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Original Paper

Instructional Design According to Design Thinking and its Impact on the Skills of Creative Problem-Solving of Second Class Middle Students

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Abstract

The research aims to build an educational learning design according to design thinking and its impact on the creative problem-solving skills of second-year middle school students. The researchers adopted the experimental approach with an experimental design for the control group with a post-test. The experiment was applied to a sample of the second-year middle school of Al-Faw Middle School, Rusafa Education Directorate/3, intentionally, as Section (A) was randomly selected to represent the experimental group that studies according to design thinking, and Section (B) to represent the control group that studies according to the traditional method. The number of sample members was (91) students. The sample was divided into (43) students in Section (A), which represents the experimental group, and (44) students in Section (B), which represents the control group. The research tool was prepared, which is the test of Creative Problem-Solving skills in mathematics, and the validity and reliability of the test were verified. The results for two independent samples showed that the students of the experimental group outperformed the students of the control group in the test of creative problem-solving skills for mathematical problems. The researchers saw some recommendations, including encouraging and urging teachers to use design thinking when teaching mathematics for the intermediate stage due to its positive impact in raising the skills of creative problem-solving for mathematical problems, which may ensure the positivity of learners and the permanence of the learning effect, and calling on the competent authorities in the Ministry of Education and its directorates to organize training courses for teachers on the application of design thinking and how to employ it in teaching mathematics.

Keywords: Educational Design, Design thinking, Skills of Creative Problem-Solving, Second Class, Students, Middle School.

1. Introduction

Through the researchers' experience in teaching mathematics for the intermediate stage, they noticed the low level of achievement of second-grade middle school students in mathematics. The problem of students' weak level of creative solution skills is one of the most important problems facing teachers and students in creative solution in mathematics. This weakness was confirmed by the results of previous research and studies in mathematics, such as the study (Al-Janabi, 2018) and the study (Al-Saadi, 2022), which confirmed that the weak level of creative solution among students may be due to teachers' reliance on traditional methods, which have a weak degree of excitement for students and their lack of interaction with mathematics, and teachers' lack of knowledge of modern teaching strategies. To verify this, the researchers directed a questionnaire to a group of mathematics teachers* in the second intermediate grade, whose number reached (20) teachers. It was found that (80%) of them had a weakness in using students' creative solution skills in mathematics. In an attempt to raise the level of achievement, the researchers tried to employ design thinking, which achieves a great deal of participation and excitement inside the classroom, and in which students learn more in order to raise the level of their creative skills when facing mathematical problems, which may ensure the positivity of learners and the permanence of the learning effect. Accordingly, the research problem can be defined as:

What is the effect of educational learning design according to design thinking in raising the level of creative problem-solving skills for second-year middle school students?

The importance of the current study can be summarized in addition to the above: -

1- This research may direct those responsible for the educational process in general and teaching and learning mathematics in particular to the importance of design thinking to raise the level and skills of students in creative solutions when facing mathematical problems (Salama, 2005; Majeed, 2021).

2) Providing those concerned with the subject of design thinking with a theoretical background on this subject (Carroll et al., 2010; Majid, 2018).

3) It may open the eyes of researchers to conduct many studies and research on the use of design thinking in teaching (Hassan, 2023).

The current research aims to identify the effect of educational-learning design according to design thinking on the creative solution of mathematical problems among second-year middle school students. Both researchers formulated the following null hypothesis:

(There is no statistically significant difference at the significance level (0.05) between the average scores of the experimental group students who will study the content material of the research experiment by design (educational-learning) according to design thinking and the scores of the control group students who will study according to the usual method in the creative solution test for mathematical problems).

$\bar{X}_2 = \bar{X}_1 : H_{\circ}$

$\bar{X}_2 \neq \bar{X}_1 : H_1$

Research Limits:

1- Second-class middle school students/ government middle and secondary day schools affiliated with the Baghdad Education Directorate / Third Rusafa, for the academic year (2024-2023) AD.

2- Mathematics book for the second intermediate grade [Chapter Five (Geometry and Measurement), Chapter Six (Coordinate Geometry), Chapter Seven (Statistics and Probability)] and prescribed by the Ministry of Education - Republic of Iraq for the academic year (2024-2023) AD.

3- Design thinking skills: Understanding the problem - defining the problem - generating ideas - designing prototypes - testing the model.

4- Second semester of the academic year (2024-2023) AD.

Defining all terms:

1- **Instructional Design:** It is "Integrated, organized, interconnected, sequential, interconnected scientific steps of an ongoing nature that require many requirements that lead to achieving specific goals for a specific type of learners during a specific period of time." (Al-Rubaie, 2012, p. 67; Hasan & Faris, 2019). Both researchers define educational design theoretically as a set of procedures specific to the educational material that represent integrated, interconnected and sequential scientific steps that operate with the highest degree of efficiency and effectiveness and that require a set of skills and processes that help students find solutions to the problems they face.

2- **Design Thinking:** It is a mental process used to build ideas in a comprehensive, integrated, meaningful and useful way from simple, meaningless parts, through five skills represented by understanding the problem, defining it, generating ideas, designing prototypes and testing the model into an integrated unit that enables students to develop their creative skills to solve mathematical problems (Carrolleal, 2010, p. 37). Procedurally: These are the mental skills and processes that include (understanding the problem - defining the problem - generating ideas - designing a prototype - testing the design) which are practiced by second-year middle school students to develop their creative solution skills, and are measured by the degree they will obtain by answering the paragraphs of the design thinking skills test prepared for the purpose of this research.

3- **Creative Problem Solving Skills** as: "Reaching a decision with the best solutions to a problem by relying on creative thinking or critical thinking according to successive logical steps and a specific methodology (Jarwan, 2014, p. 265). As for the operational definition of creative problem solving skills for mathematical problems: Both researchers define creative problem solving skills operationally as: reaching a decision with the best solutions to a mathematical problem by going through the various stages of creative problem solving, which are (reaching the problem, collecting data, defining the problem, generating ideas, reaching the solution, and accepting the solution), which helps individuals excel in responding to challenges, overcoming problems, and developing design thinking skills) and is measured by the total score that students obtain in the creative problem solving skills test prepared for this purpose.

2. Theoretical Framework

2.1 Instructional Design

The science of instructional design is one of the modern sciences that emerged in recent years in the twentieth century in the field of education. The origins of design in the educational process go back to research in the fields of psychology and education, which provided us with an inexhaustible source of knowledge and skills necessary to develop educational strategies and techniques, and led to different learning theories such as cognitive, procedural, and humanistic theories. These theories aimed to explain the science of learning and propose models for education, so programmed education and individual education appeared in different ways and learning for mastery, and thus the concept of educational design developed (Al-Hila, 1999, p. 26). At the beginning of the twentieth century the need for this science that translates all that research has reached into actual application in the field of education, and this science will give decisions about educational applications and practices based on research more than intuition (Dewey, 1990, p. 53).

The importance of educational design as follows: It tries to link theoretical and applied sciences. It sheds light on the role of feedback in the continuous development of inputs, processes and outputs of educational situations. It is concerned with the functional use of educational means in different educational situations. Using educational theories to improve educational practices through education by doing (Al-Adwan & Al-Hawamdeh, 2011, p. 20; Azmi, 2016, p. 19) adds the following points:

1- It leads to directing the learner's attention towards educational goals: Because the first steps in educational design are to determine the general educational goals and the specific behavioral goals of the material to be learned, which helps the designer distinguish distinct goals from secondary goals and distinguish applied goals from theoretical goals

2- It increases the likelihood of the teacher's chances of success in teaching the educational material: Because carrying out the process of designing, planning and prior study of educational programs is likely to predict the problems that may arise when applying educational programs and thus avoid them.

3- It saves time and effort: Pre-design and planning is represented in making appropriate decisions related to using effective educational methods that lead to achieving the desired goals.

Advantages of educational design: Directed towards achieving educational goals. Makes the learner the center and focus of the educational process. Logical and creative at the same time. Impacted by many factors such as basic knowledge, emotions and skills. Purposeful and selective social education, in which all elements interact for the purpose of the learner's growth, and responding to their desires, characteristics and learning methods, using activities and procedures to measure their capabilities.

The role of the teacher in the educational design process; it explained by Al-Qamizi (2016, p. 20) that the teacher is responsible for studying the external conditions related to the educational environment, analyzing them, including analyzing the needs of society and the educational institution in which the educational process takes place, setting the general educational objectives to be learned, analyzing the internal conditions related to the characteristics of the learner, analyzing the study material, setting behavioral objectives, designing oral tests, choosing appropriate educational materials and means, determining teaching methods, and carrying out various evaluation processes. Both researcher adds that educational design must be studied and benefited from in an attempt to link it to design thinking so that

the learner can practice and apply what he is studying in his actual reality and not focus on memorization, recall, and memorization without practicing it in the educational situation in order to raise the student's achievement and creative problem-solving skills in mathematics.

2.1.1 The theories that emerged from educational design are:

1- Merle's theory of educational elements: It is one of the theories that corresponds to Reigeluth's theory, which attempted to organize the content of the educational material but at the micro level, which is the level that deals with organizing a limited number of concepts, principles, or educational procedures and teaching them separately, in a school period estimated at 45 minutes. This theory was based on two basic hypotheses:

The first hypothesis: The educational process includes two frameworks: A: Presenting, explaining, clarifying, or teaching the educational material. B: Asking about this educational material or testing it.

The second hypothesis: The results of the learning process can be classified based on two dimensions: A: The type of educational content to be learned (facts, concepts, principles, and procedures). B: The level of educational performance expected from the learner after the learning process (Drouza, 1986, p. 53).

2- Reigeluth's Expansion Theory: The expansion theory is one of the modern methods that were invented to organize and teach education. Reigeluth invented, based on the knowledge and previous studies in the field of education, a modern and comprehensive theory called: Elaboration Theory, and it was used as a basis for organizing educational content at the expanded level. From the above, it can be confirmed that the general basis on which the expansion theory is based and from which it emerges is the Gestalt school, which believes that learning comes through the whole and not the part. Also Ausbel's concepts about advanced organizations in which the most important ideas and principles contained in the study material are organized from general to specific and in a hierarchical manner (Al-Hila, 1999, pp. 52-53).

Both Mayer (1980) and Lioyd (1990) agree that expansion helps the individual store information in memory after it has moved from short-term memory to long-term memory, and link it to the information the individual has, as it helps retrieve the required information from memory, and employ it in deducing what the individual cannot remember, and thus expansion is a skill that must be learned; to help the individual understand what he reads, and realize the relationship that links the different parts of knowledge.

2.2 Design Thinking

Today, the world is witnessing a development in science, technology, engineering and mathematics, and its clear impact on human society, which has led to many revolutions, changes and cognitive challenges in all aspects of life. Perhaps the most prominent of these changes is the use of modern technologies in various aspects of modern knowledge in contemporary life. The educational system is required to search for educational methods and models to confront many challenges. To keep pace with this change, teaching methods and scientific curricula must be developed, in a way that achieves the unity of knowledge (Ammen, 2025; Hammam, 2018, p. 19).

Design thinking has appeared in a large number of published research articles on the subject of thinking, such as the study (Kolodner & Wills, 1996), the study (Cross & Cross 1998), the study (Do & Gross, 2001), and the study (Owen, 2007), which showed that design thinking allows all disciplines to develop mutual understanding and focus on team-based learning to solve the potential problem. Donner (1999) has several images of design thinking:

1- It begins as a vague image of what the design should look like, such as how it should work? Over time, this idea crystallizes and turns into a clear and complete image.

2- It includes the individual making plans, drawings and models in the individual's mind to bring a vague idea and transform it from plans, pictures and drawings to a more realistic form that the individual can represent in reality, which helps form a specific line of thought that facilitates the development process and forms the basis for the design thinking process (Donner, 1999, p. 233).

3- It is the "picture word cycle", which includes putting ideas into words that help the designer interpret and clarify ideas. This means that the nature of design thinking is related to generating knowledge through work in multiple fields, meaning that knowledge is used to produce work, and work is evaluated to produce knowledge (Owen, 2007, p. 18; Plattner et al., 2015, p. 11) developed the world's first two design thinking institutions: a school for design thinking that began in 2005 at Stanford University, and a college that began in 2007 at the Plattner Institute at Potsdam University. He also started a research program to understand how design thinking is being developed on a scientific basis.

2.2.1 Theoretical foundations of design thinking

Below, the researchers review the theoretical foundations of design thinking (Arnold's theory 1959)

Arnold demonstrated a central theoretical belief that informs design thinking through the following steps:

1- Framing the problem and creating solution spaces in design thinking, by producing a coherent vision from chaotic problems.

2- Framing the problem in a way that inspires others and nurtures thinking. Arnold demonstrated that design and creative thinking is the result of thinking about an interesting problem, which stimulates successive creative mental activity.

3- Generating ideas increases fluency. Fluency is one of the main tasks that stimulates the number of ideas that a person produces in a specific period of time, and he demonstrated that a creative person is more fluent in thinking (Meinel et al., 2015, p. 33).

Arnold highlights variables that focus specifically on the processes that motivate design thinking:

a- The creative mindset requires emotional and motivational traits that help overcome the difficulties of innovation. Innovators need strong motivations to engage in their work despite all the difficulties, and this specifically requires some incentives represented by:

b- Boldness in facing risks: It refers to the person's readiness to challenge the situation and take risks that have not been tried, which include social risks, such as the presence of others who are skeptical of the new solutions that the individual invents because many people resist the idea of change and innovation because they fear the new approach, and because they accept the new, old and familiar ideas that seem appropriate should be abandoned because they have embraced them for some time, so the creative individual must be a leader, and be bold (Cross, 2004, p. 430).

c- Leadership: refers to the emotional energy and enthusiasm that a person has to pursue and design any project, especially when facing difficulties. Arnold notes that thinkers really like to develop a model design to solve problems (Thienene et al., 2017, p. 19).

d- Creative confidence: refers to the positive beliefs that the learner adopts about himself, his own innovation capabilities, and the value of his creative project. There are many ways through which a good idea can be destroyed or rendered completely incapable, so the confidence that the learner possesses is a prerequisite for innovation (Thienene et al., 2017, p. 21).

e- Happiness and self-satisfaction: When an individual contributes positively to building society and achieving personal potential, he will generate a feeling of happiness and self-satisfaction, which will ultimately be reflected in the development of design thinking (Thienene et al., 2017, p. 19).

Therefore, design thinking is based on creative stimuli (creative mindset, leadership, and self-confidence), as these stimuli encourage thinkers to express design thinking as part of self-realization (Rasfeld, 2015, p. 56).

2.3 Creative solution to mathematical problems

First: Creativity: Hussein Taha (2010, p. 158) believes that creativity is a process that has successive stages and aims to produce a product represented in issuing multiple solutions characterized by diversity and quality, in a general climate of consistency and harmony between its components.

The relationship between creativity and problem solving: Creativity and problem solving essentially

constitute the same phenomenon. Guilford (1969) considered that these two aspects constitute a unit due to the common points between them. Whereas if there is some creativity, it means a new solution to a problem, while the creative product appears as a means (mediator) to reach the goal, which is a solution to a problem, provided that this solution naturally includes a certain degree of novelty. Creativity in its broad sense is finding new solutions to problems if they are reached independently, even if they are not new to science and society (Abu Jadu & Nawfal, 2009, p. 49).

Some theories and models that dealt with creative problem solving: Guilford Theory (Jarwan, 2014, p. 114). TRIZ Theory. Osborne-Parnes (Bowyer, 2008, p. 32). Model for Creative Problem Solving. Model (Traffinger – Iskasen – Dorval, 2000; Treffinger et al., 2005, p. 18).

3. Methodology

The experimental method was adopted to verify the research objective, and the experimental design for the experimental and control groups with partial control was the independent variable (educational learning design according to design thinking) and the dependent variable (achievement in mathematics for second-year middle school students) (Yousif, 2024; Hassan et al., 2023), as shown in Table 1.

Table 1. Experimental research design

Groups	Equivalence of the two groups	Independent variable	Dependent variable	Dependent variable Scale
Exp. Con.	- Age in months - Intelligence - Previous achievement in mathematics -Test of previous knowledge in mathematics	Educational learning design according to design thinking	creative problem-solving skills	Test of creative problem-solving skills in mathematics

The research community represents all second-grade middle school students in the morning middle schools for boys in the Baghdad Al-Rusafa / Third Education Directorate. The researcher intentionally chose this directorate as a community for his research. The number of its schools and the number of its second-grade students were obtained from the Educational Planning Department - Statistics Division of this directorate for the academic year (2023-2024). Al-Faw Intermediate School for Boys affiliated with the Baghdad Al-Rusafa / Third Education Directorate, morning study for boys for the academic year (2023-2024), was intentionally chosen after obtaining the approval of its directorate, Appendix (1-A), to implement the current research experiment. Two sections were chosen, and Section (A) was chosen randomly to represent the experimental group that studies according to the design thinking steps, and Section (B) to represent the control group that studies according to the usual method. The number of sample members reached (87) students, after the data of the students who failed statistically were excluded; For the possibility of their having experience in the subjects of the study material from last year, and their number was (4) students, with them being allowed to attend the two research groups to preserve the school system and its continuity, and the sample was divided into (43) students in Section (A), which represents the experimental group, and (44) students in Section (B), which represents the control group, Table 2 shows this:

Table 2. Research community - Distribution of research sample students into experimental and control groups

Number of middle and secondary schools for boys in Al-Rusafa / Third		Number of second-year middle school students for the year 2023-2024		
50		10950		
Groups	Class	No. of students before exclusion	No. of students excluded	No. of students after exclusion
Exp.	A	45	2	43
Con.	B	46	2	44
Sum		91	4	87

Control procedures:

1- Chronological age: The ages of the students of the two groups were obtained in months from the school card and according to the chronological age in months until 2/1/2024. The arithmetic mean of the experimental group was (165.74) and the standard deviation was (6.226), while the arithmetic mean of the control group was (167.34) and the standard deviation was (8.342). In order to know the homogeneity of the variance of the two groups in the variable of chronological age in months, Levene's Test was adopted, as the value of Levene's statistic (F) was ((03.79)) at a significance level of (0.06)), which is greater than the approved significance level (0.05), which indicates the homogeneity of the two research groups in the variable of chronological age in months. To know the statistical differences between the two research groups, the second test (t-test) was applied for two independent samples, as the calculated t-value was (1.07) at a significance level of (0.29), which is greater than the approved significance level (0.05), with a degree of freedom of (85), and this indicates the equivalence of the two research groups in the variable of chronological age in months before conducting the experiment.

2- Previous achievement in mathematics: The researchers obtained the mathematics scores for the students of the two research groups for the first intermediate grade of Al-Faw Intermediate School for the academic year (2022-2023) from the general record of the intermediate school, Appendix (5), as the arithmetic mean for the experimental group reached (70) and the standard deviation (14.277), while the arithmetic mean for the control group reached (70), and the standard deviation (13.422). In order to know the homogeneity of the variance of the two groups in the previous achievement variable in mathematics, Levene's Test was adopted, as the value of Levene's statistic (F) reached (0.310) at a significance level of (0.58), which is greater than the approved significance level of (0.05), indicating the homogeneity of the two research groups in the previous achievement variable in mathematics. To know the statistical differences between the two research groups, the second test (t-test) was applied for two independent samples, as the calculated t-value reached (0.35) at a significance level of (0.73), which is greater than the approved significance level of (0.05), and with a degree of freedom of (85), and this indicates the equivalence of the two research groups in the previous achievement variable in the subject before conducting the experiment.

3- Previous mathematical information: A multiple-choice information test was prepared to find out what previous information the students of the two groups (experimental and control) possessed about the previous four chapters in addition to the fifth, sixth and seventh chapters, as follows: Chapter One (Relative Numbers), Chapter Two (Real Numbers), Chapter Three (Limits) and Chapter Four (Relations and Inequalities) related to the educational material from (Mathematics Book for the Second Intermediate Grade, 2023, Fifth Edition). The test consisted of (20) paragraphs, (5) points were given for each correct paragraph and zero for the incorrect paragraph. To ensure the validity of the test, a group of experts was presented before the application, Appendix (2), and most of them were agreed upon, with minor modifications to the wording of some paragraphs. Appendix (3-A) explains the paragraphs of the previous information test in its final form. The model answer for the previous information test in mathematics, Appendix (3-B), was prepared. The test was applied to the students of

the two study groups on Monday, corresponding to 12/25)/2023) AD. The arithmetic mean of the experimental group was (43) and the standard deviation (7.82), while the arithmetic mean of the control group was (44) and the standard deviation (7.86). In order to know the homogeneity of the variance of the two groups in the previous mathematical information variable, Levene's Test was adopted, as the value of Levene's statistic (F) was (0.006) at a significance level of (0.94), which is greater than the approved significance level (0.05), indicating the homogeneity of the two research groups in the previous information variable in mathematics. To know the statistical differences between the two research groups, the second test (t-test) was applied for two independent samples, as the calculated t-value was (0.372) at a significance level of (0.71), which is greater than the approved significance level (0.05), and with a degree of freedom of (85), and this indicates the equivalence of the two research groups in the previous information variable in mathematics before conducting the experiment.

4- Equivalence was achieved between the experimental and control groups in terms of the intelligence variable by applying the mental ability test (Daniels) for mental abilities for middle school students, which had previously been Arabized and adapted to the Iraqi environment by (Al-Quraishi, 1990), as it was applied to middle school students and enjoyed a high degree of validity and reliability. It was adapted for the second time by (Sakr, 2006) to suit the Iraqi environment and for the third time by (Hamadi, 2012) after confirming its validity and reliability, which consists of 45 paragraphs that include a group of shapes linked by a relationship in which there is an incomplete shape. The paragraphs were formulated in the form of multiple choice questions based on five alternatives for response by finding the incomplete shape from the alternatives. The researcher followed the test instructions when applying it to the two research groups, and after correcting the answers, he gave one point for the correct answer and zero for the wrong answer. Appendix (4-A) shows the scores for the two research groups. The test was applied on Sunday, corresponding to (12/24/2023) AD. The arithmetic mean of the experimental group was (23) and the standard deviation was (2.627), while the arithmetic mean of the control group was (23) and the standard deviation was (2.509). In order to know the homogeneity of the variance of the two groups in the previous mathematical information variable, Levene's Test was adopted, as the value of Levene's statistic (F) was (0.079) at a significance level of (0.78), which is greater than the approved significance level of (0.05), indicating the homogeneity of the two research groups in the intelligence variable. To know the statistical differences between the two research groups, the second test (t-test) was applied for two independent samples, as the calculated t-value was (1.025) at a significance level of (0.31), which is greater than the approved significance level of (0.05), and with a degree of freedom of (85). This indicates the equivalence of the two research groups in the intelligence variable before conducting the experiment. This indicates the equivalence of the two research groups in the intelligence variable before conducting the experiment.

Research requirements and tool: The research requirements include building an educational-learning design according to design thinking. After reviewing the theoretical background of educational design, which included a number of classifications that reviewed the steps of educational design and differed in steps, and it is possible to follow them in order to prepare an educational design suitable for a specific category, specific content, and specific environmental conditions. By reviewing a group of studies that dealt with educational design as an independent variable as well, and by benefiting from the theoretical background and previous studies such as (Al-Hiti, 2012), (Al-Haidari, 2015), and (Sahou, 2015), the researchers followed the following steps in building the educational-learning design according to design thinking: Analysis stage, design stage, implementation stage, evaluation stage, with the use of feedback at each stage. The research tool is test of creative solution skills for mathematical problems. Also both researchers prepared the creative solution test, and its paragraphs were specified as (10) essay paragraphs.

Table 3. Correlation coefficient of each paragraph with the total sum of paragraphs Test of creative solving skills for mathematical problems

Paragraph	Correlation coefficient degree
1	0.790(**)
2	0.424(**)
3	0.832(**)
4	0.844(**)
5	0.801(**)
6	0.846(**)
7	0.902(**)
8	0.898(**)
9	0.900(**)
10	0.923(**)

Paragraph (**) is significant at a significance level of (0.1)

4. Discuss and interpret the results

To achieve this goal: (To know the effect of educational-learning design according to design thinking on the creative solution skills of second-year middle school students); the following hypothesis was formulated: ((There is no statistically significant difference at the significance level (0.05) between the average scores of the experimental group students who studied the content of the research experiment with design (educational-learning) according to design thinking and the scores of the control group students who studied according to the usual method in the creative solution skills test)). In order to verify the validity of this hypothesis, the scores of the students of the two research groups (experimental and control) were calculated in the creative solution test. It was found that the arithmetic mean of the experimental group was (46.441) and the standard deviation was (4.526), while the arithmetic mean of the control group was (31.863) and the standard deviation was (6.811). In order to verify whether the scores data in the creative solution test are normally distributed or not, the "Kolmogorov-Smirnov Z" was adopted, and the results of the distribution normality test were as shown in table 4.

Table 4. Results of the Kolmogorov-Smirnov Z test to examine the normality of the data of the two research groups in the creative solution test

Kolmogorov Smirnov	Significance level
3.815	0.000

We note from table 4 above that the results of the examination of the value of the Kolmogorov Samir Nov significance level are smaller than the approved significance level (0.05), meaning that the data does not follow the normal distribution, and therefore nonparametric tests will be used in the research data, and the researcher resorted to the (Mann-Whitney) test; as in table 5.

Table 5. Results of the (Mann-Whitney) test in the creative solution variable

Groups	Average Ranks	Sum of Ranks	Calculated U-value	Asymp .Sig(2-tailed)	Statistical Significance at Significance Level (0.05)
Exp.	63.58	2734	104.000	0.000	Not sig.
Con.	24.68	1094			

To know the significance of the difference between the average scores of the students of the two groups, the calculated U value was (104.000) at a significance level of (0.000), which is smaller than the approved significance level of (0.05), thus rejecting the null hypothesis and accepting the alternative, which states that: (There is a statistically significant difference at a significance level of (0.05) between the average scores of the students of the experimental group who studied the content material of the research experiment by design (educational-learning) according to design thinking and the scores of the students of the control group who studied according to the usual method in the creative solution skills test)) To know the size of the effect (d) of the independent variable (educational design) on the dependent variable (creative solution) for the experimental group only, the researcher found the value of (η2), as (η2) expresses the percentage of the total variance in the dependent variable (creative solution to mathematical problems) that can be attributed to the independent variable (design thinking) as in table 6.

Table 6. The size of the effect of the independent variable (design thinking) on the variable of creative solution to mathematical problems

Ind. Var.	Dep. Var.	η2	D	Effect size
Design Thinking	Creative Problem-Solving	0.884	0.929	Very large

The research results on creative solution of mathematical problems as shown in Table 6 indicate the presence of a statistically significant difference between the two groups in favor of the experimental group who were taught according to design thinking. This result is the first, to the researchers' knowledge, that addressed design thinking in an educational-learning design. The researchers attribute this result to the following:

1- Designing the content according to design thinking contributed to its construction process and thus reflected its impact on the academic achievement of the experimental group.

2- Educational design is based on logical scientific foundations and identifies students' needs and is based on activities that suit their abilities for the purpose of developing them and relying on feedback to correct their mistakes.

3- Educational design according to design thinking instills the student's self-confidence and strengthens his relationship with his peers by working together in groups to raise his level of achievement.

4- Teaching with educational design according to design thinking makes the student a contributor and participant in the educational process, which is reflected in their achievement.

5- Adopting design thinking helped students understand and define the problem and generate ideas to choose the correct solution model, which had an impact on the academic achievement of the students in the experimental group.

5. Conclusions

The educational design according to design thinking has a great impact in raising the level of creative solution to mathematical problems for the research sample of second-grade middle school students. The educational design according to design thinking takes into account the individual differences among the

research students and at the same time makes the mathematics subject beloved and interesting to them and increases their learning and motivation.

In light of the results and conclusions reached by the researchers, the following recommendations can be made: Encouraging and urging teachers to use design thinking when teaching mathematics for the middle stage due to its positive impact on achievement and creative solution to the problems facing their students in mathematics. Training students on how to reach a solution to the problem by understanding it, defining it and collecting data about it. Calling on the competent authorities in the Ministry of Education and its directorates to organize training courses for teachers on applying design thinking and how to employ it in teaching mathematics. Including enrichment exercises in the mathematics book that require the use of design thinking to solve them and emphasizing the creative solution in them.

In continuation of this research, the researcher proposes some of the following procedures: Conducting a similar study on the effect of educational learning design according to design thinking on other variables such as mathematical ability and mathematical thinking. Conducting a similar study on design thinking in other educational stages and subjects. Conducting research to determine the extent to which intermediate students possess design thinking. Conducting a study to compare design thinking with other models on a sample of students.

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