

## **Algebraic thinking skills included in the mathematics textbook for middle third grade**

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### **Abstract:**

The aim of the current research is to find out the extent to which algebraic thinking skills are included in the mathematics textbook for the third intermediate grade for the academic year (2020-2021) by answering the main research question:

What algebraic thinking skills are included in the mathematics textbook for middle third grade?

The descriptive and analytical approach was used, and to achieve the goal of the research, a list of the main algebraic thinking skills and the sub-skills were prepared, and after analyzing the content of the mathematics textbook, the stability of the analysis was verified through the analysis over time and across individuals using the Holsti equation, and it obtained a stability ratio of more than 82%. The research resulted in including algebraic thinking skills as a whole, but in varying proportions. The percentage of algebra skill as a language for mathematics (46.75%), algebra skill as a tool for studying functions and mathematical modeling (21.24%), representation skill (16.30%) and problem-solving skills (%) 7.01), the skill of algebra as mere arithmetic (4.52%), and the skill of inference (4.17%) (ranking).

In light of these results, a number of recommendations and proposals were reached.

**Key words:** algebraic thinking, algebraic thinking skills, textbook, content analysis.

### **1.Introduction:**

There are wide global efforts exerted in many countries of the world since the early eighties to develop teaching and learning mathematics, these efforts came in response to national and international calls calling for a review of mathematics curricula, and so that this education can meet the needs of comprehensive development, it faces many challenges. To graduate a new type of learners who are able to know themselves and understand others, as well as to meet the requirements of the times and the future, and equip them with the skills that enable them to achieve their own lifelong learning, and this only comes through building modern mathematical curricula in line with the era of globalization and the rapid explosion of knowledge and technology.

#### **1.1. Research problem:**

In view of the progress achieved in the scientific and knowledge field and in all other areas of life, educational and educational institutions are witnessing simultaneous developments, as the education goals focused on correctly directing students towards facing challenges, by preparing curricula that help to develop types of thinking, It is known that the development of an individual's thinking can take place through the different curricula within educational institutions that help students solve the problems they face, and that mathematics is an essential and important component of what is happening now and what is expected in the future, and therefore mathematics curricula and Her upbringing must fit with the data of development and take off her traditional cloak. Students need more useful mathematics in their daily lives, and to make it easier to learn in preparing them to face future challenges.

The scientific experience in the field of educational work is of utmost importance in discovering the most important problems that exist in the reality of our schools, as the problem that the researcher finds himself in light of his educational experience has importance to the researcher that pushes him to study it and delve into it. (Jaber and Kazem, 1978: 49)

And through the experience of the two researchers in the field of teaching mathematics, and their constant reading of middle textbooks, noticed that these books need analysis and study, especially the mathematics book for the third intermediate grade, which is considered a new book and of a new edition, as well as their introduction to the success rates. For the third intermediate grade for the last two years, I noticed the poor rates of students in mathematics. One of the reasons may be the book's lack of algebraic thinking skills.

Through the researchers' acquaintance with previous studies that dealt with the subject of algebraic thinking, the two researchers noted that there are many studies whose results have shown that there is a weakness of students in algebraic thinking skills or that they do not possess these skills at the required level, such as a study (Al-Hanini, 2008) and a study (Jabr, 2018). The study (Al-Ahmadi, 2019) and other studies.

Hence, the problem of this research is determined by answering the main question:

What algebraic thinking skills are included in the mathematics textbook for middle third grade?

## **1.2. research importance:**

The importance of this research is related to:

•the theoretical part:

1. Based on the call of global trends in modern education to develop curricula and evaluate them.
2. The importance of the availability of algebraic thinking skills in mathematics textbooks for all school levels is highlighted.
3. The importance of the intermediate stage, especially the third intermediate grade, in the ladder of the educational system in Iraq, after which it is a stage of transition and transformation from childhood to adolescence, as educational and educational institutions seek to develop the mental capabilities of students in them and prepare students who are distinguished by excitement and breadth of their ideas to reach ways Suitable solution.

Application part:

1. Being the first study in Iraq (according to the two researchers' knowledge) analyzes the mathematics textbook for the third intermediate grade according to the skills of algebraic thinking, in addition to the scarcity of research in Iraq that dealt with this type of thinking.
2. This research can pave the way for other researchers to study the extent to which algebraic thinking skills are included in other stages or grades of study, or study the development of algebraic thinking skills and their development among intermediate school students.
3. This paper provides information to teachers on the algebraic thinking skills included in the mathematics textbook for the third intermediate grade.
4. This research may help planners, officials and those concerned with numbers and writing of textbooks for mathematics to develop it in light of algebraic thinking skills.
5. The supervisors may benefit from it by including thinking skills in teacher training programs.
6. Presenting the content analysis card according to the algebraic thinking skills.
7. Provide a list of the main skills and sub-skills of them that may benefit students who are researchers and those interested in studies related to algebraic thinking skills.

## **1.3. research aims:**

1. Analyzing the content of the mathematics textbook for the third intermediate grade in light of the prepared list of algebraic thinking skills.
2. Identifying the ratios of including algebraic thinking skills in the mathematics textbook for the third intermediate grade.

## **1.4. Limits of the search:**

1. Algebraic thinking skills and sub-skills thereof, which are six main skills, namely: (problem solving, representation, inference, algebra as an abstract arithmetic, algebra as the language of mathematics, algebra as a tool for studying functions and mathematical modeling) and eighteen sub-skills of them.
2. The content of the mathematics textbook scheduled for the third intermediate grade (in its parts one and two), the second edition of 2019, in Iraq.

## **1.5. Define search terms:**

**Algebraic thinking** has defined it (Kriegler, 2008): It is a type of thinking that is organized into two basic components: (1) mathematical thinking tools, (2) basic algebraic ideas. Mathematical thinking tools include a set of skills, namely: problem-

solving skill, And the skill of representation, the skill of inference, and the basic algebraic ideas are the field in which these tools grow. (Kriegler, 2008, 1)

**Algebraic thinking skills**, as he knew them (Al-Maatham and Al-Menoufi, 2017): They are special skills in algebraic thinking, which are represented by the perception of patterns, the representation of algebraic relationships and functions, the understanding and use of variables and algebraic structures, and logical inference to treat or solve algebraic problems. (Al-Maatham and Al-Menoufi, 2017: 149)

As for the definition of the two researchers, procedurally, they are the skills of algebraic thinking, represented by (problem-solving skill, representation skill, inference skill, algebra as abstract arithmetic, algebra skill as a language of mathematics, and algebra skill as a tool for studying functions and mathematical modeling).

**The textbook** has defined it (Al-Issawi and others, 2012): that it is one of the basic elements on which the curriculum is based, and it forms the container that contains the study material, and it is the main reference that provides the learner with information more than other sources. His lessons before confronting his students in the classroom. (Al-Issawi et al., 2012: 125)

**Content analysis**, as defined by (Badawi, 2019): “It is a method that aims to describe content in an objective description and methodology, which leads to identifying the basic elements of learning.” (Badawi, 2019: 63)

As for the procedural definition of the researcher: It is a method that aims to describe the content of the mathematics textbook for the third intermediate grade according to algebraic thinking skills.

## **2. A theoretical background**

### **2.1. Thinking:**

Thinking is one of the basic human needs and has a relationship with society, as it is necessary for a person to think and make sound decisions that enable him to adapt to the society in which he lives, as advanced societies instill in their children the quality of self-confidence and dependence on them and qualify them to make sound decisions and give them adequate opportunity To be considered, therefore, the good management of community affairs required preparing a generation of thinkers who are good at managing individuals' affairs on strong foundations of awareness and understanding.

Thinking is considered one of the basic tools for acquiring knowledge. Therefore, educational systems emphasize filling minds with facts and knowledge, but urging them to work on learning and developing thinking so that the individual can meet the requirements of his life. (Abu Jadu and Naufal, 2007: 29) Therefore, one of the basic educational duties is to develop students' thinking, and to teach them how to think in order to be more able to solve their problems, and then they can easily face the requirements of their lives in the short and long term, which supports in Building civilization, and thus education contributes to the formation of a good citizen with an integrated personality, interacting with those around him. (Ibrahim, 2009: 121) (Al Amer, 2010: 48)

### **2.2. mathematical thinking:**

Mathematical thinking is one of the important types of thinking in the educational process, as it increases the learner's ability to understand mathematics and some other school subjects, and also helps him to acquire sound thinking methods that accompany him throughout his life.

Abu Zinah (2010) believes that mathematical thinking is a process of searching for a meaning or idea in a situation related to a mathematical context, and this means that it is thinking in the field of mathematics, where the elements or components of the situation are represented in numbers, shapes, symbols, concepts or mathematical generalizations. (Abu Zinah, 2010: 38)

### **2.3. Algebra & Algebraic thinking:**

#### **2.3.1. Algebra and its Relation to Calculation:**

The science of algebra came into existence at the hands of the Arab Muslim scholar Muhammad ibn Musa al-Khwarizmi in his famous book (The Science of Algebra and the Interview) in the ninth century AD. People are obligated from the need for it in their inheritances and wills, in their divisions, rulings, and trade, and in all that they deal with between them, including land area, river drainage, engineering, and other aspects of it and its arts .”(Musharrafa and Ahmad, 1937: 16 )

Algebra is one of the important branches of mathematics that students learn after learning an appropriate amount of arithmetic. Algebra focuses on algebraic activities that help students reach generalized expressions about the behavior of numbers, and the development of properties of arithmetic operations. (256: 2010, Alghtani and Abdul Hameed)

And that the subject of algebra came to facilitate mathematical operations and not to complicate them, it came to solve problems, not to devote or escape from them, and the mathematics auditor finds that our teaching of algebra begins in the elementary stage, but in an unclear form. Problem:  $9 = \dots + 3$ , because in reality we are asking him to solve an algebraic equation without saying so. (Amin, 2012: 212)

### **2.3.2. Algebra is one of the important branches of mathematics:**

Students' learning of algebra is considered a basic requirement that many professions need and rely on, and upon which many successful decisions are made in life. Algebra enables us to understand many ideas in many fields such as physics, chemistry, astronomy, commerce and economics, as it is thus the golden gate to understanding the world that surrounds coffee beans. (lesser, 2000: 62)

Algebra is the most abstract branch of mathematics, due to its abstract nature represented in the use of coding as a mathematical process to formulate different life situations in the form of functions, inequalities, equations and other different algebraic structures and combinations, which in their entirety represent the cornerstone of the formation of mathematical knowledge. (Mersal, 2016: 171)

### **2.3.3. Algebraic thinking (its concept and importance):**

Algebra is one of the concepts that students should learn, because the algebraic concept can be used in all fields of mathematics, and one of the methods used to develop students' algebraic abilities is to think algebraic.

And that the subject of algebra came to facilitate mathematical operations and not to complicate them, it came to solve problems not to devote or escape from them, and the mathematics auditor finds that our teaching of algebra begins in the elementary stage, but in an unclear manner. An example of this is when the student is asked to find the missing number in Issue:  $9 = \dots + 3$ , because in reality we are asking him to solve an algebraic equation without saying that (Amin, 2012: 212)

As a result of the large number of studies that were carried out on algebraic thinking, there were many and differing views about it, as some saw it (the use of mathematical symbols and tools to analyze different mathematical situations by: extracting information from the mathematical situation, and representing information mathematically in the form of words, drawings, tables, figures, and equations, And the interpretation and application of mathematical results, such as solving a problem to obtain the value of the variable, and testing hypotheses).

(Herbert & Brown, 1997: 123-124)

As for others, they saw it as the ability to build relationships between different quantities to understand, explain, discuss and represent these relationships using words, drawings and symbolic language. (Melillo, 1999: 14)

(Jones, 2012) is interested in introducing algebraic thinking early, and when children learn to identify a pattern Make predictions that they will be able to learn algebra. (Jones, 2012: 342)

Algebraic thinking begins in children before they enter school, so young children notice patterns (who is facing you? In front, behind) and notice relationships (who has a bigger cake?) And they represent these relationships through modeling or drawing pictures, and this is all considered A start to algebraic thinking. (Al-Maatham and Al-Menoufi, 2017: 140)

### **2.3.4. Goals Learning of algebraic thinking:**

- Learning algebraic thinking is one of the important things that aims to:
- Describe patterns and relationships using a variety of representation tools: words, tables, equations, diagrams, and graphs.
- Understand how different representations relate to each other.
- Recognizing patterns and anticipating results in different situations.
- Learn about the characteristics of linear patterns.
- Understand and use basic algebraic symbols. (Badawy, 2008: 465)

### **2.3.5. Algebraic thinking skills:**

Thinking skills are of great importance to learners, as they are the tools of thinking, and the level of efficiency and use of these tools determines the level of effectiveness of thinking, and these tools represent the basis from which good thinking starts, and this is reflected positively on the educational attainment of the learners and on The quality of life they lead. (Abu Athera, 2012: 174)

The two researchers have adopted a 2008 Bedouin classification which believes that algebraic thinking is: (1) Tools of Mathematical Thinking (2) Basic Algebraic Ideas. Mathematical thinking tools include three mathematical skills: 1-

Problem-solving skills 2- Acting skills 3- Thinking skills, As for the basic algebraic ideas, they are represented by: (1) Algebra as abstract arithmetic (2) Algebra as the language of mathematics (3) Algebra as a tool for studying functions and mathematical modeling. (Badawy, 2008: 235)

#### **2.4. Textbook :**

It is a holistic system that deals with the content component of the curriculum, and includes several elements: namely, the goals, the content,

And activities, and evaluation, and aims to help teachers and students in the classroom and in the subject matter to achieve the goals of the curriculum predetermined. (Mari & Al-Haila, 2000: 335)

The textbook is one of the main sources of student learning, and it is a legible source, and it includes the cognitive content element represented by facts, knowledge, concepts and generalizations, and its goal is to help teachers and learners alike in achieving the desired goals, and the textbook seeks to develop skills They are essential for students, such as reading, understanding, interpretation, criticism, and other skills required to prepare them for the future. (Attia, 2009: 314-315)

#### **Objectives of using the textbook:**

The use of the textbook has many goals, including:

- 1- It helps students to acquire sound study habits.
- 2- It develops students' ability to think in all its forms and levels.
- 3- It meets the educational needs of learners. (Ghanim and Abu Shairah, 2010: 2)
- 4- It enriches and enhances students' learning.
- 5- It helps students to understand the logical, conceptual and psychological structure of the material.
- 6- It provides motivation to learn for students.
- 7- It takes into account the individual differences between the learners. (Al-Hasani, 2011: 345-346)

#### **2.5. Content Analysis:**

Content analysis is a basic method based on analyzing a lot of information and knowledge in an era that is witnessing a tremendous information and knowledge revolution. Analyzing that content to its elements and ideas and describing it, quantitatively and qualitatively, in an organized scientific way, not relying on subjective impressions or random treatments. (Muhammad and Abdul-Azim, 2012: 11)

#### **Objectives of content analysis:**

The content analysis has goals, which he mentioned (Attia, 2009), which are:

- 1- Knowing the ideas, principles, concepts, skills and trends in the content.
- 2- Determine the types of thinking and mental skills that the textbook helps to develop among students.
- 3- Discovering strengths and weaknesses for the purpose of modifying and improving them.
- 4- It provides those in charge of authoring the curricula with the ideas and topics that the knowledge content of the textbook should include. (Attieh, 2009: 177)

#### **3. Previous studies:**

This part deals with the studies that dealt with the algebraic thinking variable, including:

##### **3.1. The study of (Al-Hanini, 2008):**

This study aimed to reveal the levels of algebraic thinking among students of the eighth grade basic and to identify the relationship of algebraic thinking and its skills with algebraic achievement. Two tools were used in this study, which are the algebraic achievement test and the algebraic reasoning test. The two tools on the research sample represented by (514) male and female students from the eastern region in the north of the Sultanate of Oman. The results of the study resulted in difficulties for students of the eighth grade in basic algebraic thinking skills, with a positive relationship between students' level of compulsory achievement and their ability to think algebra and his skills.

##### **3.2. The study of (Al-Ahmadi, 2019):**

This study aimed to determine the level of algebraic thinking among the students and to determine the common algebraic errors they have. A measure of algebraic thinking was used on (674) female students from public schools in the city of Riyadh, and the results resulted in a decrease in the level of algebraic thinking among a sample. The overall study also showed that the algebraic errors common in the study sample are dominated by conceptual errors related to the variable, the negative sign and the concept of the function, and that these errors increase steadily with the progress of the school stage.

#### 4. Research methodology and procedures:

**4.1. Research methodology:** The two researchers followed the descriptive and analytical approach for its suitability in achieving the research objectives.

**4.2. The research community and its sample:** The research sample represents the same research community represented by the mathematics textbook prescribed by the Iraqi Ministry of Education for students of the third intermediate grade, with its two parts (first and second) for the academic year (2020-2021), the second edition

#### 4.3. Research tool:

Preparing the research tool is one of the main steps that the researcher relies on to achieve his research objectives, as the current research required preparing a list of the main algebraic thinking skills and the sub-skills indicating them, for use in analyzing the mathematics textbook for the third intermediate grade in its first and second parts, by following the following steps:

4.3.1. Reviewing a set of previous research and studies that dealt with algebraic thinking skills, with the aim of forming a list of analysis that will be relied upon in this research.

4.3.2. Determining a list of the main algebraic thinking skills and sub-skills. This research was based on a classification (Badawi, 2008:) as the list contained (6) basic skills and (18) sub-skills distributed as follows:

**Table 1.** List of algebraic thinking skills

	Main Skills	Sub-skills
1	Problem Solving	1. Use problem solving strategies 2. Explore multiple entry points / multiple solutions
2	Representation	1. Present the relationships visually, symbolically, numerically and verbally 2. Moving between different representations 3. Interpreting information within representations
3	Inference	1. Induction 2. Conclusion
4	Algebra as simple arithmetic	1. Use conceptual mathematical strategies 2. Proportion and proportionality
5	Algebra as a language of mathematics	1. Meaning of variables and variable expressions 2. Meaning of solutions 3. Understand and use the characteristics of the number system 4. Reading, writing and dealing with numbers and symbols using algebraic rules 5. The use of equivalent symbolic representations to deal with formulas, algebraic expressions, equations and inequalities
6	Algebra as a tool for studying functions and mathematical	modeling 1. Researching, expressing and generalizing patterns and rules in realistic contexts 2. Representing mathematical ideas using equations, tables, drawings, or words 3. Work with input and output patterns 4. Development of graphic skills

#### 4.3.3. Validation of the analysis tool:

Truthfully intended analysis tool is the ability of the instrument to measure what it was prepared to measure. (Abu Naufal and Abu Awad, 2010: 269)

Therefore, the preliminary list of algebraic thinking skills was distributed to a group of experts and specialists in teaching methods

Mathematics, their opinions were collected and used to reach the final list, as the percentage of agreement reached more than 80%, and this good percentage indicates the suitability of the tool for the goal for which it was set.

#### 4.3.4. Analysis procedures:

A. Determining the purpose of the analysis process: The analysis process in this research aimed to identify the extent of including algebraic thinking skills in the content of the mathematics textbook for the third intermediate grade.

B. Determining the analysis sample: The analysis sample represented the content of the mathematics textbook for the third intermediate grade scheduled for public and day schools for the academic year (2020-2021) in its first and second parts.

C. Determining the unit of analysis: The two researchers relied on the explicit and implicit idea as a unit of analysis, and this is considered an accurate quantitative description of the studied content in the analysis process.

D. Determining the enumeration unit: the recurrence was relied on as a counting unit.

E. Preparation of the analysis card: An analysis card has been prepared to monitor the results of the analysis process, which includes basic and sub-algebraic thinking skills, analysis unit, page, repetition and ratios.

F. Steps in the analysis process: The analysis process was carried out according to the following steps:

- Reading the content of the mathematics textbook in its two parts (first and second) for the third intermediate grade, initial reading, so that the picture becomes clear in the minds of the two researchers.
- Carefully re-read each paragraph and focus on analytical reading
- Begin by analyzing each example, activity, question, and exercise, and extracting the skills contained in it in the analysis form prepared for that.
- Dumping the results of the analysis and classifying them into the list prepared for monitoring results.
- Converting results into frequencies and percentages.

4.3.5. Validity of the analysis: For the sake of validity of the analysis, the two researchers presented a model from the analyzed material, the first chapter of the mathematics textbook for the third intermediate grade, to a group of referees in methods of teaching mathematics, and the opinions of the judges were consistent with the analysis process, and thus the validity of the analysis was verified.

4.3.6. The reliability of the analysis: The two researchers used two types of reliability:

A. Stability over time: The two researchers re-analyzed a sample of the content of the mathematics textbook for the third intermediate grade, namely the first and fourth semester (after having been randomly selected from the target subject for analysis) in light of algebraic thinking skills after a period of time after the first analysis process, and the calculation was calculated. The coefficient of consistency between the two analyzes using the Holsti equation, as the results of calculating the ratio of agreement between the two analyzes ranged between (94% - 95%), which is a good percentage, as the stability coefficient is considered good if its ratio is (70%) or more. (Al-Dulaimi, 2015: 120)

B. Consistency with external analysts:

The two researchers used two externals \* analysts who are specialized and experienced in the analysis process to ensure the stability of the analysis, as the two researchers, in agreement with the analysts, re-analyzed the (first and fourth) chapters of the content of the textbook, i.e., 30% of the content of the mathematics textbook for the third intermediate grade. And after the analysis, the stability coefficient was calculated using the Holsti equation, as the results of calculating the agreement percentage ranged (81% -89%) and this is a good percentage.

#### 4.4. Statistical means:

The two researchers used the following methods in treating the statistics:

- 1- Percentages and frequencies as methods of calculation.
- 2- Holsti equation to find agreement ratios.

#### 5. Results of research and explanation them:

##### 5.1. Results:

After analyzing the content of the mathematics textbook for the third intermediate grade in its first and second parts according to algebraic thinking skills, and after completing the analysis process, the frequencies and percentages of these skills were calculated and the following table shows that:

**Table 2.** Frequencies and percentages of algebraic reasoning skills included in the content of the mathematics textbook For the third intermediate grade, with its first and second parts

	Algebraic thinking skills	, percentage	frequencies	rank of skill
1	Problem-solving skill	% 7.01	271	4
2	representation skill	% 16.30	630	3
3	Inferential skill	% 4.17	161	6
4	algebra as an abstract arithmetic	% 4.52	175	5
5	Skill algebra as a language of mathematics	% 46.75	1807	1
6	The skill of algebra as a tool for studying functions and mathematical modeling	% 21.24	821	2
Total		99.99%	3865	-

## 5.2. Explanation of results:

Through the results shown in Table (2) for analyzing the content of the mathematics textbook for the third intermediate grade in its first and second parts for algebraic thinking skills, the two researchers obtained (3865) iterations distributed over six main skills, as the skill of algebra as a language for mathematics ranked first by (1807) Repetition with a rate of (46.75%), followed by the skill of algebra as a tool for studying functions and mathematical modeling by (821) iterations with a rate of (21.24%), while the skill of acting ranked third with (630) iterations at a rate of (16.30%), then after The skill of problem solving was (271) iterations with a percentage of (7.01%), and the skill of algebra as an abstract calculation ranked fifth with (175) iterations with a percentage of (4.52%). As for the inference skill, it ranked last with (161) iterations with a percentage of the amount of (4.16%).

The two researchers see from the previous results that the mathematics textbook for the third intermediate grade dealt with algebraic thinking skills all together, but in varying proportions, and according to the researchers' belief that the reason is due to the authors' interest in the language of mathematics because it includes meaning for mathematics solutions, meaning for variables, and understanding and using the properties of a system Numbers, and the use of algebraic rules to deal with numbers and symbols, as well as the use of equivalent symbolic representations to deal with formulas, algebraic expressions, equations and inequalities. Skills that are not covered in all chapters, and if they are mentioned in small proportions, such as the skill of reasoning, it was not referred to at all in the second and third chapters, as well as the skill of algebra as a mere arithmetic. It was mentioned in a very small percentage in the second semester and it was not mentioned at all in the third chapter. Take into account this aspect because of its impact on developing students' algebraic thinking skills.

## 5.3. Recommendations:

1. The necessity to include algebraic thinking skills in all mathematics textbooks and for all stages, whether primary or secondary, due to the importance of this type of thinking as it is considered a type of mathematical thinking.
2. The two researchers concerned with preparing school curricula with specializations in the Iraqi Ministry of Education recommend the necessity of developing the content of mathematics textbooks in a manner that takes into account the plurality in choosing topics and activities in line with students' algebraic thinking skills and distributing them in a balanced manner among the chapters of the textbook.
3. Preparing training courses for teachers and teachers that qualify them to know and understand algebraic thinking skills and how to employ it during the education process in order to acquire them by students.
4. The necessity for the colleges of education in Iraqi universities, especially those in charge of them who specialize in mathematics curricula and teaching methods, to increase interest in pre-service mathematics teachers, and to provide them with a set of algebraic thinking skills and how to develop them among students.
- 5- Taking into account the algebraic thinking skills that are lacking in the mathematics textbook for the third intermediate grade.
6. Making use of the list of main and subsidiary algebraic thinking skills that the two researchers reached in this research in developing mathematics textbooks.

## 5.4. Proposals:

- 1- Conducting a similar study for this research on mathematics textbooks for the other stages.



- 2- Study the relationship between algebraic thinking and other types of thinking, such as engineering thinking.
3. Building a training program for mathematics teachers on algebraic thinking, and measuring its effectiveness on developing algebraic thinking among their students.
- 4- Conducting a descriptive study to find out the extent of students' possession of algebraic thinking skills
5. Conducting an experimental study (effectiveness of an instructional strategy) to develop students' algebraic thinking skills.
6. Conducting a study to reveal the nature of the correlational relationship of algebraic thinking skills for teachers on the one hand and their students on the other hand.
7. Conducting tracer research to detect the growth of algebraic thinking among middle school students.

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