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The Role of Educational Robot Programming in Developing Creative Thinking Skills among Kindergarten Children Aged (4-5) Years "A Comparative Study"

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Abstract

The current study aimed to identify the role of programming an educational robot in developing creative thinking skills among kindergarten children aged (4-5) years. As well as knowing the significance of the differences between kindergarten children aged (4-5) years in the level of creative thinking according to the type of practice for programming the educational robot. The researchers also used the causal-comparative approach as the most appropriate approach for this study. The study sample consisted of (71) kindergarten children out of (108) children aged (4-5) years present at the level of Al-Manhal Kindergarten and Bin Hamida Hisham Kindergarten. The sample was selected randomly. To achieve the research objectives, Paul Torrance (E.P.) test for creative thinking in children using movements and actions (1981) was relied upon. After processing the data, the study reached several results: The most important of them are: Programming the educational robot has a role in developing creative thinking skills among kindergarten children. The (Fluency) dimension ranked first, followed by the (Originality) dimension in second place, and the (Imagination) dimension ranked third and last. - There are statistically significant differences at the level ($\alpha \leq 0.05$) between the averages of creative thinking skills among kindergarten children who use the educational robot and kindergarten children who do not use the educational robot at the age of (4-5) years. In favor of the kindergarten that uses the educational robot.

Keywords: *Robot; Educational Robot Programming; Creative Thinking; Kindergarten Children.*

1. INTRODUCTION

Educators emphasize that early childhood is one of the most important and difficult stages of development in a child's life because it is the cornerstone of building a child's personality as "preschool is the foundation of a child's later life, and most children's tendencies are formed right or wrong during their early years" (Ramadan; Abdulkader, 2021, p. 188). As the study of Lazhar, B.M., et al. (2022) indicates that a child is born with an innate willingness to accomplish certain things that require acquiring a skill to refine and discover in order to reach a high level of creativity and the ability to perform, formulate problems and solve them in various areas of life. Therefore, Torrance (1966) considers that early childhood and early stages of education represent the golden years of developing and enhancing creative thinking, and they are one of the foundations of innovative development, through which children

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represent the largest growth rate of innovation functions more than any later stage of life (Abd al-Salam et al., 2019, p. 225).

The development of thinking skills has also become a basic requirement and educational need for education, especially in early childhood. The reason for the inability of learners to store all information in their memory may be that kindergarten centers and schools must bear in mind and in their educational policies the need to rehabilitate and teach children how to learn and think, in order to keep pace with rapid cognitive and social changes. This is possible only through modern technological programs such as educational robot programs and contemporary educational curricula that focus on the teaching of thinking skills through a clear set of steps suited to the stage of growth and absorption capabilities of each individual to some degree of creativity and innovation. The Massachusetts Institute of Technology (MIT) has demonstrated that "in controlling a concrete three-dimensional and electronic tool, this promotes certain learning patterns among students at an early age and, building on this idea, researchers have begun to develop ways to use small mobile robots as an educational tool in primary and secondary schools" (Al-Aqeel, Al-Shamri, 2015, p. 486).

2. RESEARCH PROBLEM

The application of educational robot programming in many countries of the world has been widely used at different levels of education in general and in kindergartens in particular, given its importance and role in achieving the objectives of the kindergarten curriculum and programs through various educational robot activities and games in order to develop the physical, mental, psychological and social characteristics of early childhood. Most educational systems have therefore taken care of kindergartens in terms of the specifications, standards and quality equipment that children's day-care facilities should have.

The rapid and unprecedented advances in robot science and artificial intelligence have also led to increased reliance on robots for many tasks in the field of education. Most countries have invested in this area and developed the potential for research and development, because robot is the main entry point for teaching basics and principles of design, programming, implementation and research. It also provides an educational environment that encourages manual work and promotes communication skills, role-sharing and decision-making. The robot also relies on the theory of complementarities between science by integrating different sciences to acquire knowledge and design fundamentals as well as electronic and mechanical engineering, whether it is used as an educational curriculum within specific goals and plans, or as a non-systematic educational activity that is given after school hours, or during summer activities and competitions based on project fundamentals and the development and evaluation of hypotheses followed by the resolution of difficult problems requiring higher thinking skills (Elikin; &Sullivan; &Bers, 2014); (Al-Masaieed, 2020). Like critical thinking, mathematical thinking, creative thinking and other levels of thinking.

A study (Al-Hasehmi et al., 2018, p. 4) indicates that the use of robot as one of the most important applications of artificial intelligence plays a major role in education, particularly in the process of problem-solving and the generation of innovative ideas, which are essential skills that must be acquired by students in their various stages of study and in various sciences and disciplines, so States and global corporations are seeking to provide their human cadres with systematic thinking skills to manage and organize the process of finding creative solutions and generating new ideas.

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The study (Al-Masaieed,2020) conducted by some private schools in Amman to survey information on the part of teachers in the use of educational robots also confirms the effectiveness of the use of the latter; where it has found considerable interest among some teachers in the use and application of robots in education to keep pace with the increasing motivation of students towards advanced technical learning and their desire to increase their performance and educational attainments and develop their creative thinking skills, but this has come up against some of the challenges faced by teachers in the use of educational robots.

Through previous studies on the role and importance of educational robots in the educational environment and the potential development of intellectual skills among learners, this study highlighted the role of educational robot programs in developing creative thinking in kindergarten children aged (4-5). The problem of the study has therefore been limited by the following questions:

- Does robot educational programming play a role in the development of creative thinking skills in kindergarten children aged (4-5) years in Algeria?
- Are there statistically significant differences at the level) $\alpha \leq 0{,}05$ (of the average creative thinking skills of kindergarten children using the teaching robot and kindergarten children not using the teaching robot at the age of 4 to 5?

3. STUDY HYPOTHESES

To answer the questions raised, the following assumptions have been formulated:

- The educational robot has a role in developing creative thinking skills among kindergarten children aged (4-5) years in Algeria
- There are statistically significant differences at the level ($\alpha \leq 0.05$) between the averages of creative thinking skills among children of the kindergarten that use the educational robot and those of the kindergarten that do not use the educational robot at the age of (4-5) years.

4. OBJECTIVES OF THE STUDY

The present study aims at:

- Unveiling the role of educational robot programming in the development of creative thinking skills in kindergarten children aged (4-5) years in Algeria is revealed.
- Identifying the extent to which there are statistically significant differences between averages of creative thinking skills in kindergarten using educational robots' children at the age of (4-5) years, and kindergarten not using educational robots' children at the age of (4-5) years.

5. IMPORTANCE OF THE STUDY

The importance of the present research is due to the weight of the variables it addresses, namely creative thinking skills, which take the lead in educational research, especially in early childhood, by highlighting the role of the educational robot programming in the development of creative thinking skills in kindergarten children aged (4-5) years in Algeria and the importance these skills play in shaping the personality of kindergarten children, as well as the

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possibility of including the educational robot in kindergartens and primary schools for children, by taking advantage of and taking into account the results of this research.

6. THEORETICAL ASPECT OF THE STUDY

6.1. The educational robot:

It is a subset of teaching techniques, which are used to facilitate learning and improve educational performance, and which provide the implementation and the ability to add social interaction to the learning context, thereby advancing software-based learning. Al-Omari (2022) defines an educational robot as: a structural body with arms and limbs connected to each other with ties that enable them to move in different directions on the basis of orders received, which is produced by the robot, which is programmed by dedicated computer applications.

6.2. Educational robot programs:

The kindergarten child's ability to use robotic tools and carry out orders and tasks that he or she wishes to do through his or her specific programming language.

Abdul Jawad (2019) defines the ability of students to draft a set of orders that are written according to a set of rules and defined by the programming language (Visual Basic.NET) and then goes through several stages until they are implemented on the computer.

Educational robot programming relies on the implementation of computer-programmed tasks by a structural device consisting of a set of parts with electronic chips in which orders are preserved and then executed as programmed for each mission. Garwan and Waldwick (2016) define "Educative robot programs that encourage people to invent different ideas and work on inspiring designs from different materials with the ability to program and control all of this by computer" (Al-Anzi, 2018) in (Al-Omari, 2022).

6.3. Educational robot components:

The educational robot consists of several parts that perform its functions by following a set of instructions stored in the electronic memory of the device, which are designed through specialized computer software, linked to the robot parts. Robots are one of the modern technologies that are gradually taking a prominent place in all fields. In 2008, the number of service robots exceeded the number of industrial robots. The robot is entering the daily lives of individuals at school and at home, and the social impacts that it has on children and adolescents are very important. It helps them to grow and develop culturally and educationally. Attention must therefore be extended to bringing the educational robot into line with the lives of students in order to provide them with every scientific benefit, as the technological development continuous (Al-Badou, 2017, p. 140).

6.4. Justifications for the use of educational software in kindergartens:

- Most studies have shown that artificial intelligence has significantly improved children ' s perceptions of artificial intelligence, automation, computer science, robotics and other skills such as creativity, emotional control, collaborative information, reading and writing skills, and computational thinking. Future directions are also being discussed for research into artificial intelligence in early childhood. (SuYang, 2020).
- The need to reform and develop educational systems and to advocate for the use of communication and information technologies in this area.

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- The increasing need for tools to promote self-learning for learners, the most important of which is educational software.
- The beginning of the emergence of many educational software in Arab markets, with commercial models lacking proper vision and thorough pedagogical treatment.
- The need of teachers at the kindergarten level to produce software that helps them to complete their tasks, as well as acquire skills to use and employ computer techniques and software in the service of their professional, educational and academic tasks.
- The widespread use of multimedia in the production of various materials, ... which emphasizes the need to ensure that various educational materials are made available in service for the curricula at all levels of education.
- The increasing numbers of Arab personnel with skills in the field of computer science and informatics and its manufacture and the need to draw on their expertise and employ them in this vital area (Al-Mawadih et al., 2013, p. 205-206).

6.5. Role of educational robotic games in developing children's intellectual skills:

If we look at the important role of play in the theories of psychology and education, and the important role it plays in developing the social, mental, linguistic and other skills of the child, they all point to the fact that early childhood play has become the keystone of children's learning, especially since the quality of the games that children play today is no longer traditional. Today's children have been drawn more towards electronic games than other traditional games, as Lev Vygotsky has expressed that "every play has rules that govern it and help in the child's development, and as the knowledge age progresses and evolves, we have another kind of educational play: e-playing" (Machit; Bahadik 2019, p. 145). The rapid development of the electronics world has contributed to the use of e-software in the educational environment, which is now known as educational robots, designed according to programs that help learners develop their intellectual skills, and educational institutions have accelerated the introduction and investment of educational robots' programs in educational activities in order to develop children's creative thinking skills and use their intellectual processes more effectively.

6.6. Creative thinking skills:

Creative thinking is defined as the ability of an individual to produce solutions and ideas that have the greatest degree of ulteriority, flexibility and originality, and far-reaching repercussions, in response to a situation or a problem. This production is not spontaneous or random, but the product of creative efforts, and creativity is a human quality that has characterized it since ancient times.

Gilford (1965) and Torrance (1966) agreed that nothing could contribute to raising the well-being of nations and peoples and to achieving satisfaction and mental health more than to raising the level of their innovative performance. This is perhaps even more true of our society, which is in dire need of innovative individuals capable of offering new solutions to our accumulated problems (Abraham, 2001). As is well known, creativity is of particular importance in all developing societies, where it is an important element in the development of nations. The true human power that helps to promote nations is the category of creative thinking. Accordingly, our children must be prepared to be creative by creating an educational environment rich in the excitement that attracts their attention, providing them with information

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and skills in multiple fields, helping them to discover their mental abilities and develop their preparations, giving them freedom to express their views, to move away from what is familiar and to help them to think properly. Thus, (Al-Aqeel, Al-Shamri, 2015, p. 485) consider that the educational environment has become a breeding ground for students ' talents and creativity to keep pace with the technical development of the world and to stimulate students ' leadership and innovation, through the implementation of various scientific programs and activities, providing them with basic information and skills that are in keeping with the skills of the twenty-first century and that contribute to enhancing students ' abilities in modern ways and methods in accordance with global academic standards.

7. APPLIED PROCEDURES FOR THE STUDY

7.1. Methodology of the study:

Given the nature of the current study, which attempts to reveal the differences between the averages of kindergartens using educational robot programming children and those of kindergartens not using educational robot programming children at the age of 4 to 5, researchers have relied on the comparative causal approach as the appropriate method for this study.

7.2. Study Population:

After the field visit of the researchers during the survey, the original study population was identified as 108 children aged between 4 and 5 years at the beginning of the school year (2022-2023), separated in two kindergartens, 40 of whom were children belonging to Al-Manahil kindergarten (55.56%) and 32 children belonging to Ben Hamida Hisham kindergarten (44.44%), in different study departments (introductory sections, preparatory sections and kindergartens), as shown in the following table:

Table No. (01): Distribution of members of the study population by age and kindergarten

Kindergarten	Age Groupe		Total	Percentage %
	4 years	5 years		
Al-Manahil (With Robots)	23	41	64	59,26%
Ben Hamida Hisham (Without Robots)	19	25	44	40,74%
Total of the Study Population	42	66	108	100%

Source: Prepared by the Researchers

Table (01) shows a convergence in the study population, with a total of 108 children in both kindergartens, 64 of them in Al-Manahil, representing (59.26%). While there were 44 children in the Ben Hamida Hisham kindergarten, (40 74,%) of the total study population.

Hence, we have identified the field of study by identifying the study population which consists of the children of these kindergartens, which in turn leads us to determine the sample of the study.

7.3. Study Sample:

Owing to the characteristics of the study community, which consists of 108 kindergarten children, the basic study sample was selected in a non-indiscriminate manner to be composed of 71 children between the ages of 4 and 5 years, distributed according to the different study

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variables (sex, age, kindergarten), where (40.85%) are male and (59.15%) are female. This is further illustrated by the following table:

Table No. (02): Distribution of the study population members by age and type of kindergarten

Age / Kindergarten	Age Groups		Total
	4 years	5 years	
Al-Manahil (With Robot)	21	19	40
Ben Hamida Hisham (Without Robots)	13	18	31
Total	34	37	71
Percentage %	47,89%	52,11%	100%

Source: Prepared by the Researchers

Table (02) shows a convergence in the study sample, where there are (21) children aged 4 in Al-Manahil kindergarten and (13) in Ben Hamida Hisham, totaling (34) which represents (47,89%) of the study sample, whereas there are (19) children aged 5 years in Al-Manahil kindergarten and (18) in Ben Hamida Hisham, together (37) representing (52,11%) of the study sample, so that the total number of the study sample members gets to (71).

7.4. Data collection tools:

The value and credibility of scientific research depends on the ability of the researcher to identify the appropriate tools he uses in dealing with data related to his subject, and building them in such a way that makes him confident of the obtained results. Despite the diversity of data collection tools, each subject has a suitable tool for it, researchers have relied on the Torrance test (1981), to measure the creative thinking of kindergarten children, where the test is aimed at measuring the creative thinking skills of kindergarten children and identifying their creative abilities.

7.4.1. Description of the Torrance test to measure the creative thinking of kindergarten children:

In this study, the researchers used the children's creative thinking test using movements and actions by Paul E. Torrance (1981), translated into Arabic, Mohammed Thabit Ali Al-Din (Katami et al., 2007, p. 217). This test is considered appropriate for children between the ages of 3 and 7. One of the advantages of this test is that it does not require the child to respond verbally, although verbal response is acceptable. Children of this age are limited in their linguistic abilities, yet verbal responses are accepted, and the responses expected from children on this test are within their capabilities.

a. Test steps:

The test consists of four activities as follows:

First: how many ways? The examiner says to the child: Each of us can walk or run from one place to another. Can you move from this place to that (between two places in the room) without walking or running? The examiner shall encourage the child to answer and shall record a list of the child's responses or movements.

Secondly: Can you move like...? Can you emulate the animal movement or the following things: (The examiner gives the names of the animals or things one by one) a tree, a rabbit, a fish, a snake, a car, an elephant. A reference to each name is recorded as follows:

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Table No. (03): Type of movement and degree of approval

Type of movement	Inappropriate	Appropriate	Excellent
Degree of Approval	1	2	3

Thirdly: What other ways? The examiner gives the child an empty matchbox and asks him to throw it away in the trash can, and then he gives him another one and says, "Can you put this box in the trash can using another method?" The examiner records the child's responses.

Fourthly: Use: The examiner grabs an empty matchbox can and says to the child: Can you think of any way this empty can be used instead of throwing it away? The examiner records all the responses given by the child.

b. Test correction:

The test gives three subgrades and a total mark, as follows:

- **Fluency**: It is the total number of appropriate responses to the first, third and fourth activities.
- **Imagination**: The degree of imagination is estimated on the basis of the child's responses to the second activity as follows:
  - Zero (0): if the child does not move and does not imagine the role required.
  - One (1): if an inappropriate effort is made by him or her to the required role.
  - Two (2): if his or her role is appropriate without further elaboration.
  - Three (3): if the performance exceeds the minimum requirement, the child uses his or her imagination to explain and detail the role.

The child is given two extra points for telling his story through movements and actions, which is an elaboration of the required role.

- **Originality**: The estimation of originality depends on statistical scarcity. The response, if appropriate, is counted, still it is rare.

The degree of originality is assessed on the basis of the child's responses to the first, third and fourth activities. And the child is given:

- Zero (0): for common responses.
- One (1): for the not so common ones.
- Two (2): for rare responses.

In the first activity, the degree of originality of the following responses is as follows:

- Zero (0): for flipping, spinning around himself, getting in the car, riding a bike, running, crawling, walking on one of the legs or jumping.
- The degree of originality of the following responses is (1): crawling on the back, flying, swimming, walking on four, walking on the heels, walking on the hands.
- The degree of originality of the following responses is (2): skating, sitting on a chair and pushing it, riding on a wooden plank, dancing, playing ball, limping or rolling.

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In the third activity (What other methods?), the child gets:

- Zero (0): on originality for throwing the box by his hands or feet while standing or sitting.
- One (1): for tying the matchbox to a thread or throwing it at with a ball bat, hitting it with the head or putting it on a pencil.
- Two (2): for hitting it with a ruler, putting it in a cloth piece, putting it on the cheek, standing on a chair and throwing it, grabbing it with a plier, or blowing it out of the hand.

In the fourth activity (Use), the following answers are evaluated at:

- Zero: storing matches, wheat, corn, buttons, keys, pins or nails, and making it into a table, a phone, a bed, a window, ashtray, coloring box or a moneybox.
- The following answers are given (1): keeping stamps in them, make a buffet out of it or a refrigerator, storing photographs, a watch box, a gift box or a medicine box.
- The following answers get (2): I put makeup in it, I make traffic lights with it or an accordion, a tower, a statue, a bell, a tank, a bird, a lantern or a ruler.

7.5. Psychometric properties of the tool:

a. Accuracy of the test:

To calculate the accuracy of the standard used in the study, the following criterion has been relied upon:

Ericsson studied the relationship between the test scores of children and their sense of humor on a sample of 28 children between the ages of 4 and 5. The correlation coefficients of fluency and sense of humor were between 0.44 and 0.46, whereas the correlation coefficients of originality and sense of humor were between (0.40 and 0.42). As sense of humor is a characteristic of creative behavior, these associations provide evidence of the accuracy of the creative thinking test using movements and actions (Katami et al. 2008, p. 220).

b. Consistency of the test:

The correction consistency (i.e., the agreement of the correctors) was measured on a sample of 30 children in the second grade (in an American study) and the overall consistency level was (0, 60).

In a second American study, the consistency coefficient was measured by repeating the test two weeks later on a sample of 20 children aged 3 to 5 years, the overall consistency level was (0,84).

In a study conducted in Egypt, the consistency factor for a sample of 42 children aged 3 to 5 was (0.76) for fluency, (0.77) for originality, (0.72) for imagination and (0.82) for the total grade. In a sample of 56 children aged between 6 and 7 years, the consistency factor was (0.49) for fluency, (0.26) for originality, (0.42) for imagination and (0.43) for the total grade (Katami et al. 2008, p. 219).

From the above, the coefficients of accuracy and consistency are high, and statistically significant, indicating that the test of creative thinking has a high degree of consistency.

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7.6. Procedures for the application of the basic study:

The study experience has been applied in accordance with the following steps:

- At the end of February of the 2022-2023 school year, the researchers carried out a plan for field work in Al-Manahil and Ben Hamida Hisham kindergartens, in the state of Bordj Bou Arreridj, Algeria, due to the availability of two preparatory classes, consisting of (71) boys and girls, distributed equally among the two kindergartens (Al-Manahil/a), (Ben Hamida Hisham/b), Al-Manahil kindergarten (a) was selected as an experimental group, and Ben Hamida Hisham kindergarten (b) was selected as a control group.
- Making sure of the heterogeneity of the study sample age wise (children must be aged between 4 and 5 years).
- A program dedicated to drawing activities and stimulating the imagination of the child to think and fantasies, aimed at the pilot group was implemented for (45) minutes during (03) separate daily sessions.
- In the meantime, the nanny of the Ben Hamida Hisham kindergarten continued teaching the children of the control group in the traditional way.
- Following the completion of the experiment, the creative thinking test of expression was applied to both the experimental and the control group to determine the impact of the program on the development of the three creative thinking skills (fluency, imagination and originality).
- Correcting the creative thinking test according to the test correction guide for statistical processing using the percentages to validate the hypotheses.

8. PRESENTATION OF STUDY RESULTS

In this section, we will try to present the results of the study, which were arrived at after the necessary statistical treatments to the collected data, with a view to verifying the validity of the hypotheses, reaching and analyzing the results, and then discussing them in the light of the theoretical frameworks and previous studies relevant to the subject matter of the study. Study data have been processed by SPSS (Version 26), which allows the researcher "to store data within a special file (Data Editor) as well as to make conversions on data and perform all kinds of necessary and required analyses for the research process" (Al-Qadi; Al-Bayati, 2008, p. 199) using the following statistical treatments: percentage calculation, arithmetic mean, standard deviation, Kolmogorov-Smirnov Test, in order to detect differences and to calculate the significance of these differences between the average grades of the children in the kindergarten using the educational robot and those in the one not using it.

8.1. Verifying the distribution type of the data:

Before proceeding with statistical processes and treatments of hypotheses, it will be ensured that the nature of the data follows the natural distribution, with a view to selecting statistical methods and tools appropriate to the hypotheses so that we can finally get real results. To figure out the type of distribution, the researchers conducted the Kolmogorov-Smirnov Test, sometimes called Good Conformity test or the Conciliation Quality test, and the test results showed that the data were not distributed naturally in the creative thinking skills scale, and table (06) shows the results of the Kolmogorov-Smirnov test:

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Table No. (04): Results of the Kolmogorov-Smirnov test

Kolmogorov-Smirnov test on a sample		
		Creative Thinking Skills
N		71
Normal Parameters	Average	14,80
	Standard deviation	5,517
Most extreme differences	Absolute	0,136
	Positive	0,136
	Negative	-0,083
Z of Kolmogorov-Smirnov		0,136
Asymptotic Significance (Bilateral)		0,002
Shapiro-Wilk		0,950
Asymptotic Significance (Bilateral)		0,007

The results of the statistical analysis of the creative thinking skills scale show that the significance (Sig=0.002) according to Kolmogorov-Smirnov Test, being less than (0.05) means that the sample data are drawn from a population whose data do not follow normal distribution.

8.2. Presentation and analysis of study results:

8.2.1. Presentation and analysis of the results of the first hypothesis:

The first hypothesis states that "the educational robot has a role in developing creative thinking skills among kindergarten children aged (4-5) years in Algeria." The hypothesis aims to answer the first question in the problem of the study, which is: What is the role of the educational robot in developing creative thinking skills among kindergarten children aged (4-5) years in Algeria? To verify the validity of this hypothesis in terms of measuring the level of creative thinking skills, the arithmetic means, standard deviations, relative importance, ranking, and degree of appreciation were found for each of the three dimensions of the scale and then for the scale as a whole. Table No. (05) Shows this:

Table No. (05): Arithmetic means, standard deviations, relative importance, and degree of appreciation for the dimensions of the creative thinking skills scale, ranked

The number of the Dimension	Dimensions	Arithmetic Mean	Standard Deviation	Relative Importance	Rank	Degree
1	Fluency	3,61	1,736	40,11	1	Average
2	Imagination	2,17	1,171	27,12	3	Weak
3	Originality	3,25	1,834	36,11	2	Average
Total Degree		14,80	6,517	56,92		Average

It is clear from Table No. (05) that the overall arithmetic mean for the dimensions of the creative thinking skills scale for kindergarten children was average, reaching (14.80), and a standard deviation of (6.517), which indicates that programming the educational robot has a role in developing creative thinking skills among children. Kindergarten children, where the [Fluency] dimension ranked first with a mean of (3.61) and a standard deviation of (1.736), followed by the [Originality] dimension in second place with a mean of (3.25) and a standard deviation of (1.834). The [Imagination] dimension came in third and last place with a mean of (2.17) and a standard deviation of (1.171).

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8.2.2. Presentation and analysis of the results of the second hypothesis:

The second hypothesis states: "There are statistically significant differences at the level ($\alpha \leq 0.05$) between the averages of creative thinking skills among children of the kindergarten that use the educational robot and those of the kindergarten that do not use the educational robot at the age of (4-5) years."

According to this variable, it is expected that there will be statistically significant differences between the average scores of the study sample members in creative thinking skills. To verify this hypothesis, the arithmetic means and standard deviations of the study sample's responses on the three dimensions and the tool as a whole were extracted, and to test the significance of the differences between the response means, the Mann-Whitney (U) test was used to detect differences - if they exist – between the children of the kindergarten that uses the educational robot and the averages of the children of the kindergarten that does not use the educational robot. The reason for using this non-parametric test as an alternative to the parametric test is that the observations (data) are quantitative and do not follow a normal distribution. Table No. (08) Also shows the results of the differences:

Table No. (06): Results of the Mann-Whitney (U) test for the significance of the differences between the means in the level of creative thinking skills among the children of the kindergarten that uses the educational robot and the children of the kindergarten that does not use the educational robot, aged (4-5) years

Statistics / Dimensions	Variable: Using/Not Using the robot	Number	Ranks Mean	Ranks Total	Value of (Z)	Value of (U)	Value of (Sig)*
Total Degree	Using	40	43,34	1777,00	-3,515	314,000	0,000
	Not Using	31	25,97	779,00			

(*) At the level of statistical significance ($\alpha = 0.05$).

It is clear from Table No. (06) that the value of (Z) reached (-3.515) and the value of (U) reached (314.00), and the value of its level of significance, which reached (0.000), is less than the set limit, which is (0.05), i.e. At a significant level (0.05). In favor of the kindergarten that uses the educational robot, the average rank is (43.34), compared to the average rank of the kindergarten that does not use the educational robot (25.97). Which means that there are statistically significant differences between the average scores of the study sample members in creative thinking skills in the total score.

8.3. Discussing and interpreting the study results:

8.3.1. Discussing and interpreting the results of the first hypothesis:

The arithmetic mean indicated that the level of creative thinking skills was not high among the two kindergartens children, but rather came to a moderate degree, as the arithmetic mean reached (14.80), and a standard deviation of (6.517). This result can be interpreted to indicate that the regular kindergarten that does not use the educational robot had scores on the scale that were not high enough, but rather were low, very familiar, and lacking in creativity.

This is supported by what Al-Masaieed (2020) indicated that the degree of use of the educational robot among private school teachers came in a moderate degree, and the results showed that the dimension of [fluency] when using the educational robot came in first place with a moderate degree, With a mean of (3.61) and a standard deviation of (1.736), the [originality] dimension came in second place with a mean of (3.25) and a standard deviation

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of (1.834), and the [Imagination] dimension came in third and last place with a mean of (1.834). It reached (2.17), and a standard deviation of (1.171), with a weak degree. This can be explained by the fact that there is a weakness in the use of imagination, an inability to interpret instructions, and the children's inability to express and innovate.

Despite what was confirmed by the study of Qarin and Majidir (2021), which concluded that the use of educational computer games has a role in developing the flexibility skill of kindergarten children. Computer games are like educational robots, but the current study showed a noticeable lack of imagination.

The results of the current study are consistent with the study of Al-Khalidi and Al-Wreikat (2013), which dealt with the reality of the use of educational robots and information technology teachers in the second cycle (5-10) of basic education in the Sultanate of Oman. The study concluded that the reality of teachers' responses to the axes of the reality of using the robot was to a moderate degree. The results of this study are also consistent with Durak, Yilmaz & Yilmaz's study (2019), which found that the skill levels of high school students in computer thinking skills and self-efficacy in the field of programming came in at a moderate degree, as well as for problem-solving skills and verifying their experience in the training processes for the programming activities accompanying the robotic activities were moderate.

8.3.2. Discussing and interpreting the results of the second hypothesis:

There were statistically significant differences between the average scores of the study sample members in creative thinking skills in the total score. At a significance level of (0.05), the calculated (U) value was (317.00), and this difference is in favor of the kindergarten that uses the educational robot, with a rank average of (44.58). Thus, the results of the research have proven the validity of this hypothesis. This result can be interpreted to mean that the educational robot leaves a clear impact on children's creativity because they are in a stage dominated by play, movement, and activity.

They - that is, the children - view the robot as a toy that achieves psychological and cognitive satisfaction for them. Their presence in the kindergarten in a team also develops competition and social communication for them, which stimulates creativity, because children's creative abilities depend on many factors within the kindergarten's formation, its financial capabilities, and the competence of its human resources. The robot also stimulates children's creative thinking and clearly contributes to children's creativity.

This is what Maryam Saeed Ali Baaween (2022) indicated that virtual educational robot competitions have an impact on developing future skills among students and teachers. In the same context, Al-Badou's study (2017) indicated that laboratory teaching based on the educational robot has an impact on developing the mathematical achievement of female students, as the results indicated that there were statistically significant differences at the significance level ($\alpha = 0.05$) between the experimental and control groups in the study variable. In favor of the experimental group that studied using the laboratory based on the educational robot.

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9. CONCLUSION

After reviewing, discussing and interpreting the results of the study, the following results were reached:

- Programming the educational robot has a role in developing creative thinking skills among kindergarten children. The (Fluency) dimension ranked first, followed by the (Originality) dimension in second place, and the (Imagination) dimension ranked third and last.
- The results of the study hypotheses were significant, meaning that in the sample of kindergarten children who used the educational robot and the kindergarten children who did not use the educational robot at the age of (4-5) years, there were significant differences in creative thinking skills as a whole and in its two dimensions (fluency and imagination), except for the dimension of or the originality index, the results of which showed that there were no differences between kindergarten children who used the educational robot and kindergarten children who did not use the educational robot at the age of (4-5) years.
- The researchers hope that there will be complete and sophisticated care for kindergarten children, because the results of the research have proven that this age stage is an important stage for the formation of skills, especially the creative thinking skills that children acquire, through the application of an educational robot or any other strategy that leads to high academic achievement or the development of skills or competencies. Or changing negative behaviors to positive ones with less effort, a shorter time, and less money is something that deserves to be taken into consideration and taken into account, because as the old Arabic proverb says: education at a young age is like engraving on stone.

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