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The Effectiveness of Producing a Blended Learning Environment Based on the Programming of an Educational Robot to Develop Problem-solving Skills in Science for Intermediate School Students in the Kingdom of Saudi Arabia

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Abstract

This study aimed to examine the effect of producing a Blended learning environment based on the programming of an educational robot to develop problem-solving skills in Science for intermediate school students in the Kingdom of Saudi Arabia. The sample of the study consists of (60) intermediate school students. A total of Four research questions and hypotheses were used in the study. A pre-post-test design was used to achieve the study's objectives in which special treatment was given to the experimental group, whereas no treatment was given to the control group. SPSS was used as a statistical tool to examine the present research results. The study's results proved the effectiveness of a Blended learning environment based on the programming of an educational robot in developing problem-solving skills in Science for intermediate school students in the Kingdom of Saudi Arabia, as

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the experimental group showed a better performance in the post-test than the control group. Moreover, the correlation test results indicated a significant positive relationship between the Blended learning environment based on the programming of educational robot performance and students' developing problem-solving skills in Science.

Keywords: Problem-solving skills in Science, Blended learning Environment, Educational Robot programming

1. Introduction

Preparing learners for employment, citizenship, and life in the 21st century is challenging. Globalization, new technologies, immigration, international competition, changing markets, and environmental challenges drive the acquisition of the skills and knowledge students need to live and succeed in the twenty-first century. Educators and researchers describe these abilities as 21st-century skills, higher-order thinking skills, and more profound learning outcomes to meet the challenges of the 21st century.

Due to changing technologies, disruptions in the labor market can create new high-value jobs. Still, they can also destroy many existing occupations with disastrous consequences for economies in the short, medium, and long term. There is a clear consensus that the new approach to learning must consider the characteristics of today's students, become more integrated, and students must be supported to develop problem-solving competencies and skills throughout the different stages of education. Problem-solving skills in the science course are among the skills that have a significant role in developing the student's ability to face his daily life outside the school and deal with it, including many situations that are sometimes complex.

Problem-solving is a critical departure from the traditional approach to education that revolves around rote memorization. It exposes learners to actual problems that they can feel and encounter daily and provides opportunities for understanding, benefit, and application in similar situations (Thouqan Obeidat and Suhaila Abu Al-Sameed, 2007). In this regard, Al-Azzawi (2009) indicated that the problem is a situation that challenges the existence of an obstacle, which prevents direct access to a solution at the beginning, and Tawfiq Merhi and Muhammad Al-Haila (2013) believe that problem-solving is one of the basic skills that a person must master in the current era with variables multiple.

Teaching Science is vital to enhance students' thinking and problem-solving capabilities. To achieve this, teachers must embrace alternative teaching methods that inspire a constructive learning environment. By redefining the roles of both teacher and student, learners will be encouraged to practice and enhance their newfound skills. (Al Shafia, 2019).

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

The study of Fawzi Al-Adawi, et al (2017) confirmed that students have difficulties in solving problems in Science, as science problems require research and investigative skills to deal with problems correctly that ultimately leads to solving those problems, as confirmed by the study of Noha Al-Hassi , et al (2020) To develop students' competence in solving science problems, it is necessary to use innovative methods and methods in teaching.

The problems of Science were understanding and learning abstract concepts and complex skills, which is evident in the unit on waves prescribed for intermediate school students as students struggle to calculate wavelengths, reflections of sound waves, and refractions. The process requires a series of sequential steps and a skill set to solve problems that many students find daunting. (Al-Ghamdi , Ibrahim Refaat, 2017).

Therefore, there is an urgent need to teach students and train them on these skills to become more efficient and effective in long-term learning, which is what all those in charge of the educational process seek, primarily that students can be taught these skills through organized training, which was confirmed by the study of (Hamdi Al-Faramawy, 2002), (Ayman Habib, 2003), (Mohamed Sayed, 2004), (Mona Badawi, 2006). Like other mental and performance skills and abilities, what applies to cognitive thinking skills applies to problem-solving skills.

The advent of robotics and artificial intelligence has revolutionized the education sector, with countries worldwide investing heavily in research and development. Robotics has become the primary tool for teaching students design, programming, implementation, and research fundamentals, promoting hands-on learning, and enhancing problem-solving, communication, role-playing, and decision-making abilities. By combining different sciences, robotics facilitates interdisciplinary education, including basic electronics and mechanical engineering concepts. Whether used as part of the curriculum, as an extracurricular activity, or as a summer program, robotics competitions provide a platform for students to develop and verify hypotheses, solve complex problems, and enhance their critical thinking skills. The ubiquitous prevalence of robots is a testament to their dominance in various fields and disciplines, serving as a benchmark for measuring the industrial prowess of nations. (Elikin, Sullivan, Bers,2014)

Therefore, the current research aimed to develop problem-solving skills in Science among intermediate school students through a blended learning environment based on programming (educational robots).

2. Problem of Research

The researcher conducted an exploratory study on a sample of (10) second-grade students in the intermediate stage in Andalusia schools in the Taif educational area, and the study found that (100%) of the study sample

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

suffer from difficulties in Science, and that (70%) find that the subject of waves and solving problems and problems contained in them is one of the most difficulties they face in studying Science, due to the difficulty of imagining problems and providing solutions to their problems, and (90%) of the study sample confirmed their preference for the problem-solving method in learning Science, And the need for (90%) of students to learn the steps of solving problems and understand the mechanisms of their implementation in Science, and (100%) of students confirmed their preference for using technology with traditional learning side by side, and their desire to learn through modern learning methods based on educational robots, and the exploratory study also included a test in problem-solving skills in Science in the unit of waves, which failed all students, as no student from the survey sample exceeded the degree of success.

Many research studies have confirmed the existence of a deficiency in problem-solving skills in Science, such as: Noha Al-Hassi and others (2020), Fawzi Al-Adawi and others (2017), Tawfiq Marei and Muhammad Al-Haila (2013), Turki Al-Salami (2013), and Nasser Al-Owaishek (2009). and Hassan Al-Khalifa (2005). Because of the reality of science teaching in schools, especially in the Kingdom of Saudi Arabia, concerning the development of problem-solving skills in Science, the researcher found a weak interest in developing those skills and an invalid interest in developing realistic experiences.

Because thinking strategies enable students to control their thought processes and remember the associated experience, teaching and learning thousands of behaviors related to a problem can occur to efficiently solve the problem and transfer it to a new situation. It also emphasizes the importance of problem-solving skills and their educational place in the student's life. They are located at the top of the learning pyramid as they are the diligence that flows into the information processing model, where the individual carries out his actions based on the information. (Sami Milhem, 2001, p. 229)

From the above, it can be said that thinking skills, in general, and problem-solving skills, in particular, must be developed among students from the stages of public education. To develop problem-solving skills well, students' thinking must be recognized while facing the problem, where it is possible to intervene and help students and guide them in time to reach the learner to different solutions through the practice of problem-solving skills.

Search problem:

The research problem can be extracted from the results of previous studies such as the study of: Noha Al-Hassi and others (2020), Fawzi Al-Adawi and others (2017), Tawfiq Marei and Muhammad Al-Haila (2013), Turki Al-Salami (2013), Nasser Al-Owaishek (2009), and Hassan Al-Khalifa (2005), which confirmed the existence of difficulties in mastering the skills of

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

solving science problems, in addition to the results of the exploratory study carried out by the researcher, which found a weakness in problem-solving skills in Science and that In the cognitive and performance aspects, the research problem was identified in the low level of problem-solving skills among intermediate school students in the Kingdom of Saudi Arabia.

3. Questions of Research:

The main question of the research can be formulated as follows: What is the effectiveness of producing a blended learning environment based on educational robot programming for developing problem-solving skills in Science for intermediate school students?

The following sub-questions are derived from the main question:

3.1- What are the problem-solving skills in the science course required for intermediate school students?

3.2- What is the proposed scenario for designing the blended learning environment based on (educational robot) programming in developing the cognitive and performance aspects of problem-solving skills in the science course for intermediate school students?

3.3- What is the effectiveness of producing a blended learning environment based on educational robot programming for developing the cognitive aspects of problem-solving skills in Science for intermediate school students?

3.4 - What is the effectiveness of producing a blended learning environment based on educational robot programming for developing the performance aspects of problem-solving skills in Science for intermediate school students?

4. Objectives of Research:

The researcher seeks to treat the shortcomings in the difficulties related to the cognitive and performance aspects of problem-solving skills in the science course among intermediate school students through:

4.1- Determining problem-solving skills in science courses for intermediate school students.

4.2- Building the proposed perception of the blended learning environment based on (educational robot) programming in developing the cognitive and performance aspects of problem-solving skills in Science for intermediate school students.

4.3- Measuring the effectiveness of producing a blended learning environment based on educational robot programming in developing the cognitive aspects of problem-solving skills in Science for intermediate school students.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

4.4- Measuring the effectiveness of producing a blended learning environment based on educational robot programming in developing the performance aspects of problem-solving skills in Science for intermediate school students.

5. Significance of the Research

5.1- Designing a model for a blended learning environment that combines video clips, examples, images, and audio files, presented through the website to suit the nature of intermediate school students.

5.2- Developing the knowledge and skills of intermediate school students in problem-solving skills in Science.

5.3 - Determining the most appropriate educational technology tools for intermediate school students according to the mastery of problem-solving skills required in the middle stage.

5.4 - Suggist new generalizations and ideas about planning lessons in this way in teaching Science that help teachers and students.

5.5 - Teachers know the importance of applying educational robot programming, which may result in the development of teaching methods used in Science to develop problem-solving skills among intermediate school students.

5.6 - It helps in developing teacher performance evaluation so that the focus becomes on the teacher's actual performance in providing the learner with the skills necessary for his life.

6. Variables of Research

The researcher relied on the following variables:

Independent Variable: the electronic and traditional blended learning environment based on educational robot programming.

Dependent variable: Cognitive and performance aspects of problem-solving skills in Science.

7. Hypotheses of the Research:

H.1. There is a statistically significant difference at the level (0.05) between the mean scores of the pre and post-applications for intermediate school students (for the experimental group) by testing the cognitive aspects of problem-solving skills in the science course in favor of the post-application.

H.2. . There is a statistically significant difference (0.05) between the mean scores of the pre and post-applications for intermediate school students (the experimental group) with a note card for the performance aspects of problem-solving skills in the science course in favor of the post-application.

H.3. There is no statistically significant difference at the level (0.05) between the mean scores of the two research groups (control - experimental)

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

in the post-test of the cognitive aspects of problem-solving skills in the science course among intermediate school students.

H.4. There is no statistically significant difference at the level (0.05) between the scores of the two research groups (control and experimental) in the observation card of the performance aspects of problem-solving skills in the science course post-application among intermediate school students.

H.5. There is effectiveness in using a blended learning environment based on educational robot programming to develop the performance aspect of problem-solving skills in Science for intermediate school students in the Kingdom of Saudi Arabia.

8. Theoretical Framework:

One of the most important ways for the learner to move away from the traditional reality of education, represented in memorizing and remembering, as mentioned (Obaidat and Abu Al-Sameed 2007), is the method of solving problems in his life. In this regard, Al-Azzawi (2009) showed that the problem is a situation that requires thinking that challenges the existence of an obstacle that prevents Without direct access to the solution the first time. Marei and Al-Hilha (2013) believe that facing problems is one of the basic skills that a person should learn and master in our current era, which is characterized by many intertwined variables.

Therefore, there is an urgent need to educate and train students in these skills to become more efficient and effective in their work. Long-term learning, which is desired by all those in charge of the educational process, primarily since students can be taught these skills through structured training, was confirmed by the study of:
(Flavell, 1979) ; (Ashman & Adrian, 1994) ; (El-Hindi, 1995); (Puntambekar, 1997). And Arabic, such as (Hamdi Al-Farmawi, 2002), (Ayman Habib, 2003), (Mohamed Sayed, 2004), (Mona Badawi, 2006). It is like the rest of the other mental and performance skills and abilities, as what applies to cognitive thinking skills applies to problem-solving skills.

Teaching Science has a vital and essential role in developing students' thinking and problem-solving skills, and this requires a positive teaching climate that supports thinking and practices its skills by adopting unconventional teaching practices that change the roles of the teacher and the learner and stimulate the teaching environment (Rashid, 2009).

Therefore, the current study aimed to prepare a blended learning environment based on (educational robot) programming to develop problem-solving skills in Science for intermediate school students.

The educational process is a dynamic process based on observation, thinking and feedback, recent trends have highlighted the importance of integrating robots in education for their effectiveness in keeping pace with technological

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

developments, and this integration also enhances creative thinking skills among students by encouraging them to ask questions critically and develop hypotheses that they can test and interact with during lessons. In addition, this approach takes into account the individual differences of students, allowing them to explore their unique strengths and abilities. (Hashem Sharnoubi, 2016).

Robotics in education is built on the constructivist approach, which emphasizes the student's previous knowledge and experience and his influence on the surrounding environment in addition and language. This enables students to express their creativity in designing and programming robots based on their unique ideas and knowledge. Whether integrated into the curriculum or pursued as an independent project, robots support modern educational methodologies by encouraging creative thinking, design, and integrating Science and literature with technology to align with workforce requirements. (Alimisis, et al., 2010).

Incorporating robots into education is a powerful way to inspire students with Science and technology. With its ability to foster creativity and design thinking, it makes students equipped with not only knowledge but also practical skills to apply them effectively. This mechanism for integrating knowledge and materials through problem solving is why robots have become an important tool in learning curricula at all levels. (Alimisis, & Education , 2013)

The advanced robot facilitates the development and refinement of learners' higher cognitive abilities, including creativity and problem-solving skills. This is achieved through time management, organization, project management, resource identification and systems analysis, encouraging innovation and creativity. (Customer Prosperity, 2018).

As stated by Ghada Al-Shami (2020, p. 182) that the diversity of robotics projects, allows teachers to design and implement a range of activities, including design competitions and experiments to achieve the best results. Robotics projects provide real-world examples that link learning to practical applications, such as ATMs and smart doors, that enable students to develop solutions to real problems faced by their communities using scientific research strategies. (Bartneck, et al., 2010, 473).

Given the many challenges facing society today, the ability to engage in problem-solving is one of the most important survival tools that humans possess. Many teachers and psychologists believe that the skills involved in solving problems are teachable. Political leaders have become vocal about the need to develop students' creative problem-solving abilities by involving them in real-world problem solving.

ISSN: 1857-7881 (Print) e - ISSN 1857-7431

9. Methodology of Research:

9.1 Research Design:

The research followed quasi-experimental approach with the two-groups design (Controller – Experimental). The researchers divided the participants into two groups Controller Group (CGA) and the experimental group (EGB) with pre-post-testing procedures .The quasi-experimental approach to determine the effectiveness of the independent variable teaching using a blended learning environment with its two electronic parts based on (video clips, presentations, illustrations, sound files, and simulation slides) provided through the website and the traditional part based on classroom workshops on (cognitive and performance aspects of solving skills Problems in the science course.

Table 2. Quasi-experimental design of the research

Groups	Pre-test	Treatment	Post-test
Controller Group (CGA)	- Achievement test for the cognitive aspects of problem-solving skills in Science - Notecard for problem-solving skills in Science	Teaching the traditional way	- Achievement test for the cognitive aspects of problem-solving skills in Science - Notecard for problem-solving skills in Science
the experimental group (EGB)		Teaching using a blended learning environment based on educational robot programming, both electronic and traditional	

9.2 Population Sampling Techniques

In this study, the population included all the students who enrolled in intermediate school(Second grade) in Taif, Kingdom of Saudi Arabia. Three hundred students were studying in 2 different schools. The systematic sampling method was preferred as it allows the researchers to choose the sample from the population based on intervals in equal numbers as a probability sampling method (Elsayir, 2014). In this respect, students were chosen based on the interval of 5, so 60 students were selected from the population, which included 300 students in total. The students in this study were then divided into two separate groups, with 30 students in each group, experimental (N = 30) and control (N = 30), so the research could be conducted successfully, and necessary arrangements were made accessible to finalize the research. Below figure 1 shows the sampling process.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

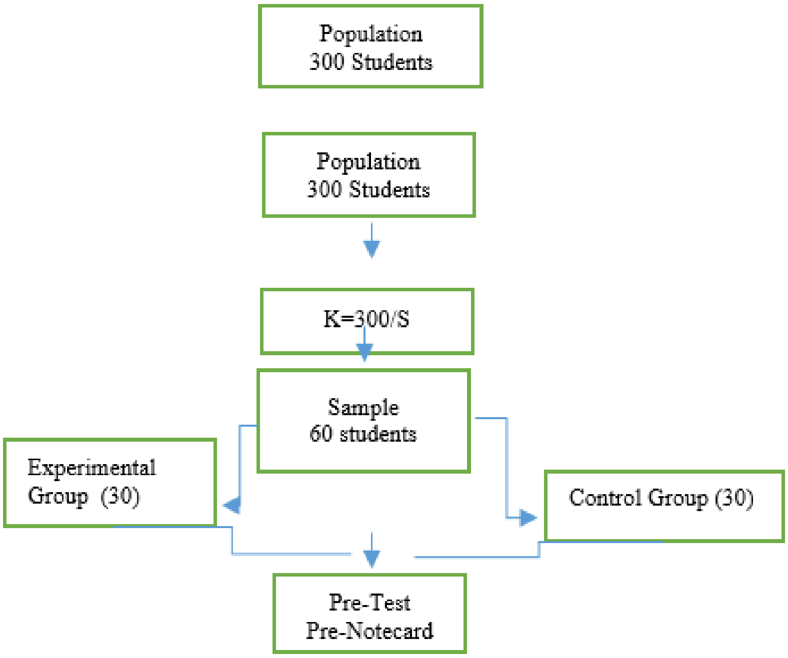

Figure 1. Sampling Technique

A systematic sampling approach was applied because, in the present research, one cluster of students was divided into two different groups. It was the best accessible technique for selecting the study's sample (Gay, 2012).

Table 1. Research sample

Group	Students(N)	Total Percentage
Controller Group (CGA)	**30**	**50%**
ExperimentalGroup (EGB)	**30**	**50%**
Total	**60**	**100%**

9.3 Instrumentation:

The research includes the following tools:

9.3.1- Data collection tools:

Exploratory study.

- List of problem-solving skills in Science based on (understanding the problem - developing a plan for the solution - implementing the solution plan - validating the solution).

List criteria for producing a blended learning environment based on educational robot programming.

ISSN: 1857-7881 (Print) e - ISSN 1857-7431

9.3.2 Measuring tools:

- An achievement test of the cognitive aspects of problem-solving skills in a science course.

The test was validated for its validity and reliability. The validity of the test was run through content validity (Jury validation), and Cronbach's Alpha statistic was applied. The value of (r) was (0.823), which indicates a high-reliability coefficient.

- A note card on the performance aspects of problem-solving skills in Science.

The stability of the note card was run by calculating the alpha coefficient, and Cronbach's alpha was using the SPSS statistical package program, where the value of the Cronbach alpha coefficient was (0.88), which indicates that the card has high stability.

9.3.3- Experimental tool:

-Blended learning environment based on educational robot programming.

9.4. Treatment Instrument:

A blended learning environment based on the educational robot programming was built using and blended into the sconed-grade Science. Pupils could use it through their laptops in school and at home.

9.5 Delimitation of the Research:

The limitations of the current research were:

- **Human limits:** 60 students.
- **Spatial boundaries:** (Safwa Al-Taliah Private Schools - Al-Andalus Private Schools) in Taif, Kingdom of Saudi Arabia.
- **Time limits:** the third semester of the year 2021-2022
- **Objective limits:** Designing a blended learning environment based on educational robot programming presented through the website in the electronic part and in classroom workshops in the traditional part to develop the cognitive and performance aspects of problem-solving skills in a science course for intermediate school students.
- List of problem-solving skills in Science based on (understanding the problem - developing a plan for the solution - implementing the solution plan - validating the solution).

The twelfth chapter of the science subject for the second intermediate grade is entitled (Waves), in which students find great difficulties during learning, their weak scores on the monthly tests in them, the inadequacy of the teaching aids that support learning with them, and the abstraction of their information in the textbook.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

9.6. Procedures:

The researcher relies on the following procedures:

9.6.1- Review previous studies and research on problem-solving skills in Science.

9.6.2- Building a list of standards for designing the e-learning environment based on the programming of the educational robot, presenting it to experts and arbitrators in the field, and making modifications.

9.6.3- Building an achievement test for the cognitive aspects of problem-solving skills, presenting it to experts and arbitrators in the field, and adjusting.

9.6.4- Building an observation card for the performance aspects of problem-solving skills, presenting it to experts and arbitrators in the field, and making adjustments.

9.6.5- Building a product evaluation card for the performance aspects of problem-solving skills, presenting it to experts and arbitrators in the field, and adjusting.

9.6.6- gramming, presenting it to experts and arbitrators in the field, and making adjustments.

9.6.7- Selection of an exploratory sample of intermediate school students.

9.6.8- The exploratory application of research tools to verify their stability.

9.6.9- Choosing the primary research sample randomly and dividing it into control and experimental groups.

9.6.10- Pre-application of the achievement test and the observation card on the two research groups.

9.6.11- Processing of the empirical research group using the blended learning environment based on programming the educational robot.

9.6.12 - Post -application of the achievement test, observation card, and product evaluation card on the two research groups.

9.6.13- Data collection, analysis, and statistical processing.

9.6.14- Interpretation of the results.

9.7 Data Analysis:

Statistical analysis of the collected data was applied using the Statistical Package for Social Sciences (SPSS) Version (21) to process and calculate the data by applying the following statistical styles:

9.7.1. A Paired-Samples t-test to compare the mean scores for the pre-and post-applications of the critical thinking skills test and the Science concepts achievement test.

9.7.2. Effect size to study the effect of the independent variable (a blended learning environment based on educational robot programming) on the dependent variables (problem-solving skills) to find out the variation in the degrees of the dependent variables attributed to the effect of the independent variable. Therefore, the effect factor was extracted using Eta2 via (t) value

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

resulting from the mean difference in problem-solving skills in (science achievement tests- not card) for intermediate school pupils in pre and post-tests.
9.7.3. Using the two independent samples t-test to compare the mean scores of the first experimental group (CGA) and the second experimental group (EGB).

10. Findings and Discussions:

10.1. The Learning Theories and Blended Learning in Education

Firstly, constructivism theory is defined as applying learning theory and Epistemology. The main aim of these two theories is learning to students, but it is essential to start by defining constructivism.

This theory is about organizing the teaching environment with objects suitable for engaging the learner with content, which is crucial in the learning process. Nonetheless, there are some main principles of learning.

The researcher believes that the most prominent features of the behavioral model of the educational design process using the blended learning environment:

- Defining the educational content, dividing and analyzing it into sub-tasks and final, each of which has prerequisites that the student learns in the blended learning environment (the electronic part, the cognitive aspects of problem-solving skills are determined, and the presentation of images, videos, presentations, and simulations) and in the traditional part, during which the student implements the performance aspect of the specific skill (workshops). Classroom performs the required tasks using the robot).

The learners' previous experiences are identified, giving students solid motivations, stimulating their input behavior, and providing them with tribal experiences in the electronic part of the blended learning environment.

Good behavior is described, its characteristics, conditions of performance, and criteria by which performance is judged, and this is done through the blended learning environment.

Presenting all content elements: information, facts, concepts, principles, theories, etc., that are required to be acquired; To achieve this behavior, break it down or break it down into small units and subtopics.

Organizing the content elements in a specific and clear way and gradually formulating them, from easy to complicated and straightforward to complex, To help the learner perceive and acquire it.

- Allowing the learner to learn the required behavior (the electronic part through the blended learning environment) and to practice and repeat it to memorize it and keep its impact through providing appropriate activities and training (the traditional part through the classroom workshops).

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

- The learner is provided with feedback and reinforcement to guide him and improve his mistakes through the blended learning environment with both parts.

Second, the constructivist theory

Muhammad Khamis (2014, 23) defined the constructivist theory as an epistemological theory based on the basis that knowledge is learning and that knowledge is not objective, that is, it is not facts that exist in the external world separately from the individual. Instead, it builds them individually through his understanding and interpretation of the real world within an authentic context and in The light of the individual's experiences and experiences.

Clark (1994) stated that it is the educational strategy that leads to differences in learning, not the message form or delivery technology, while Kozma (1991) indicated that the strategy would not be possible without technology because technology can display images and graphics and make available The opportunity for the teacher to control his instruction and thus the role of the learner becomes positive in the educational environment and is no longer limited to observation only. Muhammad Khamis (2014). This is consistent with the constructivist theory that considers the learner to build knowledge through his understanding and interpretation of the facts in the external world and their general principles that he mentioned Muhammad Khamis (42,41,2003):

1- Providing and using the information in a practical way related to real life.
2- Constructivism focuses on the process of building information reflexively. All information is not provided to the learner in advance but is reflected on him through his research and conclusion to form knowledge.
3- The constructivist theory considers each learner a unique case and has a different way of learning.

This is what the blended learning strategy considers, which ensures the student’s participation in the educational process because the student must finish studying the module by performing the assigned activities and handing them over electronically through the blended learning environment to be evaluated by the teacher. (Ehab Shabak, 45, 2017).

Third: the theory of cognitive flexibility theory Spiro et al. Spiro, etc. (1987):

It believes that knowledge can be automatically restructured by transferring it in different contexts and stresses the importance of tribal knowledge for students and its role in acquiring new knowledge and that methods that rely on memorization do not allow the acquisition of higher levels of expertise and be a motivation for the learner to solve a specific

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

problem or obtain knowledge. The effect of Spiro etc. (1987) within the blended learning environment is best preserved.

10.2 Robots in Education

In education, a robot is defined as a set of tools and programs that seek to create an environment that is Competitive and motivational that will create an innovative generation controlled by computers and through which materials are designed

The educational robot includes the basics of design and its programming mechanism to perform multiple tasks (Jarwan, Dweik, 2016).

The Science of robotics and its use in education is based on the constructivist approach or what is known as the constructivist theory, as the student uses his information and previous knowledge, and what has been learned is affected by the environment that surrounds him in addition to society, language, and other matters. And his creativity in applying knowledge on the ground, and we conclude that the robot in education supports contemporary educational methodologies in its implementation, whether it is done within the specified curriculum or as an external project that considers thinking outside the box and activating innovative methods, designing models and integrating scientific and literary materials with technology to keep pace with labor markets (Arlegue, Pina, Moro, 2012).

The importance of the robot enables it to motivate and excite students about Science and to link it with tools of technology and e-learning.
At all levels, educational curricula help students to be creative and design because success does not depend only on knowledge but rather the mechanism of integrating the knowledge and materials that have been given and applied with practice on the ground and thinking in solving problems. (Alimisis,2013)

In education, the robot focuses on the integration of different sciences by establishing interconnected and interconnected relationships that lead to an increase in students' understanding of materials. Students carry out various tasks using Science, mathematics, techniques, programming language, and the primary language and expand by adding their knowledge, which ultimately leads to creativity and design; Because the sciences were not created abstractly and separated, but instead, they are connected in practical life as well as the teaching mechanism must be so. Design and creativity, because of which their knowledge and understanding of how technology and software work with Science will increase, in addition to the mechanism of presenting various concepts, knowledge, and academic lessons to students and transforming education into a personal, fulfilling, and enjoyable experience through exploration, handicrafts and thought that is taught helpfully. Therefore, it is worth emphasizing that we do not teach robotics to graduate robotics specialists but rather to help children understand design, installation, and the

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digital world to which they belong., Robotics can also be used to train students on whole numbers, decimals, fractions, measurements, geometry, or ratio and proportion, in addition to various Languages, dialects, and higher-order thinking skills, followed by the use of robotics to explain any of the scientific concepts such as order, arrangement, organization, evidence, examples, and explain

Each of stability, change, measurements, balance, or the relationship of form to function. (Yasin, 2015).

10.3. Problem-solving Skills in Science

Teaching modern sciences is based mainly on solving problems that significantly impact the development of the learner's thinking skills. Thus this topic has received considerable attention from researchers in the educational field.

Zeitoun (1999) believes that the purpose of the problem-solving method is to help students find solutions to problems and situations on their own through scientific reading, asking questions, presenting the problem, and reaching its solution, which prepares them for success in addressing the problems they face in their daily lives. This method also helps Students discover and apply scientific concepts and principles and benefit from them in new educational situations. Amer (2009) added that the problem-solving approach helps improve students' motivation and transfer the effect of learning. It creates confidence in students, pushes them to discover solving problems presented to them later, and increases their ability to deal with those problems with appropriate accuracy and speed. However, the problem-solving method helps develop students' creativity and trains them to use the scientific method of thinking.

11. Research results and dissection:

The researchers utilized two instruments (Science concepts and critical thinking skills tests) to test the researcher’s hypotheses. The following results were obtained and analyzed using SPSS statistical software version (21) as follows:

H.1. There is a statistically significant difference at the level (0.05) between the mean scores of the pre-and post-applications for intermediate school students (for the experimental group) by testing the cognitive aspects of problem-solving skills in the science course in favor of the post-application.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Table 3. Paired Sample Statistics of the cognitive aspects of problem-solving skills in the Science Achievement Test

Application	Mean	Std. Deviation	Earning		(t) Value	df	Sig	Eta2
			Mean	Std. Deviation				
Pre	15.03	1.520	13.700	2.103	35.675	29	0.00	0.977
Post	28.73	1.285						

The above Table indicates that the post-test scores are higher than the pre-test scores. Therefore, there is a development in the pupils' Problem-solving skills in Science after implementing the educational blended learning environment based on the programming of an educational robot.

H.2. There is a statistically significant difference at the level (0.05) between the mean scores of the pre-and post-applications for intermediate school students (the experimental group) with a note card for the performance aspects of problem-solving skills in the science course in favor of the post-application.

Table 4. Independent Sample T-Test of Science Concepts Achievement Test

Application	Mean	Std. Deviation	Earning		(t) Value	df	Sig	Eta2
			Mean	Std. Deviation				
Pre (CGA)	15.63	1.497	13.100	2.456	36.376	58	0.00	0.958
Post (EGB)	28.73	1.285						

The Table shows that the average degrees of the post-application to test the cognitive aspects of problem-solving skills in Science for intermediate school students in the control group amounted to (15,63) with a standard deviation (1,497). At the same time, it was equal to (28,73) with a standard deviation (1,285) in the experimental group. The arithmetic mean of the gain in the cognitive aspects was (13,100) with a standard deviation (2.456), and the (t) value of the difference between the two means was (36,376), which is a function at the significance level (0.05) as the calculated significance is (0. ,00), which is less than (0.05). The effect size was extracted using the Eta2 square through the value of (t) resulting from the difference in the mean scores of the dimensional application to test the cognitive aspects of problem-solving skills in Science for intermediate school students in the experimental and control groups. As it was shown in Table (2) that the value of the ETA square is (0.958), which indicates that the impact of the blended learning environment based on programming the educational robot is significant in developing the cognitive aspects of problem-solving skills in Science for intermediate school

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

students in Saudi Arabia, and this means Rejecting the null hypothesis and accepting the second research hypothesis.

H.3. There is no statistically significant difference at the level (0.05) between the mean scores of the two research groups (control - experimental) in the post-test of the cognitive aspects of problem-solving skills in the science course among intermediate school students.

Table 5. Black's constant value for the effectiveness of the blended learning environment based on educational robot programming among the students of the experimental group in the pre and post-applications to test the cognitive aspects of problem-solving skills in Science

Mean Scores of Pre-tests	Mean Scores of Post-tests	Total Grade	Black Adjusted Gain Ratio	Significance
15.03	28.73	32	2.175	Accepted

It is noted from the Table that the adjusted gain percentage for Black to judge the effectiveness of the blended learning environment based on programming the educational robot was (2,175). It exceeded the minimum (1.2), and therefore the value indicates that the blended learning environment based on programming the educational robot was effective In developing the cognitive aspects of problem-solving skills in Science for intermediate school students, which means rejecting the null hypothesis and accepting the third research hypothesis.

H.4. There is effectiveness in using a blended learning environment based on educational robot programming to develop the performance aspect of problem-solving skills in Science for intermediate school students in the Kingdom of Saudi Arabia.

Table 6. An Independent Sample T-Test of Problem-solving Skills in Science Test

Application	Mean	Std. Deviation	Earning Mean	Earning Std. Deviation	(t) Value	df	Sig	Eta2
Pre (CGA)	36.27	2.532	35.633	3.117	31.909	29	0.00	0.972
Post (EGB)	71.90	3.403						

It is noted from Table that the average score of the observation card of the performance aspects of problem-solving skills in Science for intermediate school students in the tribal measurement was (36.27) with a standard deviation of (2,532). At the same time, it was equal to (71.90) with a standard deviation of (3,403).) In the dimensional measurement, the arithmetic mean of the gain in the performance aspects was (35,633) with a standard deviation of (3,117), and the (t) value of the difference between the two averages was (31,909), which is a function at the significance level (0.05) as the calculated significance is (0. ,00), which is less than (0.05). The effect size was extracted using the Eta2 square through the value (t) resulting from the difference in the mean scores of the observation card of the performance aspects of problem-solving skills in Science for intermediate school students between the pre-measurement and measurement dimensional. It was found from Table (29) that the value of the ETA square is (0.97), which indicates that the impact of the blended learning environment based on programming the educational robot is significant in developing the performance aspects of problem-solving skills in Science for intermediate school students in the Kingdom of Saudi Arabia. This means rejecting the null hypothesis and accepting the fourth research hypothesis.

H.5. There is no statistically significant difference at the level (0.05) between the scores of the two research groups (control and experimental) in the observation card of the performance aspects of problem-solving skills in the science course post-application among intermediate school students.

Table 7. Value of the results of the independent samples t-test to verify the significance of the difference in the observation card of the performance aspects of problem-solving skills in Science between the mean scores of the experimental and control groups in the post-application.

Application	**Mean**	**Std. Deviation**	**Earning**		**(t) Value**	**df**	**Sig**	**Eta2**
			Mean	**Std. Deviation**				
Pre (CGA)	36.20	2.511	35.700	3.879	32.818	58	0.00	0.949
Post (EGB)	71.90	3.403						

It is noted from Table that the average degrees of the post-application of the observation card of the performance aspects of problem-solving skills in Science for intermediate school students in the control group amounted to (36,20) with a standard deviation (2.511). At the same time, it was equal to (71,90) with a standard deviation (3,403) in the experimental group. The arithmetic mean of the gain in the performance aspects was (35.700) with a standard deviation of (3,879), and the (t) value of the difference between the two averages was (32,818), which is a function at the level of significance (0.05) where the calculated significance is (0.00), which is less than (0.05). The effect size was extracted using the Eta2 square through the value of (t) resulting from the difference in the mean scores of the dimensional application of the observation card of the performance aspects of problem-solving skills in Science for intermediate school students in the two groups Experimental and control. It was found from Table (5) that the value of the ETA square is (0.949), which indicates that the impact of the blended learning environment based on programming the educational robot is significant in developing the

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

performance aspects of problem-solving skills in Science for intermediate school students in the Kingdom of Saudi Arabia, and this means Rejecting the null hypothesis and accepting the fifth research hypothesis.

Conclusion

12.1- There is a statistically significant difference at the level (0.05) between the mean scores of the pre-and post-applications for intermediate school students (for the experimental group) by testing the cognitive aspects of Science problem-solving skills in favor of the post-application.

12.2- There is a statistically significant difference at the level (0.05) between the mean scores of the pre-and post-applications for intermediate school students (the experimental group) with a note card for the performance aspects of Science problem-solving skills in favor of the post-application.

12.3- There is no statistically significant difference at the level (0.05) between the mean scores of the two research groups (control-experimental) in the post-test of the cognitive aspects of Science problem-solving skills among intermediate school students.

12.4- There is effectiveness in using an integrated learning environment based on educational robot programming to develop the performance aspect of Science problem-solving skills for intermediate school students in the Kingdom of Saudi Arabia.

12.5- There is no statistically significant difference at the level (0.05) between the scores of the two research groups (control and experimental) in the observation card of the performance aspects of Science problem-solving skills in post-application among intermediate school students.

12.6- It is effective to use an integrated learning environment based on educational robot programming to develop the performing aspect of Science problem-solving skills for intermediate school students in the Kingdom of Saudi Arabia.

These findings agree with several studies such as Shami (2020), Jarwan Waldweik (2016), Eguchi (2014), Elkin et al. (2014), Al-Zahrani (2014), Abu Musa and Al-Sous (2014), Al-Hadabi and Al-Jajeb (2011), Bartneck (2011), Rusk (2008), Islam Allam (2007), Valerie (2006), and Kanda et al. (2004).

Recommendations

Considering the findings of the research, which proved the validity of the research hypotheses, several recommendations can be made, which are as follows:

1. Spreading awareness of the importance of blended learning environments in developing cognitive and skill aspects and solving problems in Science.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

2. Activating the role of blended learning environments based on an educational robot as one of the effective means and tools in the field of skill development for students.

3. Adopting the blended training environment designed by research to develop science problem-solving skills for all intermediate school students in the Kingdom of Saudi Arabia.

4. Holding training courses for teachers on modern teaching methods and employing educational robots in blended learning environments to benefit from them in education.

5. Suggest implementing training courses in educational robots and their use in education for intermediate school teachers.

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