 | **0.66 | 21 | **0.58 |
| 9 | **0.78 | 22 | **0.59 |
| 10 | **0.58 | 23 | **0.64 |
| 11 | **0.74 | 24 | **0.70 |
| 12 | **0.79 | 25 | **0.64 |
| 13 | **0.56 | | |

**Statistically significant at the significance level (0.01)

Table (1) shows the values of the correlation coefficients between each item and the total score of the scale. The correlation coefficients ranged between (0.42-0.79), and all of them were statistically significant. These values are considered acceptable and appropriate for conducting the current study (Ebel, & Frisbie, 1972; Awda, 2014).

**Reliability of the Physics Learning Motivation Scale**

To verify the reliability of the scale, the reliability coefficient was calculated using Cronbach's alpha method to measure internal consistency between items. The scale was administered to a pilot sample, independent of the main study sample and from the study population (Marka District), comprising 35 students. The reliability coefficient was 0.94, indicating a high level of reliability.

To a high level of stability.

**Study Variables**

1. The independent variable is the teaching method, which has two levels:

A. The educational robot method.

B. The traditional method.

2. The dependent variables: Motivation

**Study Design**

O X O Exp. Group

O ___ O Con. Group

Where:

Exp. Group: The experimental group that studied using the educational robot.

Con. Group: The control group that studied using the traditional method.

O: Motivation scale for learning physics.

X: The experimental treatment using the educational robot.

Study Procedures

The current study proceeded through several steps, including:

1. Reviewing the theoretical literature and previous studies relevant to the study topic.

2. Selecting the second unit (Force and Motion) from the first-semester physics textbook, preparing the semester plan, and analyzing the content and lesson plan related to the educational robot. This was implemented during the first semester of the 2024/2025 academic year (Appendix (5)).
3. Develop a physics learning motivation scale based on previous studies and consultation with specialists, then present it to a panel of judges.
4. Obtain a task facilitation letter from the Middle East University, which was sent to the Ministry of Education as an attachment.
5. Select study participants and assign them to two groups (experimental and control).
6. Apply the physics learning motivation scale to a pilot sample (reliability sample) to determine validity and reliability.
7. Applying the pre-test physics motivation scale to the experimental group and the control group to ensure group equivalence.
8. Training students on using the Macke Block software and how to operate the 1Mbot robot.
9. Applying the physics motivation scale to the experimental group and the control group.
10. Transcribing the study participants' responses using SPSS.
11. Analyzing the results, discussing them, and drawing recommendations.

**Statistical Processing**

- Extracting reliability using Cronbach's alpha.
- Extracting the Pearson correlation coefficient between the item and the total score to verify construct validity.
- Extracting arithmetic means and standard deviations to determine the equivalence of the groups.
- Using analysis of covariance (ANCOVA) to answer the study questions.

## STUDY RESULTS

**Results related to answering the study question, which states: "What is the effectiveness of the educational robot in developing the motivation of ninth-grade students toward learning physics?"**

A motivation scale was administered pre-test to both groups, and the arithmetic means and standard deviations of the students' performance in each group were calculated. A t-test was then conducted to determine the significance of the differences between the means.

There were no statistically significant differences between the two groups on the pretest. Table (2) shows the detailed results of these analyses.

Table (2) Results of the t-test for the significance of differences between means on the pretest responses to the physics motivation scale for ninth-grade students.

| Variable | Group | number | Arithmetic average | Standard deviation | value (v) | Significance level |
|---|---|---|---|---|---|---|
| Motivation scale | empiricism | *30* | *1.98* | *0.17* | *0.709* | *0.414* |
| | The female officer | *30* | *1.94* | *0.21* | | |

It is noted from Table (2) that there are no statistically significant differences between the average performance of the experimental and control groups on the motivation scale at the significance level ($\alpha = 0.05$), as the value of (t) reached (0.709) at a significance level of (0.414), which means that the two groups were equivalent before implementing the study. The arithmetic means and standard deviations of the performance of ninth grade students from the two groups on the dimensional motivation scale were extracted, and Table (3) shows these results.

Table (3) Arithmetic means and standard deviations of ninth-grade students' responses to the post-test motivation scale for learning physics.

| Group | number | Arithmetic averages | Standard deviations |
|---|---|---|---|
| Experimental | 30 | 2.73 | 0.12 |
| Control | 30 | 1.86 | 0.22 |

Table (9) shows the presence of apparent differences in the arithmetic means and standard deviations between the experimental and control groups on the post-physics motivation scale, where the arithmetic mean for the experimental group was (2.73) and the standard deviation (0.12), and the arithmetic mean for the control group was (1.86) and the standard deviation (0.22). To determine the significance of these differences, the analysis of common variance (ANCOVA) test was conducted, and Table (10) shows these results.

Table (4) Analysis of covariance (ANCOVA) of responses of ninth-grade students in the experimental and control groups on the post-motivation scale

| Source of variance | Sum of squares | Degrees of freedom | Mean squares | F value | Statistical significance | (η2)eta square |
|---|---|---|---|---|---|---|
| Tribal (Joint) | 0.683 | 1 | 0.683 | 1.622 | 0.314 | 0.36 |
| Group | 10.798 | 1 | 10.798 | 25.648 | 0.000 | 0.90 |
| Error | 23.997 | 57 | 0.421 | | | |
| Total Corrected | 28.469 | 59 | | | | |

Table (4) shows the presence of statistically significant differences at the significance level (α = 0.05) between the average performance of ninth grade students in the control and experimental groups, as the calculated value of (F) reached (25.648) with a statistical significance of (0.000). To know who these differences belong to, the adjusted arithmetic means of the experimental and control groups were extracted on the motivation scale, and Table (11) shows these results.

Table (5) Adjusted arithmetic means

| group | Adjusted arithmetic mean | Standard error |
|---|---|---|
| Experimental | 2.72 | 0.027 |
| Control | 1.87 | 0.027 |

Table (5) shows that the adjusted arithmetic mean was in favor of the experimental group with a higher adjusted arithmetic mean than the control group. To determine the size of the effect, Eta

square (η2) was calculated, which reached (0.90). Thus, it can be said that (90%) of the explained variance in the total score of the motivation scale between the experimental and control groups is due to the use of the educational robot, and (10%) of the effect size is due to other factors.
The results of data analysis showed that there were statistically significant differences between the average scores of ninth-grade students on the motivation scale towards learning physics, attributed to the experimental group that used the educational robot in its teaching, as the value of (Eta square) reached (0.90), which indicates that 90% of the variance in responses
The students' motivation to learn physics is attributed to their ability and responsiveness when using the educational robot, which stimulates their motivation to learn the software used to gain greater knowledge of modern technology. This result can be explained by most students' familiarity with a large number of artificial intelligence applications Different, these applications allow teachers to join educational projects anywhere and anytime (Ghanem, 2023), and some students learned about the robot used and the software, through most students' knowledge of the software and the company that manufactured the robot Mbot1, as a number of students were beneficiaries in Increasing their motivation to learn about the uses of educational robots in the educational process and integrating them into artificial intelligence applications, and the learner's ability to direct his behavior and knowledge to increase motivation towards learning and continuously ask questions during the installation and operation of the educational robot (Sarhan, 2023).the study's findings sought to increase students' motivation to learn physics using the Mbot 1 robot and Macke Block software, potentially integrating it into the educational process. Most students were drawn to the many robot-related tools used in our daily lives, emphasizing that integrating these tools into science subjects and enrichment activities can be simple if properly understood and mastered the study agreed with the study of Al-Masry et al. (2023), which worked on developing a unit in the science subject with the aim of investigating its impact according to the STEAM approach on developing mental motivation among third-grade students. The study indicated the presence of an impact of the approach and the existence of a correlation between motivation and achievement. These results were consistent with the study of Alawneh (2024) and Al-Shamal, which demonstrated a strong relationship between the use of artificial intelligence techniques in teaching science and increasing students' motivation to learn.

**Recommendations and Suggestions**

In light of the study's findings, several recommendations are made:

- Use an educational robot as an effective teaching tool in teaching physics to ninth-grade students.
- Use an educational robot in ninth-grade physics to enhance students' motivation to learn physics
- Conduct studies to determine the effectiveness of educational robots, their motivation, and the challenges facing educational robots in classrooms at various levels.
- Develop specialized training programs for teachers in schools that use educational robots to increase student and teacher motivation.

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