International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 6 Issue 10, October - 2022, Pages: 19-26

The Effectiveness of Employing the Teaching Strategy for The Sake of Understanding the Skills of Mathematical Proof Among the fifth-grade Students of Applied Science

Sundus Noori Shuker

College of Education for Girls,Tikrit University, Iraq.
Email: snory@tu.edu.iq

Abstract*: The research aims to identify the effectiveness of employing the strategy of education for understanding in the skills of mathematical proof among students of the fifth grade of applied science**. The researcher selected the study sample of students from the middle of the Tigris for girls and chosen deliberately and their number (132) students distributed randomly four divisions, and randomly selected Division (B) to represent the experimental group taught according to the strategy of education for understanding by (30) students, and chose the Division (D To represent the control group, the traditional method was used with (32) students. The researcher prepared a test of mathematical proof skills consisting of (30) paragraphs**. After completing the research experiment, the researcher found that the experimental group studying in accordance with the strategy of education for understanding in the post-test in the mathematical proof skills is superior to the control group which is taught in the normal way.*

Keywords: Mathematics, Skills of Mathematical, Teaching Strategy, Applied Science.

Research problem

Despite the importance of mathematical proof as a basic concept in mathematics and the importance of developing skills among students as a major educational goal of teaching mathematics, many literature and studies confirm that mathematical proof is one of the most difficult subjects that students learn, including (Moore, 1994: 249) (Heinze, 2004: 41); The skill of proof is not an easy skill, but rather requires patience, patience and sympathy with the students (William Obaid et al., 2000: 158).

Indeed, the reality indicates that our students have a problem related to understanding and constructing or formulating a mathematical proof or organizing the steps of the proof (recording the proof) in a mathematically acceptable manner, which is indicated by some previous studies. The reality reflects a deficiency in the development of these skills among students through the different stages of education, which negatively affected the achievement of Students and their attitudes towards studying mathematics (Ibrahim Refaat, 2001: 3).

The researcher noticed through her work as a mathematics teacher that there are some deficiencies in acquiring mathematical proof and its skills. The mathematics course for the fifth grade contains mathematical proofs that require searching for solutions to address this, and the researcher also found that female students of the fifth grade of science have a weakness in their ability to deal with mathematical proof and its skills and their inability to convert it from a verbal form to a symbolic image or other and how to build it and use information And the previous laws in forming logical associations that lead them to achieve it, and the lack of verification of the validity of their findings, which is evident through their low scores in the questions related to proofs, as well as polling the opinions of some mathematics teachers who strongly supported the existence of such weakness in their students and the lack of a clear vision To treat it, the reasons they mentioned were their lack of knowledge of mathematical proof skills.

From the foregoing, the current research problem has crystallized, which indicates the need to adopt an education strategy for understanding. It takes into consideration the process of building mathematical knowledge in an active and effective manner by creating the best conditions for learning when the learner is exposed to real problems and tasks that need him to understand and absorb the knowledge presented to him in order to practice Non-routine thinking processes such as mathematical proof skills, which are mathematical procedures (mental activities) that the student performs when she encounters a mathematical situation that requires her to prove the validity of a mathematical case, starting from thinking about the proof until verifying the correctness of its steps after recording it in writing or searching for another or more proof for the same Proof of issue.

Accordingly, the problem of the current research is determined by answering the following question:

What is the effectiveness of employing an educational strategy for the sake of understanding the skills of mathematical proof among fifth-grade students of applied science?

Research Importance

Most countries work in light of the scientific revolution and the explosion of knowledge to prepare their individuals and societies to adapt to this reality, which is described as the era of rapid changes and transformations, which is characterized by the multiplicity of sources of knowledge, information and globalization, and in light of that education plays an important role in leading societies, and paints a bright picture for the future if They did their role as they should, then the education officials realized that there is no room for delay in dealing with this reality except by developing the ability of individuals to think that enables them to learn for life.

The nature of mathematics makes it a fertile field for training students on sound thinking methods. Mathematics has advantages in terms of its reliance on logic, clarity of facts, and its absence from subjective factors that may affect the conclusion of conclusions. It is also considered a language distinguished from the usual language with its accuracy, clarity and brevity, which made it the language. On which all the natural sciences depend, today we see that mathematics plays a big role in all aspects of life.

Mathematical proof is an effective tool for practicing objective logical thinking, as it is considered one of the most important mathematical concepts that can be used in creating educational situations that encourage students to initiate and participate, make guesses, suggest solutions, and discover relationships (Ahmed Sid Ahmed, 1999, 83). Important and central in the study of mathematics as it relies on clear and correct hypotheses, leading to logical results. These same results are also used to reinforce and build mathematical theories later on (Tall, 1995,27).

Evidence occupies an important place in mathematics and represents a major pillar of inference processes. In view of the importance of proof in the field of mathematics, the student's acquisition of the ability to master mathematical proof methods has become an urgent necessity. As mathematics, which relies on presenting its material on logical and intellectual foundations, the understanding of mathematical proof methods and their employment constitutes a catalyst for both the teacher and the learner alike in order to find mathematical solutions in a concise and easy way (Sorour, 2014: 50-52).

The proof in general indicates that it is the presentation of clear evidence, evidence, or a group of evidence to convince a person or group of a specific issue, and in its broad sense it is "the acquisition of certainty while paying attention to the values of correctness for an assumption" (Abu Saleh, Abed and Khasawneh, 2003: 66) and the proof - in general - is Any discussion or presentation of evidence that convinces a person of a particular issue, "or it is" a type of treatment aimed at convincing the validity of a case by presenting evidence that calls for conviction to the point of certainty of the validity of that case "(Obaid et al., 2000, 129) (Ahmed, 2001: 62) believes that the proof represents a logical treatment that consists in tracing the statements that each one of them derives from the previous one based on recognized evidence such as axioms, theories and data. Therefore, it is assumed that we train our students to recognize those basic pillars on which they are based This is the logical treatment so that they can deal with the problems of proof in a correct manner, and try to search for those statements and arrange them in a correct logical manner.

(Knuth, 2002) defined the functions of proof in confirming the correctness of a given statement, clarifying the reason for the validity of the statement, communicating through mathematical knowledge, uncovering new mathematics and creativity in it, and placing the statements in an intuitive system (Knuth, 2002: 379-406).

On the other hand, one of the new ideas in the field of teaching is the so-called strategic teaching, which enables the individual to acquire knowledge by improving and activating thinking and his skills instead of focusing on teaching knowledge. Among the strategies used in this type of teaching is the education strategy for understanding, which generally refers To provide a supportive and accessible learning environment for learning, and the strategy of education for understanding is based on constructivism theory, and consists of three basic principles. Knowledge is not passively transmitted through sensations or means of communication, so knowledge is actively constructed by the perception of subjects, and perception is an adaptive function in biological terms. It tends to be adaptive or apt to succeed, just as perception provides an organization of the object in the empirical world rather than an exploration of physical reality (Gibson, 2001: 45).

Research goal

The study seeks to achieve the following goal:

Knowing the effectiveness of employing an educational strategy for the sake of understanding the skills of mathematical proof among fifth-grade students of applied science.

Research hypothesis

There are no statistically significant differences at the level of (0.05) between the mean scores of the students of the experimental and control groups in the skills of mathematical proof.

Search limits

Research is determined by:

1. The human and spatial limit: The study was limited to female students of the fifth grade of applied science in the schools of Baghdad / Al-Karkh 1.

2. Academic limit: five classes of mathematics, which include:

A- Chapter 1 Logarithms.

B- Chapter Two Sequences.

C- Chapter Three Conical Segments.

W- Chapter Four Circular Functions.

C- Chapter Five: Purpose and Continuity.

3. Time limit: The study was implemented in the first semester of the 2018/2019 academic year.

Define terms

Teaching for Understanding Strategy: This was defined by everyone

- (Loughran & others, 2012) that it is: "a framework by which the student learns to think and contemplate the knowledge that has been transferred to him and learn how to criticize and examine it and then accept or reject it according to scientific logic" (Loughran & others, 2012: 42).

- (Chan, 2013) as "a strategy that helps students deep dive into meaning and participate in discussing problems, ideas, processes of reasoning and understanding (Chan, 2013: 3).

The researcher defines the education strategy for theoretical understanding as follows: the set of methods, means and educational methods whose use leads to the occurrence of learning, as it describes the main components of a system of educational materials and methods that will be used to show specific educational outcomes for the learner, and in this sense the strategy is more than just a description of the content that It will be presented to the learner.

Mathematical proof skills were known by both

(Rifaat, 2001) as the logical evidentiary measures taken by the student to prove the validity of a mathematical report.

(Ahmed, 2006) Mathematical (mental activities) procedures that the student performs when he is faced with a mathematical situation that requires him to prove the validity of a mathematical issue, starting from thinking about the proof until verifying the correctness of his steps after recording it in writing or searching for one or more other proof for the same issue under proof. (Ahmad, 2006: 29)

The researcher defines the skills of mathematical proof in theory, such as the following indicative procedures that include planning to prove a case or a sports report, monitoring this plan and formulating it in an acceptable manner, and evaluating it self in the light of acceptable mathematical evidence.

Background theory and previous studies

First: theoretical background:

Education for Understanding Strategy:

The strategy of teaching for understanding represents a framework based on the assumptions of constructivism theory, which has a philosophical and psychological point of view in its assertion that knowledge and understanding cannot be taught by heart, and learners must build their knowledge and understanding through the experience given from the outside world, especially by teachers (Philips It is also a framework that is somewhat similar to a map that shows things in a large size, so that teachers can know the nuances of their exercises around these large things and at the same time focus on important ideas (Perkins, 2006: 11). (Garegae) (2007) as a strategy that describes the course of educational action in a way that enables the anticipation of the desired results, and the planning of means to achieve them, which includes forms of interaction between the student, the teacher, and the subject of knowledge "(Garegae, 2007: 1).

The researcher adopted the framework as an educational strategy for the sake of understanding. It is a general strategy type and consists of the following stages:

1- The first stage: generative subjects

The generative subject is the central or basic subject required to be taught, which can be linked to various topics, and it must have the following characteristics:

That the generative topic relates to other topics.

That there are available resources and resources on the obstetric topic that are far from the textbook.

The topic will be central and fundamental.

(Visnovska, 2009: 42)

2- The second stage: objectives of understanding

Understanding goals define what a particular concept should be in terms of ideas, processes, relationships, or specific questions. The generative topic should include more than one development of the learner's understanding but rather preserves the learner's focus. The teacher must set several goals for understanding the generative topic or idea, as well as the main concepts. And the processes and their use, and the formulation of the goals of understanding should not be a behavioral formulation, as the objectives of the understanding must be general up to a semester, a specific topic, or an educational unit, and be clearly formulated and focus on the basic concepts included in it (Yassin and Zainab, 2012: 164).

3- The third stage: participation in understanding renderings

The performance that supports the goals of understanding must be a part of every unit from beginning to end, and the performance of the comprehension is the essence of teaching for understanding, and focuses on the learner and not on the teacher. Here, activities that show the understanding of learners should be presented such as:

• Make a practical presentation of what has been studied.

Description of what has been observed and inferred from the topic.

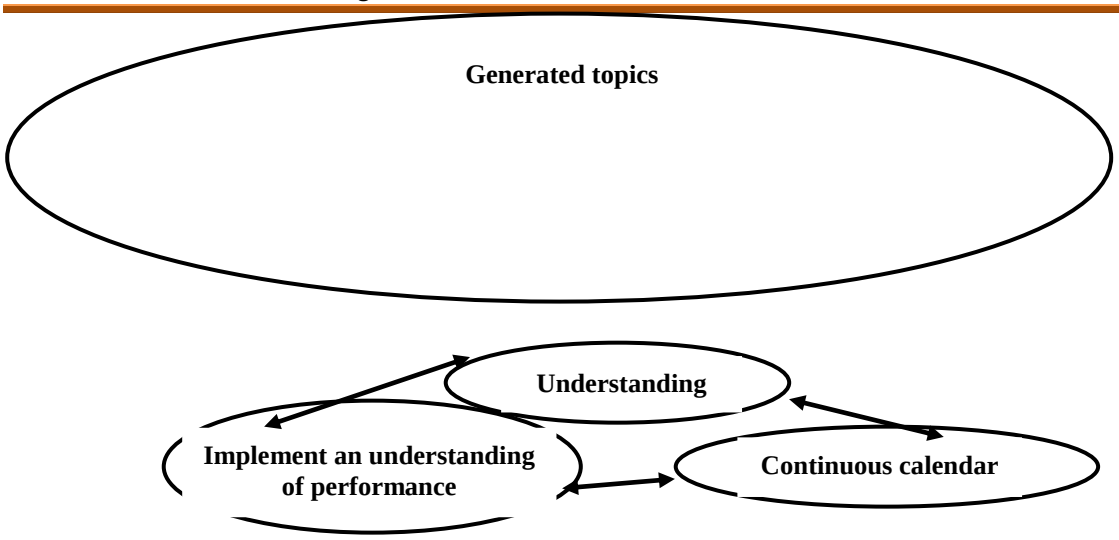
• Determine the activities in which students use higher thinking skills. (Qatami, 2013: 472)

4- The fourth stage: continuous evaluation

Evaluation is a continuous process and throughout all stages of the strategy and aims to provide learners with feedback during the learning process (Newton, 2000: 70).

The figure shows the stages of the strategy of teaching for understanding.

A form showing the stages of a strategy for teaching for understanding.



(Yassin and Zainab, 2012: 163)

To clarify the education framework in order to understand more, and to find the relationship between it and the elements of teaching planning, Perkins (1993) linked what he called the four basic stones of the fundamentals of education for understanding with the elements of teaching planning as shown in the following diagram:

Scheme showing	The four basic stages of education for comprehension with general questions of education	Education stages in order to understand general questions about education (lesson planning elements)
1	.Generating themes	What should we know?
2	Objectives of Understanding	What is worth understanding?
3	Performances of understanding	How should we study for understanding?
4	Continuous Assessment	How do we know students understood and how can students develop a deeper understanding?

(Perkins, 1993: 15)

Research on Teaching for Understanding has produced a number of successful pilot programs that have resulted in principles and practices. Brophy (1990) has summarized eight general elements about Teaching for Understanding, namely:
The curriculum is designed to equip students with the knowledge, skills, values, inclinations and attitudes that are of use inside and outside the school.
The educational or academic goals emphasize the development of the student's experience within the context or the applied field while emphasizing or encouraging conceptual understanding and the self-organized use of the skill.
Organizing the content around a specific group of ideas (basic concepts and principles).
The teacher's role is not only to provide information but also to develop strategies that will support students' response to learning.
The student's role is not limited to copying the information only, but also to obtain a clear and understandable meaning as well as constructing meanings.
Activities and duties must include solving problems, not just storing in memory.
Higher-order thinking skills are not taught as separate methodological skills, but they must be developed in the teaching process, i.e. knowledge of the subject within the applied context, which requires the student to relate what he learns to his life outside of school by thinking creatively.
The teacher creates a social environment within the classroom, that is, it can describe an educational community in which a dialogue about learning takes place. (Brophy, 1990: 155)
Through the foregoing, we find that this type of education achieves the most important goals of education, as its focus does not agree with the traditional view of education, as it is not merely the acquisition of knowledge and skills that are not sufficient to achieve

understanding, which in turn requires an effective use of knowledge and skills. Separate and isolated (Qatami, 2013: 444). It focuses on the comprehension performances that help students to use their understanding in an improvised manner and in different ways while expanding their future knowledge horizons not by copying information but to obtain a clear and understandable meaning in the cognitive construction of meanings leading to solving problems.

Previous studies:

Studies focused on education strategy for understanding

A- The study of Al-Mayouf et al. (2011)

The aim of the research is to know the effect of educational design based on the strategy of education for the sake of understanding in the achievement of mathematics among fifth-grade students, and in order to achieve the goal of the research, the researchers adopted the experimental method with two groups of post-test. They set the following null hypothesis: 1. "There is no statistically significant difference at the level of significance (0.05) between the average grades of fifth-grade scientific students who learned according to the proposed educational design based on the Education for Understanding Strategy (the experimental group) and the female students who learned the same subject in the method The usual (control group) in the achievement test. " The research community, which represents the preparatory schools for girls within the Third General Directorate of Karkh, was identified. The research sample was chosen (58) students from the fifth grade of scientific students were randomly selected, and the sample was divided into two groups: - An experimental group studied according to the educational design based on the education strategy for understanding . A control group was studied according to the usual method. Equivalence was performed between the two groups in the variables (previous mathematics achievement, IQ level, pre-requisites, lateral thinking, chronological age). For the purpose of collecting data for the experiment, an achievement test was built, in its final form, of (40) test items of the objective type. Appropriate statistical analyzes were conducted, to ascertain the psychometric properties of the test and the use of statistical tools to analyze the results of the test application, such as the Pearson correlation coefficient and the Keoder-Richardson equation 20, and the results indicated the superiority of the experimental group students who studied according to the educational design based on the education strategy in order to understand the requests who studied according to The usual way. The most important findings of the two researchers in this research: 1. Teaching according to the educational design based on the strategy of teaching for understanding has an impact on improving the achievement of the students of the experimental group compared to the control. Emphasis on understanding the material and linking new topics with previous topics, which led to the cohesion of their scientific material and mastery of it and thus provided a high possibility for thinking and using information.

B- Al-Rashidi study (2018)

This study aimed to know the effectiveness of the education strategy for the sake of understanding in the development of proactive thinking in mathematics among gifted fifth grade students in the city of Hail in the Kingdom of Saudi Arabia, and the number of the study sample reached (60) students from among gifted students. The quasi-experimental approach was used. Where the current study relied on collecting its data on the proverbial thinking test directed at gifted students after training them on the strategy of teaching for understanding that was prepared by the researcher, and after training the gifted students on the strategy, the proverbial thinking test was applied to the sample.

Method and procedures

First: the experimental design

The researcher used the post-test design for two equal groups (experimental and control), which is one of the true experimental designs as in Table (1).

Table (1)

The experimental design used in the research

the group	The independent variable	Dependent variable	Measuring the dependent variable
Experimental	Education strategy for understanding	Mathematical proof skills	Mathematical proof skills test
Control	The usual way		

Second: the research community

The research community was identified for fifth-grade scientific students in government day schools for girls for the academic year (2019-2018) at the Baghdad Center / General Directorate of Education Al-Karkh Third.

Third: the research sample

The researcher chose Tigris Preparatory School for Girls in a deliberate manner because it includes four divisions for the fifth grade of applied science from among other schools, and this helps to conduct the experiment in it, in addition to that the school administration's willingness to cooperate with the researcher and the availability of the requirements of the experiment, as well as the fact that most or all of the students are from the same region This helps their daily attendance without interruption from the experience, the number of its students reached (132) students, and the researcher randomly chose Division (B) to represent the experimental group that studies according to the strategy of education for understanding by (34) students, and chose Division (D) to represent the group Control, and the traditional method is used by (33) female students. Table (2) shows the numbers of the two research groups.

Table (2)
Shows the numbers of students for the two research groups

the group	Division	The number of female students before exclusion	The number of female students who have failed	The number of students after exclusion
Experimental	B	34	4	30
Control	D	33	1	32
Total		67	5	62

Fourth: the equivalence of the two research groups
Empirical research requires that the two research groups be similar in characteristics that can affect the dependent variable, and that they differ only in the effect of the independent variable. (Ibrahim and Abu Zaid, 2010, p. 234) In order for the researcher to find out the effect of the independent experimental variable on the dependent variables, it is necessary to control all the variables affecting this relationship, and the researcher made sure to perform equivalence between the two groups of research in the following variables:
Age of Time
Prior Achievement in Mathematics
General average for the Prior Achievement
Information in Mathematics Prior Knowledge
Intelligence

Research Tool: Mathematical Proof Skills Test:

Determining the limiting skills of Mathematical proof
In general, it is limited to (5) basic skills and (12) minor skills, to become as follows:
a. Planning skill: includes the following sub-skills:
- Determining the given and required in the form of symbolic relationships.
Translate the case into an appropriate mathematical form (symbolic, verbal, geometric figure).
Giving the general idea of the proof.
B. The skill of building proof sequences: It includes the following sub-skills:
- Deriving a set of conclusions from the data.
- Selection of useful conclusions related to the wanted or the steps to reach it.
- Deriving new results from the selected results with an explanation of the reason.
- Determine the mathematical relationships between the results that have been reached.
T. Evidence drafting skill: It includes the following sub-skills:
Express in mathematical symbolic formulas the steps of a mathematical proof.
Complete recording or writing a complete math proof.
C. Solution review skill: It includes the following sub-skills:
Judging the correctness or error of a mathematical proof or some of its steps, with an explanation of the reason.
Determine which proofs are most appropriate in case there is more than one proof in light of criteria.
Dr.. Solving in more than one way or methods: This sub-skill includes the following:
- Finding more than one mathematical proof for the same mathematical issue in question.

These main and subsidiary skills were classified in a list and presented to a group of arbitrators and specialists in mathematics, methods of teaching it, measurement, evaluation, and curricula. An agreement percentage was adopted (80%) and above. And the sub in its final version.

Formulation of the test items: The formulation of the test items

The paragraphs of the Mathematical Proof Skills Test were formulated in its initial form consisting of (30) paragraphs, and after preparing the test paragraphs, they were presented to a group of experts and specialists in mathematics and its teaching methods, measurement and evaluation, curricula, and teachers of mathematics and its teachers for some preparatory and secondary schools to benefit from their opinions and directions, the percentage of agreement was adopted (80%) and above, and in light of their opinions

and observations, some amendments were made to a number of paragraphs, and thus the Mathematical Proof Skills Test includes (30) items ready to be applied (to the exploratory sample) in its initial form.

- Test putty in structions

Special instructions have been drawn up for students to answer the test items and explain how to answer in order to avoid mistakes that may lose them some grades, as well as the distribution of grades between the questions as well as the time specified for answering the test items.

The correction Standards

The researcher assigned one score to the paragraph whose answer is correct, and zero to the paragraph whose answer is incorrect or abandoned, and the researcher placed a key for the correction.

The test validity

Honesty is one of the basic characteristics of the test in psychological measures because it indicates interest in what that scale measures and its adequacy in achieving that, and the honest test measures the behavior that was set to measure, and to verify the validity of the test, the researcher relied on the following:

Virtual honesty:

View and discuss results

This chapter deals with discussing the results of the research after statistical analysis as follows:

First: Results of validating the research hypothesis:

The hypothesis states that: There are no statistically significant differences at the level of (0.05) between the mean scores of the students of the experimental and control groups in the test of mathematical proof skills.

To verify the validity of this hypothesis, the researcher used a "T. test independent sample" and the following table demonstrates that:

Table (3)

The arithmetic mean, standard deviation, the calculated and tabular T value, and the statistical significance of the scores of the students of the two research groups in the Mathematical Proof

T	the group	the number	SMA	standard deviation	Degree of freedom	T-value		Statistical significance at (0.05) level
						Calculated	Tabular	
1	experimental	30	23.00	2.16	60	18.15	2	Function in favor of empiricism
2	Control	32	14.81	1.30				

Therefore, it rejects the null hypothesis, and this confirms the positive impact of the strategy of education for understanding on the traditional method of testing the skills of mathematical proof.

Second: Interpretation of the results:

The positive effect of using mathematical proof skills is due to the following reasons:

The strategy of teaching for understanding goes hand in hand with the student's thinking about mathematical proof, as she works to increase her ability to diagnose the learning situation correctly and accurately. And to choose a learning strategy to deal with the proposed learning problem, which increases the ability to plan for mathematical proof and to have the motivation to integrate into the learning situation in order to be able to build sequences of mathematical proof, and to monitor the strategy used, which enables it to evaluate its performance in mathematical proof.

- The Education for Understanding strategy guided the students 'thinking path and kept away from them the information or unnecessary relationships or the known repeated errors of proof performance.
- Teaching according to the strategy of education for understanding is more effective than the regular method, in achieving scientific and educational goals in teaching mathematics, depending on the vocabulary of the prescribed curriculum on the one hand, and taking into account the mental and psychological developmental characteristics of students on the other hand.

Making female students a center for the educational process and giving them a positive role by using their previous information and initial experiences in learning new and subsequent information, and working to enhance their experiences and develop their cognitive abilities led to the development of mathematical proof skills, and this is represented by increasing participation while studying mathematics and taking better interest in the scientific material Preparing reports and enjoying scientific activities.

Third: Conclusions:

1- Its positive and effective impact on the mathematical proof skills of female students.

2- The Education for Understanding strategy contributed to encouraging the students to have freedom of opinion and exploration, and to raise questions, raise them, and participate positively during the lesson in particular.

3- The Teaching for Understanding in Teaching strategy helped in classroom management, dialogue and discussion effectively.

Fourth: Recommendations:

1. Providing structured training plans and programs for training in the method of teaching for understanding in teaching for all academic levels.
2. Working on developing a special guide for training teachers to use the teaching method for understanding while providing training opportunities on the guide.
3. Focusing on developing modern and innovative curricula and teaching methods that work on the mathematical proof skills of female students, because school curricula depend on memorization and rote memorization.

Fifth: Suggestions:

• Conducting a comparative study between one of the methods of teaching mathematics with the teaching strategy in order to understand other variables such as (gender, critical thinking, and inferential thinking).
• Conducting a study to know the effectiveness of the education strategy in order to understand the trends towards mathematics.

The References

1- Ibrahim and Ibrahim Refaat (2001) "The effectiveness of using the module in developing the skills of mathematical proof and achievement in engineering for first-grade middle school pupils." Master Thesis, Ismailia College of Education, Suez Canal University.
2- Abu Saleh, Muhammad and Abed, Adnan and Khasawneh, Amal (2003) Mathematics Curricula and Teaching Methods, Sana'a, Republic of Yemen: Ministry of Education.
3- Ahmed, Ahmed Mohamed Sayed (1999). In the teaching of mathematics (second part). Benha, Modern University Press.
4- Ahmed, Muhammad Ahmad (2001). Developing the mathematical proof skills of first-grade secondary students in general education. (Unpublished Master Thesis), Faculty of Education, Ain Shams University, Egypt.
5- Badr, Salem Issa, and Ababneh, Imad Ghadhab (2007), Principles of Descriptive and Inferential Statistics, First Edition, Dar Al Masirah for Publishing and Distribution, Amman, Jordan.
6- Al-Rashidi, Saud Abdul-Aziz Ghazi (2018) The Effectiveness of Education Strategy for Understanding in the Development of Pro-Thinking in Mathematics for Gifted Fifth Grade Students in Hail in the Kingdom of Saudi Arabia, Journal of Scientific Research in Education, Issue 19 of 2018.
7- Sorour, Ali (2014). How to use modern technology in teaching and learning mathematics. Journal of Educational Development, (54) Sultanate of Oman.
8- Obaid, William and others (2000), Mathematics Education, Cairo, The Anglo-Egyptian Library.
9- Allam, Salah Al-Din Mahmoud (2006), Educational and Psychological Tests and Standards, Edition 1, Dar Al-Fikr for Publishing and Distribution, Amman, Jordan.
10- Qatami, Yusef (2013): Learning Strategies and Cognitive Teaching, Dar Al Masirah for Publishing, Distribution and Printing, Amman.
11- Al-Nabhan, Musa (2004), Basics of Measurement and Evaluation in the Behavioral Sciences, Edition 1, Dar Al-Shorouk for Publishing and Distribution, Amman, Jordan.
12- Yassin, Wathiq Abdul Karim and Zainab Hamza Raji (2012): The Structural Introduction, Models and Strategies in Teaching Scientific Concepts, 1st Edition, Noor Al Hassan Library, Baghdad.
13- Brophy, J. (1990) 'Teaching Social Studies for Understanding and Higher-Order Applications', The Elementary School Journal 90.
14- Chan, Eng Fung (2013): An exploratory study of the teaching for understanding framework (TFU) Applied to a Year primary connections unit, MPhil Thesis, school of Education, The University of Queensland.
15- Garegae, Kgomotso Gertrude (2007): A Quest for Understanding in Mathematical Learning: Examining Theories of Learning, Lecturer, Department of mathematics and Science education Faculty of Education, University of Botswana.
16- Loughran, J., Berry, A., &Mulhall, P. (2012): Understanding and developing science teachers' pedagogical.
17- Newton, D. P. (2000). Teaching for understanding: What it is and how to do it. London, GBR: Routledge Falmer.
18- Perkins, D. (2006). From Idea to Action. Course handout of Teaching for Understanding 2 at WIDE World program developed by Harvard Graduate School of Education. Retrieved from http://learnweb.harvard.edu/wide/.
19- Phillips, D. C. (1995). The Good, the Bad, and the Ugly. Educational Researcher, 24(7), 5-12. doi:10.2307/1177059.
20- Tall, D. (1995): Cognitive development, representation and proof, conference on justifying and proving in school Mathematics, institute of Education, London.
21- Visnovska, Jana (2009): Supporting Mathematics Teacheres Learning: Building on Current instrunctional Practices to Achieve A Professional Development Agenda, Dissertation Vanderbilt University.