



## THE FORMAL THINKING INCLUDED IN THE MATHEMATICS BOOK FOR THE FIRST INTERMEDIATE GRADE

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<p><b>Received:</b> 11<sup>th</sup> January 2022 <b>Accepted:</b> 11<sup>th</sup> February 2022 <b>Published:</b> 28<sup>th</sup> March 2022</p>	<p>The study was carried out in Iraq in 2021, which includes formal thinking in the mathematics book for the first intermediate grade. Therefore, the current research crystallized in the analysis of the mathematics book Part One for four (4) chapters, and the research community consisted of (143) pages of the fourth edition of 2019 and the research sample consisted of (116) pages and formal inference skills were used: hypothetical inference, deductive inference, proportional inference, and synthetic inference, adjusting the variables and logical inference as a tool for analyzing the content of the mathematics book was built by the researcher and after the validity and reliability of the research were verified, the analysis was carried out according to the skills of formal analysis.</p> <p>She came up with the following recommendations:</p> <ol style="list-style-type: none"><li>1- Recommending curriculum developers to include formal thinking skills in the mathematics book.</li><li>2- Addressing the failure of the textbook in terms of employing formal thinking skills and emphasizing the need to provide them in the future</li><li>3- Balance in employing all skills within the textbook without focusing on a skill and neglecting other skills</li><li>4- Providing training programs that include formal thinking skills for mathematics teachers to increase their teaching ability and potential</li><li>5- Evaluating mathematics books according to specific time periods in order to reform and develop on the basis of the development in teaching methods and skills</li></ol> <p>The results of the current research are:</p> <ol style="list-style-type: none"><li>1- Formal thinking skills vary in terms of frequency</li><li>2- The book chapters focus on one skill without the other, such as defining and controlling variables, proportional inference and logical inference, while there was weakness in hypothetical and synthetic inference.</li><li>3- Equality between the skill of proportional inference and the skill of logical inference in terms of employing skills within the mathematics book for the first intermediate grade</li></ol>

**Keywords:** Formal Thinking

### FIRST: THE RESEARCH PROBLEM

The mental operations included in the content of the mathematics curriculum of various kinds are operations that help students in applying, analyzing and synthesizing information and developing higher-order thinking skills. Mathematics is characterized by a large base of information and data. (Al-Jarjari, 2003: 19).

It deals with the study of nature and its theoretical relationship, which increases the complexity of this subject, so the learner needs not only abstract deductive thinking, also learn observation, inductive thinking, collecting and organizing information, linking events and phenomena to ideas, theories and laws, and using thinking in teaching mathematics that works on Changing and developing ideas.

The interest in teaching thinking is a requirement that educational institutions strive for and set goals and educational plans for, and Iraq is one of the countries that seek to achieve this by including in the education policy a number of goals that emphasized interest in thinking and its development. Hence, we find that the interest in teaching thinking or teaching content using thinking skills dealt with various sciences and was not limited to one science without another.

Among the educational curricula that develop abilities in general and thinking in particular is mathematics, as it is the basis on which all other sciences are based, such as life sciences, physics, psychology and others, (Mustafa et al., 1980, p. 6).

Therefore, it has become necessary to focus on developing the learners' thinking styles to ensure how they think, the way they acquire information and experiences, and how to keep them and then retrieve them at a later time. Which indicates their low level of thinking in general, and this was reinforced by the study (Al-Jabari, 1992) and the study (Al-Shukri, 2007).

The current research attempted to answer the question:

What is the availability of formal thinking in the first intermediate mathematics book in Iraq?

## **SECOND: THE IMPORTANCE OF RESEARCH**

The importance of the research can be summarized in two aspects:

### **First: the theoretical importance**

1. The value of this research is considered one of the research papers in formal thinking, which can be applied in understanding the competencies of the twenty-first century

2. This research is useful in helping to motivate teachers to use formal thinking skills, through which their educational impact is changed

3. It was represented in the principles and standards issued by the (National Council Teachers of Mathematics) (NCTM, 1989, 2000) in the United States, stressing the urgent need to help students consider mathematics as an exciting topic, as well as the calls for many seminars and conferences to develop appropriate solutions and concern to developing thinking and its skills based on the fact that learning is built through experience and work, not through indoctrination and memorization. (Alshamam ,2:2011)

### **Second: The practical importance**

1. The prepared research may help the curriculum developers in the Ministry of Education to design appropriate curricula for students according to formal thinking

2. Knowing the level of formal thinking in the mathematics book that contributes to the development and modernization of society

### **Third: Objective of the research:**

1. Identifying the formal thinking skills included in the mathematics book for the first intermediate grade

### **Fourth: Research hypotheses**

- The availability of formal thinking in the mathematics book for the first intermediate grade.

The following sub-hypotheses emerged:

A- The availability of hypothetical inference in the mathematics book for the first intermediate grade

b- The availability of deductive inference in the mathematics book for the first intermediate grade

C- The availability of proportional inference in the mathematics book for the first intermediate grade

D- The availability of synthetic inference in the mathematics book for the first intermediate grade

E- The availability of determining and controlling variables in the mathematics book for the first intermediate grade

F- The availability of logical inference in the mathematics book for the first intermediate grade

### **Fifth: The limits of the research:**

This research is determined by the following:

1. Place limits: Iraq

2. Time limits: 2021-2022

3. Objective limits: Formal thinking in mathematics textbooks for the first intermediate grade.

### **Sixth: Defining terminology**

1- The Formal Thinking was defined by:

**(Wardsoth, 1990)** as:

It is the ability to solve problems and reach conclusions using logical calculations.

(Wardsoth, 1990)

**(Salama, 1995)** as:

Students realize the importance of definitions, basic terms, proofs and postulates.....etc. In addition to the interrelationships between identifiers and non-identifiers, thus he is able to build some proofs and not just supplement them or remember them.

(Salama, 1995)

**(Melhem 2009)** as:

The individual's ability to process abstractions such as ideas, symbols, relationships, concepts, and principles better than sensory objects and physical tools such as mechanical tools and sensory related activities. (Melhem, 2009)

The researcher defined it as the individual's knowledge of formal thinking skills (hypothetical inference, deductive inference, proportional inference, synthetic inference, determining and controlling variables, logical inference).

**THEORETICAL BACKGROUND AND PREVIOUS STUDIES**

**First: formal thinking**

Thinking concept:

The concept of thinking is one of the most ambiguous concepts, and the most difficult to define. This is due to the multiplicity and complexity of the steps it goes through, and one of its most prominent definitions is that it is a series of the invisible and intangible mental activities related to the brain, in which the brain performs when exposed to a stimulus that is received by one of the senses, or more than one, and what we actually touch is only the result of thinking.

Thinking Characteristics:

It depends on the information that settles in the mind. Thinking is not limited to the sensory experience that stems from it. Thinking reflects events, phenomena, and things in a symbolic verbal form. It is considered an organic and functional part of the structure of the human personality. (Al-Khalayleh, 1997: 35)

levels of thinking:

Lower levels: It includes remembering and paraphrasing literally.

Intermediate levels: such as asking questions, clarifying, comparing, categorizing and others.

Higher levels: It includes decision making, critical thinking, problem solving, innovative thinking, and retrospective thinking.

Thinking skills: the ability to perceive and the availability of sensory experience. Obstacle removal skills and the ability to avoid thinking errors.

Concept of Formal Thinking:

Piaget looks at man as a biological being of the first degree and applies biological concepts in his understanding of human intelligence. With growth, the cognitive structures increase in number and complexity, as their outcome in cognitive experience increases and his ways of thinking vary. (Al-Mufleh, 1995: 19).

Piaget classifications for the primary stage:

Piaget's theory classifies the stages of children's cognitive development that involve changes in the cognitive processes and abilities that children have.

Through his observations, Piaget developed a theory of intellectual development that included four distinct stages:

1. The sensorimotor stage.
2. The stage of conceptual thinking.
3. The stage of tangible physical operations.
4. The stage of abstract operations.

Each stage will be discussed separately:

The sensorimotor stage

Starting from birth until the age of two years, infants at this stage of development begin to discover the world and the surrounding environment using their senses and bodily movements. That is the stage in which the child begins to gather information from different experiences and learn to differentiate between people, objects, scenes, and emotional states.

It can be said that the infant does not know anything about the surrounding world and does not know how to deal with it, so he tries different activities such as shaking and throwing things or even putting toys in his mouth; Between the age of 7 to 9 months, he begins to realize the presence of things around him even if he is not able to see them, and after the infant begins to crawl or stand and walk, the increase in his physical movement leads to an increase in cognitive development, and in the period between 18 to 24 months, the stage is approaching At the end of it, then the infant begins to develop language in a simple way and begins to express using his voice. (Al-Hiti, 2008: 40).

**The stage of figurative thinking**

This stage starts from the age of two to seven years; At this stage, the child continues to develop abstract ways of thinking, including developing language skills and using words and behaviors to represent events he has experienced previously. At this stage, the child shows five main behaviors:

- Imitation: At this stage, the child begins to imitate people's behavior, even if the person imitated by the child is not present in front of him (Al-Mufleh, 1995: 33).
- Symbolizing: The child begins using objects as symbols and projecting the characteristics of one object onto another, such as the child representing the stick as a sword.
- Drawing: involves both imitation and symbolizing, so the child begins to develop his abstract skills more accurately.
- Mental imagery: the child can visualize many objects in his mind in addition to associating these objects with their names.
- Verbal description of events: the child can use language to describe and represent events, people or objects.

It can be said that the child is selfish, meaning that he understands the world only from his perspective and struggles to understand the views of others. (Al-Rimawi, 2008:44)

**The stage of tangible physical operations:**

This stage starts from the age of(7 -11) years. This stage is considered the main turning point in the stages of cognitive development of the child, during which the child becomes less selfish and more rational.

At this stage, the child acquires the ability to develop and apply logical and concrete rules to objects, including the ability to classify objects into groups and subgroups, in addition to the ability to understand logical matters such as height, weight, understanding and memorization. For example, a child is able to recognize that the appearance of water changes when placed in a small or large bottle, wide or narrow, but that the water itself does not change but rather remains the same. (Al-Mufleh, 1995:40)

**Abstract operations stage:**

It is the stage extending from 11 years to adulthood, in which children learn to use logic and create theories. It is considered the final stage of cognitive development, in which the child learns more advanced rules of logic that enable him to use logical roles to understand abstract topics and solve problems, and he is also able to analyze the environment and transcend The limits of understanding things and facts up to the search for solutions to problems.

**Characteristics of Formal Thinking:**

- 1- Formal thinking goes back mainly to hypothetical deductive reasoning
- 2- The ability to deal with events through synthetic logical operations
- 3- The growth of their abstract thinking
- 4- The individual becomes more free and without being restricted by external factors
- 5- The thinking processes of the individual become based on an inferential hypothesis to a large degree (relationship if...then...)
- 6- In other fields of science, the individual can isolate the other variable that may affect the situation (Al-Mawla Suleiman, 2011: 52).
- 7- at this stage the processes of representation and alignment Balance until it reaches the so-called cognitive equilibrium.
- 8- The student will have the ability to make inductive reasoning by making some observations to reach generalizations and principles.
- 9- The individual's ability to find logical inferences and conclusions away from material things and realistic tangible topics, that is, on the basis of abstraction of symbols.
- 10- Mental processing of more than one concept at a time.
- 11- they are affected by the culture and environment in which the individual lives.
- 12- they are affected by the individual's mental abilities, including maturity, intelligence, individual experiences, and the surrounding environmental conditions.

**Second: Previous studies: Studies that dealt with formal thinking**

- 1- A study by (Al-Mufleh, 1995) conducted in Jordan, aimed at investigating the effect of formal thinking for first-year secondary scientific students in Mafraq Governorate and their attitudes towards physics at the level of their conceptual knowledge of Newton's laws of motion.
- 2- A study by (Al-Heti, 2008) conducted in Iraq and aimed at knowing the effect of using the problem-solving method on formal thinking and academic achievement of fourth-grade secondary school students in mathematics.
- 3- A study by (Al-Mawla, 2011): conducted in Iraq and aimed at knowing the effect of a proposed strategy supported by directed imagination to solve mathematical problems in the achievement and development of formal thinking among students of the fifth scientific grade.
- 4- A study by(Al-Aibi, 2011) conducted in Iraq and its aim is to identify formal thinking and its relationship to the five major factors of personality among middle school students.

**Table (1) Previous studies on formal thinking**

Researcher name	Material	Educational stage	Size and type of sample	Curriculum type	Researcher tools	independent variable	dependent variable	Statistical means	results
Almuflih 1995, Jordon	Physics	Intermediate	176 students	Experimental	Logical thinking test, and a measure of attitudes towards learning	Formal thinking and heading towards physics	Level of conceptual knowledge of Newton's laws of motion	binary test (T-Test) bivariate analysis	There are statistically significant differences between the experimental group

					physics				and the control group in favor of the experimental group
Alhiti 2008, iraq	Mathematics	Preparatory	54 students	Experimental	Formal thinking test, achievement test	Problems solving method	formal thinking, academic achievement	binary test (T-Test) bivariate analysis	The experimental group that was studied according to the problem-solving method was superior to the control group that was studied according to the usual method in formal thinking.
Al-Eibi	Mathematics	Intermediate	400 students (male and females)	Experimental	Formal thinking test	Formal thinking method	List of the major Five Factors of Personality	Getman equation, t-test for two independent samples, t-test for one sample	Preparatory stage students have a high level of formal thinking, a mastery of the neurotic factor, and a low level of personality factors (extraversion, kindness, openness, vitality of conscience).

**RESEARCH PROCEDURES**

This chapter includes a presentation of the research procedures followed by the researcher in terms of research methodology, population identification, sample selection, and construction of the tool used in the research, as well as the statistical methods used in it.

**RESEARCH METHODOLOGY & METHOD**

The current research used the descriptive approach to suit the nature of its objectives, as this approach is not limited to data collection and tabulation, but goes beyond that, as it speculates a degree of interpretation of these data, analysis, comparison, evaluation, and generalizations.

The descriptive research method is a scientific diagnosis of a phenomenon and its quantitative insight into linguistic and mathematical symbols. (Anwar and Adnan, 2007: 37-38)

**First: Research Methodology**

The researcher adopted the descriptive (analytical) approach in collecting, classifying and analyzing research data, due to the ease of its application and the multiplicity of areas of application in it, it also provides some information that helps draw a general picture of the problem and the phenomenon that is the focus of the research (Al-Assaf, 2010: 221). The researcher used content analysis as a method to analyze the content of the mathematics book for the first intermediate grade in the light of the skills of formal thinking due to its suitability to the nature of this research.

**Second: The research community and its sample**

Research community: The current research community consists of a mathematics book for the first intermediate grade, part one, authored by Amir and others, 4th edition, for the year 2019, issued by the General Directorate of Curricula, the Ministry of Education, and applied for the academic year (2019), as shown in Table (2).

**Table (2) shows the research community**

No.	Grade	Print	Year	Chapters number	Pages
1	the mathematics book for the first intermediate grade, part one	Fourth	2019	Four chapters	143

**RESEARCH SAMPLE**

The researcher took the mathematics book for the first intermediate class (with its first parts) as a sample for her research (which is the same as the research community) after excluding the interfaces of chapters, indexes, previous tests and book interfaces from the analysis of the first part. The total number of pages for the book, the first part, was (143) pages, while the number of pages that were subjected to analysis are (108) pages, which represents (89%) of the content, the first part of the mathematics book, and table (4) shows the sample of the analysis.

**Table (3) shows the topics titles for the chapters of the mathematics book for the first intermediate grade (Part 1)**

No.	Chapter No.	Chapter title	Number of pages analyzed in the chapter	Percentage of number of pages per chapter of the book
1	First	The correct numbers	26	24%
2	Second	Relative numbers	30	28%
3	Third	polynomial	26	24%
4	Forth	open sentences	26	24%
Total			108	100%

**Third: The Research Tool**

To achieve the goal of the current research, the researcher prepared a content analysis tool, represented by a list that included formal thinking skills, and the analysis tool "is a form designed by the researcher to collect data and repetitions of the phenomena and materials whose content he analyzes, to help him complete the elements of analysis and follow a unified system in it, and to achieve great objectivity and stability coefficient high for the analysis process. (Al-Samouk and Al-Shammari 84:2006), the researcher followed the following steps to prepare the research tool:

- Examining a set of educational literature and a number of studies in the field of formal thinking skills, especially the study of (Mufflih), the study of (Al-Aibi), as well as the study of (Al-Hiti).
- Conducting a comparison between studies to determine the formal thinking skills that fit with the content of the mathematics curriculum for the first intermediate grade. The researcher relied on the study (Piaget and Enhalder) in defining the skills and their definitions, so she prepared a list that included six main skills: (virtual inference, deductive inference, proportional inference, and synthetic inference, identifying and controlling logical inference variables).

**The validity of the content tool:** The list was presented in its initial form to a group of arbitrators in the field of mathematics and its teaching methods, who expressed their opinions about the suitability of the list for the purpose for which it was developed. In arbitrage the suitability of the tool. The arbitration process resulted in an 80% agreement to make some modifications to the list to become more accurate and objective when analyzing the content. Final picture of the list: After making the required modifications, a list of formal thinking skills was drawn up in its final form, as the list included six main skills of formal thinking with the classification of each. From these skills, and thus the list became ready as a tool for analyzing the content of the mathematics curriculum for the first intermediate grade to monitor the repetitions of skills and their components and the percentages of their inclusion in the content.

#### **Fourth: Analysis of the mathematics book for the first intermediate grade**

To analyze the content of the mathematics book, the researcher followed the following steps:

- 1- Objective of Analysis: The objective of the analysis is to know the formal thinking skills included in the mathematics book for the first intermediate grade
- 2- Sample analysis: the researcher chose the content of the mathematics curriculum for the first intermediate grade (the first part), and there are several methods for selecting the sample for analysis, such as the opinion of the expert supervisor, experienced specialists, survey and analysis (Al Kasbani, 143: 2013), The sample of the analysis was clarified
- 3- Categories of Analysis:

Formal thinking skills identified by Piaget and Enhalder:

The researcher relied on the six main formal thinking skills, which are:

Hypothetical inference: The individual's ability to put forward a set of hypotheses and try to test their validity and elicit a solution and reach results, i.e. inference about possible outcomes.

Deductive reasoning: inference from a general rule to specific results.

-Proportional reasoning: the ability to establish a relationship between two relationships to reach a solution to the problem that forms the basis of the relative relationship, according to the rules of proportionality.

Synthetic inference: generating a list of possible arrangements and correlations for several variables.

-Identifying and controlling variables: the ability to know the effect of one of the variables associated with the problem فائى isolate and control the other variables that are not related to the problem.

Logical Reasoning: The ability to infer relationships between things for several ideas and concepts.

- 4- Units of analysis: There are five types of units of analysis (word, subject, idea, space and time scale, paragraph or vocabulary , personality) (Bahri, 2015: 255). As the idea becomes clear through the paragraph and is represented in the text of Al-Fati: explanation, clarification, the shat, solved examples, a question, as well as consisting of several sentences, symbols and forms, so the analysis focused on the textual (verbal) context in the content as it relied on repetition and a unit of multiplicity

- 5- regulations of the analysis process: In order for the analysis process to be done well, there must be regulations that control this process, and these controls are:

-The analysis process included the topics of the lessons in each chapter, as well as the tests at the end of each lesson, the tests at the end of each chapter, and the tests at the end of each part of the book.

The analysis does not include chapter interfaces, previous tests, index, and book interfaces

- 6- Steps of the analysis process: The analysis process was carried out according to the following steps

-Reading the content of the mathematics book for the first intermediate grade (part one) as a preliminary reading, as it is the subject of the analysis process

Re-read the content with concentration to determine the extent to which it is included in the analysis list

-Recording the results of the analysis and classifying them in tables to monitor the results of the analysis process, and converting them into repetitions and then into percentages, so that they can be interpreted and commented on later.

#### **Fifth: Analysis Validity**

The analysis was done in the light of the list of formal thinking skills. - Analysis within the framework of the scientific content of mathematical topics in the mathematics book for the first intermediate grade (Part One) of the ministerial curriculum scheduled for the year 2019-2020.

The validity of the analysis is one of the most important steps of the analysis, and validity is intended to achieve the purpose for which it was designed, and to measure what was set up to measure it (Mahmoud Ahmed and others, 190:2010). The model was presented to a number of arbitrators and specialists in mathematics teaching methods as shown in Appendix (1), and the percentage of arbitrators' agreement on the analysis process was (88.43), which is considered a good percentage to achieve the validity of the analysis

**Sixth: Analysis Stability**

Stability means the measurement accuracy of the analysis and observation tool and the consistency of the information it provides us with the purpose for which the measurement analysis tool was developed (Al-Qaisi, 118:2008). To verify the stability of the analysis, the researcher performed the following actions:

A- The stability of the analysis over time: the stability coefficient is calculated according to the time factor, that is, the researcher analyzes the analyze material twice and at two spaced intervals to verify that the same results are obtained or not (Ta'ima, 244: 2004), and to ensure the stability of the analysis for the research, the researcher performed the first analysis Then she re-analyzed two chapters (the first and second) of the content after three weeks after the first analysis, and then she calculated the stability coefficient between the two analyzes by the number of times of agreement between the two analyzes divided by the total number of the analyzed categories, and the researcher used Holste equation to calculate the points of agreement between the result of the two analyzes. Table (4) shows the stability coefficient between the two analyzes of the researcher. It was found from the above table that the stability coefficient between the two analyzes (first and second) for the content of the mathematics curriculum for the third intermediate grade in the light of analytical thinking skills is (95%), which is a high percentage of stability, which indicates the stability The first and second of the research sample.

**Analysis tool**

A - Cross-individual analysis stability: in which the stability of the analysis tool is calculated according to different analysts, as another researcher repeats the analysis after clarifying and explaining to the researcher the mechanism and nature of the research, as well as providing him with a list of skills and its components (the analysis tool), and then the stability coefficient is calculated by the number of times The agreement between the analysts divided by the total number of the analyzed categories, and to ensure the stability of the analysis tool for the current research, the researcher agreed with two analysts to re-analyze after providing them with a list of analytical thinking skills and content, The analysts re-analyzed two chapters of the book's content, or 20% of the curriculum's content, part one, and after the analysis, the reliability coefficient was calculated using the Holstey equation, between the researcher's analysis and the analysis of other analysts, and the following table shows the reliability coefficient between the researcher's analysis and the analysis of the first and second analysts (Cross-individual stability).

**Table (4) Analysis stability coefficients**

Agreement across time	Between the researcher and himself after 30 days	0.87
agreement among analysts	agreement among analysts	0.89
	Between researcher and analyst	0.86
	Between the researcher and the second analyst	0.91
	Between the first analyzer and the second analyst	0.90

The stability coefficient is a good dimension, if it is (70%) or more (Al-Bayati, 1977: 183).

**Presentation and interpretation of results**

With regard to the skills of formal thinking, the results of analyzing the content of the mathematics book for the first intermediate grade, the first part, as shown in Table (5) and as follows:

**Table (5) Frequencies, Percentages, and Order of Analytical Thinking Skills in Mathematics Book for the first intermediate grade, part (one)**

No.	Formal thinking skills	Mathematics book according to chapters				Total repetitions in chapters	Skill percentage
		C1	C2	C3	C4		
1	Define and adjust variables	30	50	66	80	226	23%
2	proportional inference	32	44	60	50	186	19%
3	logical inference	22	30	60	70	182	19%
4	deductive inference	24	22	60	62	168	17%
5	default inference	12	25	60	60	157	16%
6	Synthetic inference	22	15	29	34	60	6%
Total		175	213	315	372	943	100%



The researcher attributes the results of the research in the book's inclusion of topics, examples and mathematical exercises, which requires the implementation of the skill of identifying and controlling variables in mathematical issues and formulas in a coherent and sequential manner, which helps to identify and control variables to reach the best results. %), then the skill of logical inference at a rate of (182) recurrences at a rate of (19%), then the skill of deductive reasoning at a rate of (168) iterations at a rate of (17%), then the skill of hypothetical inference at a rate of (157) iteration at a rate of (16%), then the skill of synthetic inference at a rate of ( 60) recurring at a rate of (6%)

### Second: the conclusions

- 1- Formal thinking skills vary in terms of repetition
- 2- The book chapters focus on one skill without the other, such as defining and controlling variables, proportional inference and logical inference, while there was weakness in hypothetical and synthetic inference.
- 3- Equality between the skill of proportional reasoning and the skill of logical reasoning in terms of employing skills within the mathematics book for the first intermediate grade

### Third: Recommendations

- 1- Recommending curriculum developers to include formal thinking skills in the mathematics textbook
- 2- Addressing the failure of the textbook in terms of employing formal thinking skills and emphasizing the need to provide them in the future
- 3- Balance in employing all skills within the textbook without focusing on a skill and neglecting other skills
- 4- Providing training programs that include formal thinking skills for mathematics teachers to increase their teaching ability.
- 5- Evaluating mathematics books according to specific time periods in order to reform and develop on the basis of the development in teaching methods and skills

### Fourth: suggestions

- 1- Analyzing mathematics books according to other skills and variables
- 2- Studying the level of formal thinking among middle school mathematics teachers
- 3- The relationship of formal thinking with other variables (habits of mind, memorization, perceived abilities, etc.)
- 4- An experimental study of the effect of the effectiveness of a strategy in teaching mathematics on the formal thinking of middle school students

### RESOURCES

1. Anwar Hussein Abdel Rahman, Adnan Zangana (2007): Methodological patterns and their applications in the humanities and applied sciences, first edition, Dar Al-Wefaq, Baghdad.
2. Bahri, Mona Younes, (2015): The educational curriculum, its foundation and analysis, Dar Safaa for Publishing and Distribution, Amman, Jordan 2. Abu Zina, Farid Kamel, (2010): Developing and teaching school mathematics curricula, Wael Publishing House, Amman
3. Al-Bayati, Abdul-Jabbar Tawfiq, and Zakaria Zaki Athanios, (1977): Descriptive and inferential statistics in education and psychology, Workers Culture Foundation Press, Al-Mustansiriya University, Baghdad.
4. Al-Jabari, Mohieldin: Measuring the inferential thinking of middle school students, unpublished MA thesis, College of Education, Ibn Rushd, University of Baghdad, 1994 0
5. Al-Jarjari, Khashman Hassan Ali (2003): The effect of an educational program on developing formal thinking skills among middle school students, PhD thesis (unpublished), College of Education, University of Mosul.
6. Al-Khalayleh, Abdul Karim and Afaf Al-Lbabidi (1997). Methods of teaching and thinking for children, Dar Al-Fikr for printing, publishing and distribution, Amman, 2nd Edition.
7. Al-Rimawi, Muhammad Odeh (2008). Childhood and Adolescence Developmental Psychologist, Dar Al Masirah for Publishing and Distribution, Amman.
8. Zaytoun, Ayesh Mahmoud, (2010): Contemporary global trends in science curricula and teaching, 1st edition, Dar Al-Shorouk for Publishing and Distribution, Amman.
9. Al-Samouk, Saadoun Mahmoud and Huda Ali Jawad Al-Shammari, (2009): School curricula between tradition and modernization, Al-Warraq Publishing and Distribution Institute, Amman, Introduction to Research Methods in Education and Psychology, 1st Edition, Dar Al-Masirah for Publishing, Distribution and Printing, Amman.
10. Salama (1995) Methods of Teaching Mathematics Among the Nadhiri, 1st Edition, Dar Al-Fajrar for Publishing and Distribution, Cairo
11. Al-Shukry, Majed Shaya Khairallah (2007): The relationship of spatial ability with deductive reasoning among male and female mathematics teachers, unpublished master's thesis, College of Education for Pure Sciences Ibn Al-Haytham, University of Baghdad, 2007 0
12. Al-Shammam, Asim Ahmed Khalil (2011): "The effectiveness of three training programs based on e-learning (N.S.S) to develop the inferential thinking skills of fourth-grade students in the Department of Mathematics and their ability to solve problems", unpublished doctoral thesis, University of Mosul, College of Education, Mosul.
13. Taima, Rushdie, (2004): Content analysis in the human sciences, its concept, foundations, and uses, 3rd edition, Dar Al-Fikr Al-Arabi, Cairo.

14. Al-Assaf, Saleh Hamad, (2010): Introduction to Research in Behavioral Sciences, 1st Edition, Dar Al-Zahra, Amman
15. Al-Qaisi, Raouf Mahmoud, (2008): Educational Psychology, 1st Edition, Dijla House for Printing, Amman,
16. Al-Kasbani, Mohamed El-Sayed, (2013), The Contemporary School Curriculum between Theory and Practice, Horus International Foundation, Alexandria, Egypt
17. Laibi, Faten Kazem, 2011: Formal thinking and its relationship to the five major factors of personality among middle school students, unpublished master's thesis, University of Baghdad, College of Education for Pure Sciences, Ibn Al-Haytham
18. Laheti, Nasser Obaid Ibrahim (2008): Knowing the effect of using the problem-solving method in formal thinking and academic achievement among female fourth-grade secondary students in mathematics, a master's thesis (unpublished), College of Education for Pure Sciences\_Ibn Al-Haitham, University of Baghdad
19. Mahmoud Ahmed, Hessa Abd, Turki Al-Subaie, and Amna Abdullah, (2010): Psychological and Educational Measurement, 1st Edition, Dar Al Masirah for Publishing and Distribution, Amman, Jordan
20. Sources
21. Mustafa, Hadi Jaber and others: Foundations of Mathematics, Part 1, National Library, Baghdad, 1980 0
22. Al-Mufleh, Khalaf Muhammad Ammar (1995): The effect of formal thinking for first-year scientific secondary school students in Mafraq Governorate and their attitudes towards physics on their level of conceptual knowledge of Newton's laws of motion, Master's thesis (unpublished), College of Graduate Studies, University of Jordan, Amman.
23. Melhem Sami Muhammad (2009) Measurement and Evaluation in Education and Psychology, 4th Edition, Dar Al-Maysara for Publishing, Distribution and Printing, Amman
24. Al-Mawla, Suleiman (2011). The effect of a proposed strategy supported by directed imagination to solve mathematical problems in the achievement and development of formal thinking among fifth-grade students, "Master's thesis (unpublished), University of Mosul, College of Education, Mosul.
25. Wardsworth, B. J. (1990) Piaget's theory of cognitive advancement, translated by Fadel Al-Azrajawi and others, revised by Muwaffaq Al-Hamdani, House of Cultural
26. Affairs, Baghdad
27. NCTM (1989): the curriculum and Evaluation standards of school mathematics, Reston, VA, Oct.
28. NCTM (2000): Principles and standards for school mathematics, Reston, VA, Oct.