ESI Preprints **Not Peer-reviewed**

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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Doi: 10.19044/esipreprint.4.2023.p15

Approved: 09 April 2023
Posted: 11 April 2023

Cite As:
Agwa M.G.E., El-Desouki M.I. & Elnagar M.E. (2023). *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*. ESI Preprints.https://doi.org/10.19044/esipreprint.4.2023.p15

Abstract

The goal of this research is to measure 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. The research sample was randomly selected from sixty (60) students in the second year. The researcher used the experimental method with a quasi-experimental design (the design of the control group - experimental with a pre and post-test) Where the experimental group is taught through a blended learning environment based on the programming of the educational robot The control group is taught traditionally.

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

Introduction

Preparing learners for work, citizenship, and living in the twenty-first century is a challenging task. Globalization, new technologies, immigration, international competition, changing markets, and environmental challenges drive the process of acquiring the skills and knowledge students need to live and succeed in the twenty-first century. Educators and researchers describe these abilities as twenty-first-century skills, higher-order thinking skills, and deeper learning outcomes to be able to meet the challenges of the twenty-first century.

Here we ask: What are the critical skills that today's workforce must develop and master?

There is a clear consensus that new approaches to learning must consider the characteristics of today's students and become more inclusive, and students must be supported to develop competencies and problem-solving skills throughout the various stages of education. Disruptions in the labor market due to changing technologies can also create valuable new jobs, but they can also destroy many existing occupations with serious consequences for economies in the short, medium, and long term. The 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 school and deal with it, including many situations, which 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 in their daily lives and provides opportunities for understanding, benefit, and application in similar situations (Thouqan Obeidat, and Suhaila Abu Al-Sameed, 2007). In this regard, Rahim 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. In this context, multiple educational strategies can be followed to effectively address and solve problems.

The importance of teaching science is to enhance students' thinking and problem-solving abilities. 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. (Marwa Al Shafia, 2019).

The study of Fawzi Al-Adawi and others (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 leading to solving those problems, as confirmed by the study of Noha Al-Hussi and others (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 represented in understanding and learning abstract concepts and complex skills, which is evident in the unit of waves assigned to intermediate school students, where students struggle to deal with calculations of 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. (Amani Al-Ghamdi, and 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 learning in the long term, which is what all those in charge of the educational process seek, especially since students can be taught these skills through organized training, which was confirmed by the study of (Hamdi Al-Faramawi , 2002), (Ayman Habib, 2003), (Mohamed Sayed, 2004), (Mona Badawi, 2006). The same applies to other mental and performance skills and abilities, as what applies to cognitive thinking skills applies to problem-solving skills.

2. Problem of Research

Through the researcher's experience as an official for training and development, he noticed a clear deficiency in the problem-solving skills in the science of students in the intermediate stage in science, and that students turn away from studying it as a result of the difficulty of its topics, especially topics related to waves, in which they find many difficulties and obstacles that prevent their understanding of science problems. And the practice of its applications and experiments in practice, and the researcher looked at the scores of the monthly tests during the third semester and found deficiencies in the scores on the tests that include the waves unit.

Then the researcher studied the problem facing the students, in addition to the question of the science teachers, where it became clear that there is a deficiency in the problem-solving skills of the students, especially in the twelfth chapter (Waves), which the students’ grades decrease significantly, as this chapter is taught in traditional ways using Discussions and verbal language.

The researcher also carried out an exploratory study on a sample of (10) second-grade students in the intermediate stage in Andalusia schools in the Taif educational region. The study concluded that (100%) of the study sample suffer from difficulties in science, and that (70%) find that The topic of waves and solving the issues and problems involved in them is one of the most difficult difficulties they face in studying science, due to the difficulty in imagining problems and providing solutions to their problems, as confirmed (90%) of the study sample their preference for the method of solving problems in learning science, and the need (90%) of students to learn Steps to solve problems and understand the mechanisms of their implementation in science, and (100%) of the 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. The exploratory study also included a test in problem-solving skills in Science in the wave unit, which all students failed, as no student from the survey sample exceeded the passing score.

Because of the reality of teaching science in schools, especially in the Kingdom of Saudi Arabia, concerning the development of problem-solving skills in science, the researcher found a lack of interest in developing these skills and a lack of interest in developing realistic experiences. A study by: Noha Al-Hussi and others (2020), Fawzi Al-Adawi and others (2017), Tawfiq Marei and Muhammad Al-Haila (2013), Turki Al-Salami (2013), Nasser Al-Awaishek (2009), and Hassan Al-Khalifa (2005).

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.

4.5- 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.

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

4.7- It helps in developing teacher performance evaluation so that the focus becomes on the real performance of the teacher in providing the learner with the skills necessary for him in his life.

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 level of mastery of problem-solving skills required in the intermediate stage.

5.4 - You may add new generalizations and ideas about how to plan lessons in this way in teaching science.

5.5 - Teachers know the importance of applying the use of educational robot programming, which may result in the development of

teaching methods used in teaching 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 real performance of the teacher in providing the learner with the skills necessary for him in his life.

6. Variables of Research

The researcher relied on the following variables:

Independent Variable: Teaching to the experimental group using 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 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.

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.

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.

8. Methodology OF Research:

8.1 Participants of the Research:

The current research community is represented and sampled as follows:

Research community: It is represented by intermediate school students from the (second intermediate) grade in the city of Taif, Kingdom of Saudi Arabia.

The research sample: It is represented in the selection of students (60 students) from the (second intermediate) grade in a random manner (control-experimental) in Safwat Al-Tali'ah Private Schools and Al-Andalus Private Schools in Taif.

Table 1. Research sample

Group	Students(N)	Total Percentage
Controller Group (CGA)	30	50%
Experimental Group (CGB)	30	50%
Total	60	100%

8.2 Research Design:

Analytical descriptive approach: to collect, categorize, analyze, and interpret data by reviewing the literature and studies related to the topic of the research, and the researcher uses it to describe and analyze the foundations of the design of the blended learning environment and the cognitive and performance aspects of problem-solving skills in science. The research followed the two-group 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	Pretest	Treatment	Posttest
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	

8.3 Instrumentation:

The research includes the following tools:

8.3.1- 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 of criteria for producing a blended learning environment based on educational robot programming.

8.3.2 Measuring tools:

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

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

8.3.3 - A note card for the performance aspects of problem-solving skills in the 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.

8.3.4- Experimental tool:

-Embedded learning environment based on educational robot programming.

8.4. 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.

8.5 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 the city of 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 that is 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 the science course for middle 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.

8.6 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:

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

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 that are attributed to the effect of the independent variable. Therefore, the effect factor was extracted using Eta2 via (t) value resulting from the mean difference in problem-solving skills in (science achievement tests- not card) for intermediate school pupils in pre and post-tests.

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).

9. Theoretical Framework:

One of the most important ways for the learner to move away from the traditional reality of education, which is 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 the skill of 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, and many educational strategies can be followed in solving and addressing problems.

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, especially 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.

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 about 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 the main crucial thing 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 previous experiences of the learners are identified, giving students strong motivations and stimulating their input behavior, as well as 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 difficult, and from simple 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).
- 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, but rather builds them individually through his understanding and interpretation of the real world within a real 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 functional 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 rather 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 knowledge and be a motivation for the learner to solve a specific problem or obtain knowledge. Within the blended learning environment the effect of Spiro, etc(1987) 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 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 basic language, and expand by adding their understanding, which ultimately leads to creativity and design; Because the sciences were not created abstractly and separated, but rather 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 in a useful way. 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 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 have a significant impact on the development of the learner's thinking skills, and thus this topic has received great 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, and this method also helps The student will discover and apply scientific concepts and principles, and then benefit from them in new educational situations. Amer (2009) added that the problem-solving method helps improve students' motivation and transfer the effect of learning, and it creates confidence in students and pushes them to discover solving problems that are presented to them later and increase 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. Procedures:

The researcher relies on the following procedures:

1- Review of previous studies and research in the field of problem-solving skills in science.

2- Building a list of problem-solving skills and presenting it to experts and arbitrators in the field and adjusting.

3- 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.

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

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

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

7- Building an e-learning environment based on educational robot programming and presenting it to experts and arbitrators in the field and making adjustments.

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

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

10- Choosing the main research sample at random and dividing it into two groups, control and experimental.

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

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

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

14- Data collection, analysis, and statistical processing.

15- Interpretation of the results.

Research results:

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.

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 pretest scores. Therefore, there is a development in the pupils' Problem-solving skills in science after the implementation of 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), while it was equal to (28,73) with a standard deviation (1,285) in the experimental group, and 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), and 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 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), and 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		(t) Value	df	Sig	Eta2
			Mean	Std. Deviation				
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) while 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), and 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), while it was equal to (71,90) with a standard deviation (3,403) in the experimental group, and 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), and 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 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.

H.6. It is effective to use a blended learning environment based on educational robot programming to develop the performing aspect of problem-solving skills in science for intermediate school students in the Kingdom of Saudi Arabia.

Table 8. 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 of the observation card of the performance aspects of problem-solving skills in science

Mean Scores of Pre-tests	Mean Scores of Post-tests	Total Grade	Black Adjusted Gain Ratio	Significance
36.27	71.9	84	2.033	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 (2,033), and 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 performance aspects of problem-solving skills in science for intermediate school students, which means rejecting the null hypothesis and accepting the sixth research hypothesis.

Discussion:

The results obtained from the experiment revealed the high effectiveness of using the blended learning environment based on educational robot programming in developing problem-solving skills in science. The current research led to the following findings:

The proposed blended learning environment based on educational robot programming has proven its effectiveness in developing problem-solving skills in science for intermediate school students in the second grade at Safwat Al-Taliah Private School.

The feedback from the participants was positive through their comments and participation as they felt comfortable and motivated to interact with the educational robot in a supportive atmosphere so that they could develop problem-solving skills in the sciences that arose from the sixth unit (light and waves).

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 the field of developing cognitive and skill aspects and solving problems in science.
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 methods of teaching and employing educational robots in blended learning environments to benefit from them in teaching.
5. Suggest the implementation of training courses in the field of educational robots and their use in education for intermediate school teachers.

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