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The logical and inferential thinking skills of secondary school mathematics teachers and their relationship to their mathematical beliefs

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Abstract

The aim of the current research is to know the logical and inferential thinking skills of secondary school mathematics teachers and their relationship to their mathematical beliefs in the Karbala governorate center. The descriptive research method was adopted, and in order to achieve the goal of the research, a test of logical inferential thinking skills was built, as it was in its final form of (32) test items , The Mathematical Beliefs Scale may be in its final form (35) paragraphs, with two dimensions (the nature of mathematics, and the learning and teaching of mathematics), The research community was determined from female secondary school mathematics teachers in the Karbala governorate center for the academic year (2020-2021), and the sample size was (45) schools, and the results showed that mathematics teachers in the Karbala governorate center possessed logical and inferential thinking skills and the presence of mathematical beliefs among the research sample, In its two dimensions (the nature of mathematics, learning and teaching of mathematics),There is also a positive and direct correlation with statistical significance between the skills of logical and inferential thinking and the mathematical beliefs of female mathematics teachers.

First: the study problem

Traditional teaching methods based on memorization and information memorization do not help learners to use higher mental skills, including logical reasoning skills, as indicated by the National Council of Teachers of Mathematics (NCTM, 1989:233). However, we note that most mathematics teachers adopt the traditional method of presenting and introducing the topic, and the teacher does not highlight the importance of mathematics as one of the basic methods for developing thinking (Al-Shukri, 2007: 12).It is noticeable that all educational voices are calling today for the importance of teaching students thinking, because the goal is to build generations capable of facing challenges and able to adapt to the huge amount of knowledge and science, able to adopt the scientific method in solving the problems they face.

The system of knowledge possessed by the teacher and the system of his beliefs work in interaction and integration, and they determine the type of teacher's behavior in the classroom, as beliefs play an important role in guiding teachers' behavior (Levin & Wadmany, 2006:159), Teachers' educational beliefs represent an internal set of assumptions about educational issues such as their beliefs about the curriculum or school or teaching and learning procedures towards mathematics, and these beliefs are affected by several factors, including before professional practice (that is, during the teacher's academic study) and during professional practice, As their beliefs about mathematics in general, as well as towards learning and teaching mathematics, are affected by a number of factors, the most important of which are the teachers' previous experiences in learning mathematics, classroom teaching, peer interaction, and being satisfied with the results of research in the field of mathematics education. And the use of mathematics in multiple life situations, teachers' education programs, in addition to social factors related to the political, social, economic or historical aspects of the teacher's social environment (Malone, 2005:75 & Barkatsas). In light of the foregoing, the research problem can be summarized in the following question :

Is there a correlation between the logical and inferential thinking skills of female secondary school mathematics teachers and their mathematical beliefs? What type and direction?

Second, the importance of research

The importance of this research can be reflected in two aspects, one is theoretical and the other is practical and agency:

1- This research helps to identify the nature of the correlation between logical and inferential thinking skills and mathematical beliefs, and to identify the nature of this relationship.

2- This research provides us with a clear view of the beliefs of mathematics teachers in the Karbala governorate center about mathematics, its teaching and learning, and its shortcomings, which may contribute to identifying developmental programs in teacher and teacher preparation colleges.

3- This research helps the educational supervision in Karbala governorate to know the logical and inferential thinking skills of mathematics teachers in the governorate center, and their mathematical beliefs, and thus the establishment of training courses to develop these skills among mathematics teachers and the establishment of seminars and meetings in order to direct their thinking towards a positive belief in mathematics, which It will reflect positively on their students.

4- This research helps mathematics teachers to identify their logical and inferential thinking abilities, which gives them the opportunity to develop these skills and invest them in the education process by using appropriate and effective educational situations and expanding the circle of their teaching strategies, in order to reach the largest number of learners.

Third: Research Objectives : The objective of this research is to identify the

1- Logical and inferential thinking skills of female secondary school mathematics teachers in the governorate of Karbala.

2- Mathematical beliefs of the sample members.

3- The correlative relationship between the logical and inferential thinking skills and the mathematical beliefs of the sample members and the nature of this relationship.

Fourth: Research hypotheses

To achieve the research objectives, the following null hypotheses were developed:

1-There is no statistically significant difference at the significance level (0.05) between the mean real performance and the average hypothetical performance of mathematics teachers for the secondary stage in the Karbala governorate center on the test of logical and inferential thinking skills.

H0:X1=X2

H1 : X 1≠ X2

2-There is no statistically significant difference at the significance level (0.05) between the average real performance and the hypothetical average performance among secondary school mathematics teachers in the Karbala governorate center on the mathematical beliefs scale prepared for this purpose

H0: X1 = X2

H1 : X 1≠ X2

3- There is no statistically significant correlation at the significance level (0.05) between the skills of logical inferential thinking and the mathematical beliefs of female mathematics teachers for the secondary stage in the Karbala governorate center.

H0: X1 = X2

H1 : X 1≠ X2

Fifthly: the limits of research

1- This research was limited to female secondary school mathematics teachers in the Karbala governorate center for the academic year (2020-2021).

2- Logical and inferential thinking skills (collecting Mathematical information, memorizing Mathematical information, organizing Mathematical information, analyzing Mathematical information, producing Mathematical information, evaluating Mathematical information)

3- Areas of Mathematical Beliefs (beliefs towards mathematics, beliefs towards learning and teaching mathematics)

Sixth: search terms

A- Inferential logical thinking

(Mahmoud, 2006) defined it as "that type of thinking that we employ when we try to discern the reasons and the explanations behind things, that is, knowing the results of things and actions we do and arriving at evidence that supports or refutes a certain point of view" (Mahmoud, 2006: 146) .

The researchers define it procedurally as a set of skills that mathematics teachers use for the secondary stage in thinking, and trying to explain the causes and reasons that lie behind things, and these skills are (collecting mathematical information, memorizing mathematical information, organizing mathematical information, analyzing mathematical information, producing mathematical information, evaluating Mathematical information) and it is measured procedurally by the degree they obtain in the logical and inferential thinking skills test prepared for that.

b. Mathematical beliefs

Defines it ((Lester et al, 1989) as "subjective (non-objective) knowledge about self, mathematics and problem solving" (Lester et al, 1989:55).

The researchers define it procedurally as "the self-beliefs of mathematics teachers that formed for them, and it is measured by the degree they obtain in the Mathematical Beliefs Scale that was specially prepared for this purpose."

theoretical background

First: Logical Thinking

One of the most prominent features of inferential logical thinking is that the growth of this thinking in individuals has a direct relationship with the individual's mental development and cognitive achievement and the questions and motives he is exposed to.It is a thinking that develops with age, experience and acquired information, and it is a systematic thinking that has specific steps and clear methods. This thinking develops by searching for the relationships between things and phenomena and linking them together. It is characterized by the gradation of its stages depending on the progression of age and the increase in experience. It has a number of intellectual skills or abilities represented by(organization, classification, abstraction, analysis, generalization, synthesis, inference, induction, deduction). Another characteristic of this thinking is that it is conscious thinking, and that it is based on conscious mental processes. It is based on finding relationships between the investigated issues or phenomena on the one hand, and the information and experiences gained on the other, And that this thinking begins with sensory experiences and then develops into abstract experiences, and in light of the foregoing, it can be said that deductive logical thinking establishes both critical thinking and innovative thinking, and this confirms the importance of empowering female teachers and teachers as well (Atiya, 2015: 131-134).

Inferential logical thinking skills

Eggen & Kauchak (Eggen & Kauchak,1999) refers to the skills of inductive logical thinking, as a series of mental activities carried out by the individual with the intention of understanding what is happening in terms of apparent changes that affect the qualities and properties of things and to reach evidence that supports or rejects a particular point of view, through the ability to collecting, preserving, organizing, analyzing, generating and evaluating information, and each of the skills consists of smaller sub-skills, and the deficiency in any of the sub-skills affects the quality of overall performance (1999:131, Eggen & Kauchak),

Both (Mahmoud 2006: 148-149) and (Obaidat and Abu Al-Sameed, 2013: 98-103) categorized the logical and inferential thinking skills into six skills, as follows:

1- **The skill of collecting mathematical information:** It is done through organized and accurate observation, doubt, questioning and reflection. It includes the following sub-skills:

• **Observation:** It is a thinking process that includes watching, observing and realizing, and it is usually associated with the presence of a strong goal or reason that calls for focus and careful observation.

• Questioning: searching for new mathematical information by creating and raising questions.

2-The ability to memorize mathematical knowledge comprises the ability to retain knowledge, also known as (code) coding, as well as the ability to remember and retrieve knowledge when needed (Habib, 2003: 24) .

• Coding skill: It is intended to store mathematical information in the human mind, and sometimes some modification is made to it to facilitate its storage.

• The skill of retrieval: It is the process by which the mathematical information that a person has previously stored in his mind is recalled.

3- The skill of organizing mathematical information: The basis of its work is to organize the information obtained according to the following sub-skills:

Comparing: noting the similarities and differences between two or more concepts.

• Classification: putting things into groups according to common characteristics.

• Arrangement: placing objects or vocabulary in a system or context according to a specific test.

4- **Mathematical information analysis skill:** It is intended to analyze the total situation into a group of elements in order to find the internal relationships between these parts and includes the following sub-skills (Mahmoud 2006: 148)

• Discrimination skill: It is related to the ability to distinguish between facts, causes and results.

• The skill of determining mathematical relationships and patterns: It is concerned with realizing the function of the part and its relationship to other parts, or the relationship of the part to the whole.

5-The skill of producing mathematical information: the skills of information production are broad skills that may start with the skills of anticipation, forecasting and making hypotheses to the processes of investigation, research and experimentation, down to the skills of creativity and the production of creative ideas, and it includes the following sub-skills:

• Research and experimentation: the basis of its work is to identify and clarify the mathematical problem and to set hypotheses to explain it.

• Induction: It means issuing a total judgment by judging the parts.

• Forecasting and prediction: It is concerned with making hypotheses to explain events and situations, or its ability to predict future events.

• Creativity: It is intended to produce new ideas by adding or expanding ideas.

6- The skill of evaluating sports information: These skills include the ability to make decisions and judge the credibility of information, then indicate the accuracy of sources and contradictions, detect inaccuracies and identify errors of generalization and simplification, and its sub-skills are:

• Decision-making and judging the validity of mathematical information: "The process of conscious choice between the available alternatives in a situation that presents a problem" (Obaidat and Abu Al-Sameed, 2013:99)

• Determining generalization errors: discovering errors in the relationships that link between mathematical concepts, which are either a verbal phrase or a symbolic formula.

• Detecting mathematical fallacies: "The ability to verify and evaluate information based on specific criteria after carefully examining the available information according to the rules of logic and gradually in order to detect errors and logical fallacies in it" (Badawi, 2019: 133).

Mathematical beliefs

The belief system of mathematics teachers is formed before they begins their teaching career, even as the teacher holds many beliefs and perceptions about the nature of mathematics and towards its teaching and learning, influenced by his school experience, as well as the university experience they experienced while studying mathematics (Cobb, 1998:159).

(Pehkonen, 1999) believes that the belief system changes and may develop among mathematics teachers, affected by several factors, namely his personal experience and the experiences of his colleagues in the profession, as these beliefs are affected as a result of dialogues and discussions between colleagues, and his students play a prominent role in forming, changing or modifying those beliefs he has. Through the previous influences, we note that the beliefs of mathematics teachers vary among themselves, some of them believe that mathematics is just knowledge that can be taught easily and easily even without the intervention of the teacher, and some of them believe that mathematics is difficult to understand by students without guidance and intervention by the teacher (389: Pehkonen, 1999).

While both (2002, De Corte & Op't Eynde) and (2004:3, Lazim & et al) see that the basic dimensions of the mathematical beliefs of mathematics teachers are divided into two dimensions.

•The first dimension is beliefs about the nature of mathematics

• The second dimension is beliefs about learning and teaching mathematics, including: self-efficacy in learning mathematics, the role of the teacher, and the role of students.

The second axis / previous studies

The researchers did not find studies that directly addressed the research variables (the logical and inferential thinking skills of female secondary school mathematics teachers and its relationship to their mathematical beliefs) (to the knowledge of the researchers). Accordingly, reference was made to Arab and foreign studies related to the research variables, as shown in Table (1).

(1)table

Previous studies with logical and inferential thinking skills and mathematical beliefs

	Researcher's name and country	Aim of the study	Educational level	Sample type and size	Curriculum type	Subject	Results
1	(Shukry) Al ((2007 Iraq	Knowing the level of logical and mathematical thinking among students of mathematics departments / fourth stage in the faculties of education and sciences in the universities of the Middle Euphrates	university	males and females 300	descriptive	Maths	The results showed a low level of logical-mathematical thinking among students of faculties of education and science in the departments of mathematics fourth stage, as well as the presence of differences in logical-mathematical thinking in favor of students of faculties of education.
2	Sezen & Bülbül (2014) Turkey	This study aimed to determine the logical thinking abilities of potential mathematics teachers	university	Male and females 132	descriptive	Maths	The results showed weak abilities of potential mathematics teachers in logical thinking in the categories (relative thinking, variable control, and probabilistic thinking).
3	(Alsur(2006) Palestine	Exploring the beliefs of the students of the Mathematics Department at the Faculty of Education at Al-Aqsa University about mathematics and knowing the significance of the relationship between these beliefs and their teaching performance.	university	Male and female 87	descriptive	Maths	Teachers have beliefs that are more compatible with a constructivist view of problem solving. The teachers expressed traditional beliefs to varying degrees about the nature of mathematics, its teaching and learning, and the results of the study indicated that there is a mismatch between the beliefs of mathematics teachers and their teaching practices.
4	Barkatsa &Malone Greece	It aimed to examine the beliefs of mathematics teachers about the nature, learning and teaching of mathematics, and to examine the relationship between those beliefs and their teaching practices.	teachers	Male and female 20	descriptive	Maths	The results showed that teachers' beliefs affect their classroom practices, and that teachers' beliefs in general are formed in the early stages of study, while beliefs related to mathematics education are formed during university enrollment.

First, the research method

The descriptive research method was adopted, which is based on defining the characteristics of the phenomenon as it is and describing its nature and the quality of the relationship between its variables, causes and trends.

Second, the research community

The research community includes all the mathematics teachers for the intermediate, preparatory and secondary stages in the Karbala governorate center for the academic year (2020-2021), and their number is (218) female teacher , distributed over the schools in the following picture (83) female teacher in middle schools and (70) female teacher in middle schools and (65) female teacher in secondary schools, according to the lists obtained from the Planning Department in the General Directorate of Karbala Education.

Third: the research sample

The total sample size was (45) female teacher, which represents (21%) of the original population size for the research, and they were chosen at random.

Fourth: search tools

In order to answer the research questions and verify its hypotheses, two tools were required: a test to measure inferential logical thinking skills and a two-dimensional mathematical belief scale (about the nature of mathematics, and their beliefs about learning and teaching mathematics). In order to build the two tools referred to, the following procedures were followed:

A- Deductive reasoning skills test: The following is an explanation of the steps involved.

1- After using studies and literature that dealt with logical thinking skills, the researchers prepared a number of a test to measure the skills of logical deductive thinking that includes mathematical problems and situations that require the mastery of a female mathematics teacher and show their skills in logical deductive reasoning. The test, in its initial form, consisted of (39) items, and by (26) items of the objective type (13) Paragraph of the article type.

2- The test paragraphs were presented to a group of arbitrators in the field of mathematics and its teaching methods. Some modifications were made in terms of the wording of some paragraphs, some paragraphs were deleted and some paragraphs changed.Others and based on the opinion of the arbitrators, the number of paragraphs was reduced to (36) paragraphs ready to be applied to the survey sample in its initial form, and by (26) substantive paragraphs and (10) article paragraphs, knowing that there are some paragraphs that measure more than one skill.

3- The test was applied to an exploratory sample consisting of (35) female teachers and not from the final sample, in order to know the clarity of the test paragraphs, as they were asked to read the test instructions first and inquire about any ambiguity in any of its paragraphs, and it was found that the test paragraphs were understandable The time taken to answer the test items was calculated, as it was found that the average time required to answer the test items is (90) minutes.

- An exemplary answer has been developed for all test items that have been relied upon in correcting the test

It was given a score of one for the correct answer and zero for the incorrect answer to objective questions, As for the left-over paragraphs, they were treated as the wrong answer, as well as the paragraphs that contain more than one Choice, and as for the article paragraphs, which are of two types, their range ranged between (0-2) and (0-4) degrees. So the total score for the test was (62) with a hypothetical average of (31).

6- The appropriate statistical analyzes were carried out for the test items in its initial form by calculating the coefficients of difficulty, discrimination and the effectiveness of the alternatives after it was applied to an exploratory sample and it was found that all the items ,It is acceptable except for paragraphs (36,34,32,30), which have been omitted because the coefficient of discrimination is below the acceptable percentages ,And the final test items became (32) items.

7-The psychometric properties of the test were confirmed by the following methods

The validity of the test: the researchers verified the apparent validity of the test by presenting its paragraphs to a group of arbitrators in mathematics and methods of teaching mathematics.

After taking their observations and opinions, the items that obtained an agreement rate of (80%) or more among the arbitrators were accepted. The validity of the construction was found by calculating the Pearson correlation coefficient for each item with the total sum of the test. This indicates the internal consistency of the test items.

The stability of the test: the (alpha Cronbach) equation was adopted to calculate the stability of the test, and it reached (0.785), and this result is good and can be reassured. The researchers also used the split-half to check the stability, and the result was (0.787), which was corrected by the Spearman-Brown equation, as the result became (0.814), and this is a good indicator of the internal consistency between the test items.

B- Mathematical Beliefs Scale: Below is an explanation of the steps involved

1- The concept of mathematical beliefs has been discussed as explained in defining terms and theoretical background.

2- The current research dealt with mathematical beliefs by classifying them into two dimensions, which are beliefs about the nature of mathematics, The second dimension is the beliefs about learning and teaching mathematics, and after reviewing the literature and previous studies on the subject of the research, the scale statements were formulated distributed over the previous two dimensions In its initial form, the scale may consist of (34) items with five alternatives (strongly agree, agree, neutral, disagree, and strongly disagree).

3- The scale was presented to a group of arbitrators who are specialists in the field of mathematics and psychology teaching methods, in order to show the validity of each paragraph of the scale, as the value of the chi-square was taken between those who agreed and those who disagreed. The percentage of arbitrators' agreement was also calculated, as a percentage (80%) was adopted as a minimum to keep the paragraphs, and the researchers were keen to make the scale's instructions clear, accurate and free from ambiguity, and it was found that all the scale's paragraphs are acceptable to the arbitrators, and an additional paragraph was added so that the number of paragraphs (35) Paragraph.

4- The scale was applied to an exploratory sample consisting of (35) female teachers and not from the final sample, in order to identify the clarity of the scale's paragraphs and to diagnose the ambiguous paragraphs, As well as determining the time required to answer the items, as well as their understanding of the instructions for answering the items of the scale, and it was found that the instructions are clear, as well as the items of the scale understandable and clear, and it was found that the average time required to answer the items of the Mathematical Beliefs scale is (30) minutes.

5- The researchers relied on Likert method in preparing the scale alternatives, and since the number of alternatives is (5) Therefore, scores are given in the case of positive items (strongly agree = 5, agree = 4, neutral = 3, Disagree = 2, Strongly Disagree = 1) In the case of negative items, scores are given (strongly agree = 1, Agree = 2, Neutral = 3, Disagree = 4, Strongly Disagree = 5.

6- The statistical analyzes as well as the psychometric properties of the items of the Mathematical Beliefs Scale were conducted in the following ways:

- The validity of the scale: The apparent validity of the scale was verified by presenting it to a group of arbitrators specialized in the field of curricula, teaching methods and psychology. The percentage of arbitrators' agreement (80%) was adopted as a minimum to keep the paragraphs, and the construction validity was found by calculating each of the indicators next:
- Scale stability: Stability is one of the important factors or characteristics that must be available for the validity of the use of any scale. The researchers adopted the (alpha Cronbach) equation to calculate the stability of the scale, which amounted to (0.942), and this result is very good and can be reassured. The researchers used the split-half to verify the stability of the scale, and the result of the stability calculated by the split-half was (0.76), which was corrected by the Guttman Split-Half Coefficient, as the result became (0.86), and this is a good indicator of the internal consistency between the items of the scale.

Fifth, the final application

The appropriate statistical treatments were conducted for each of the test of logical and inferential thinking skills (32) items in its final form and the mathematical beliefs scale, which consists of (35) items in its final form. The teachers were asked to write down their personal data, then explained how to answer the items of the scale and the test and inform them that their answers are confidential, As well as emphasizing that the results obtained are for scientific research purposes only. Thus, the data is ready for statistical analysis.

Presentation and interpretation of results

1- Results related to logical and inferential thinking skills

The t-text test was adopted for one independent sample and its calculated value was (5.056), which is greater than the tabular "t" value (2) at the significance level (0.05) and with a degree of freedom (44). And because the calculated is higher than the tabular, then the null hypothesis is rejected and the alternative is accepted and in favor of the average real performance.

Table (2)The results of the T-test to measure the difference between the average real and hypothetical performance of mathematics teachers

Group	Sample size	Average degrees	Standard deviation	Standard error	Calculated t value	Tabulated t value
Real average	45	26.56	4.717	0.703	5.056	2
hypothetical mean		25				

Note that (2) is the tabular T-value at the significance level (0.05) and the degree of freedom (44).

The researchers attribute the reason to the fact that female mathematics teachers in Iraq are mostly those who graduated from the faculties of education, and they are subject to the same curricula and courses designated for students of the faculties of education, Department of Mathematics. This is consistent with the study (Abdul-Amir, 2018), which confirms that students of the fourth stage / departments of mathematics in the College of Education possess logical thinking skills.

2- Results related to mathematical beliefs: the t-text test was adopted for one independent sample, and the calculated "t" value was (16.977), which is greater than the tabular "t" value (2) at the significance level (0.05) and the degree of freedom (44), and because the calculated is higher than Tabularity, the null hypothesis is rejected and accepts the alternative and in favor of the average true performance on the scale of mathematical beliefs.

Table (3)The results of the T-test to measure the difference between the real average and hypothetical performance of female mathematics teachers in the Mathematical Beliefs Scale

Group	Sample size	Average degrees	Standard deviation	Standard error	Calculated t value	Tabulated t value
Real average	45	104.69	6.792	1.012	16.977	2
hypothetical mean		87.5				

Note that (2) is the tabular T-value at the significance level (0.05) and the degree of freedom (44).

The two researchers believe that the mathematical beliefs of female mathematics teachers are related to the teaching methods and methods that female teachers prefer about learning and teaching mathematics, and that these beliefs are of an emotional and cognitive nature, and they express educational and teaching ideas and directions that female teachers believe in their validity for field application in everything related to mathematics and that the tasks and activities What teachers do begins with ideas and beliefs, and it affects their teaching self-efficacy.

3- Results related to the quality and nature of the correlation: the researchers used the Pearson correlation coefficient (Pearson cor.) to calculate the value of the correlation coefficient between the teachers' scores to test the skills of inferential logical thinking and their scores on the mathematical beliefs scale, and to measure the significance of the correlation coefficient, the T-test of the correlation coefficients was used to test the validity of the previous hypothesis. The results were as shown in the following table:

Table (4) Correlation coefficient between logical and inferential thinking skills and mathematical beliefs and the significance of correlation among female mathematics teachers

Study tools	No individuals	mean	std	Standard error	The value of the correlation coefficient	The t value of the correlation function
Deductive reasoning skills test	45	26.56	4.717	0.703	**0.439	63.383
Mathematical Beliefs Scale		104.69	6.792	1.012		

• (**) correlation coefficient at significance level (0.01),

• Note that (2) is the tabular t-value at the level of significance (0.05) and the degree of f It is noticed from the above table that the calculated correlation coefficient between the logical and inferential thinking skills of the sample members and their mathematical beliefs amounted to (0.439), and this is a positive and good correlation coefficient because the values of the correlation coefficients ranged between (1, -1), and the closer their values are to (1) the coefficients are strong .The t-value of the correlation coefficient was (63.383), which is greater than the tabular t-value of (2) at the significance level (0.05) and the degree of freedom (43), which indicates the existence of a statistically significant correlation between the two variables and the direction of the relationship is direct, i.e. The more female math teachers have high logical and inductive reasoning skills, the more positive mathematical beliefs they will have.

The researchers believe that the higher the logical and inferential thinking skills among female mathematics teachers, the more they have a positive belief towards mathematics and towards learning and teaching mathematics. From another point of view, it points out the positive outlook towards mathematics and towards teaching and learning mathematics among the sample members qualifies them to be good and thus possess good logical and deductive thinking skills.

Second, the conclusions

In light of the study results, the researchers concluded the following:

1- Mathematics teachers in Karbala governorate possess logical and inferential thinking skills.

2- The presence of mathematical beliefs in the research sample and in its two dimensions (the nature of mathematics, learning and teaching mathematics)

3- There is a positive and direct correlation with statistical significance between the logical and inferential thinking skills and the mathematical beliefs of the sample members.

Third: Recommendations

In light of the results of the study, the researchers recommend the following:

1- Establishing courses and programs for mathematics teachers to develop thinking skills in general and logical and inferential thinking skills in particular, considering that thinking is a primary goal that all educational institutions aspire to.

2- Instilling positive beliefs towards mathematics and towards teaching and learning mathematics through holding training workshops, so that they can transfer them in the appropriate form and manner to students.

3- Establishing programs, courses and directives to stay away from memorization methods with students and adopt teaching strategies by mathematics teachers based on the use of logical and inferential thinking skills in the educational process.

4- Establishing courses and programs for mathematics teachers in the faculties of education in order to develop the skills of logical and inferential thinking among their students and to follow up on recent developments in the educational process.

5- Paying attention to the educational preparation courses for students in the faculties of education specializing in mathematics, by including them with topics and activities that enhance their beliefs towards mathematics and towards the two processes of learning and teaching mathematics.

Fourth: Suggestions

1- Conducting a similar study on college students in the Department of Mathematics, especially the fourth stage, as it is an important stage.
2- Conducting empirical studies by preparing a training program based on logical and inferential thinking skills for pre-service mathematics teachers.
3- Conducting a similar study on mathematics teachers who are graduates of the faculties of science, Department of Mathematics and comparing the results.
4- Conducting a study concerned with mathematical beliefs and their relationship to the teaching practices of mathematics teachers.

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