Content analysis of the sixth scientific-grade mathematics book according to Divergent and Convergent thinking skills

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Abstract :

The current research aimed to recognize the availability of Divergent and Convergent thinking skills in the content of the sixth scientific-grade mathematics bookfor the academic year 2020-2021by answering the key question of the research:

What arethe divergent and convergent thinking skillsincluded in the sixth scientific-grade mathematics book?

The researcher used the descriptive-analytical approach, to meet the objective of the research, . He develop a list of the divergent and convergent thinking skills and their sub-skills. Then, and after analyzing the content of the book,he checked the reliability of the analysisin two ways; the first is performed through analysis across time,and the reliability coefficient in this way reached 96%, the second is the reliability over the individuals, as the reliability coefficient in this way reached 94%, and that by using Holsti equation. The researcher has found that the divergent and convergent thinking skills included in the book disproportionately, as the deduction skill got the highest percentageof the divergent and convergent thinking skillsoverall, as it was (50%), the second was the interpretation skillby (16%), the third was the induction skillby (11%), while the fluency skill was the fourth one by (6%), the flexibility and classification skill came in the fifth by (5%), the sixth was for the originality skill by (3%), the seventh for the elaboration and comparison skill by (2%), and the last was for problem sensitivity by (0%), and according to this results, the researcher provided some recommendations, including reconsidering the content of the sixth scientific-grade mathematics book so that including the divergent and convergent thinking skills in balance, as well as making an experimental study to pursue the divergent and convergent thinking skills development among the students of sixth scientific-grade.

Keywords: Divergent and Convergent thinking skills, Mathematics book, sixth scientific-grade.

Introduction

Mathematics is one of the most important sciences,indispensable,and an essential tool for interaction between individuals in daily life. Mathematics derives its significance in the community from the development levels of this community and its life complexity, which requires a lot of things like measuring, arranging, indicating quantities, amounts, distances, volumes, and so on, so mathematics development is a necessity imposed by the needs of contemporary life and preparing for the future life, that to reject the ideas and concepts which doesn't keep up with the development of different aspects of life to be replaced by ideas and concepts more relevant to the recent intellectual current, andIf the educational institutions want to do its duty to prepare the generations to serve the community and meet its needs of cultural, mental and mathematical experiences, they have to reconsider the current curriculum based oncommunity needs and make way for the developed and new curriculum to take its appropriate place (Abu Zina, 2010: 7).

Chapter (1): Research identifies

Research problem

The textbook is a central pillar of the educational process, as it is the meeting place of the active elements in it, and it is the common factor between all students and teachers of various environments and levels, as it is the first reference for the teacher and the student, also it is the most important teaching and learning

tools in an age characterized by knowledge explosion and spread of education, which make the textbook a central pillar of community development (Abu Sarhan, 2017:237).

The recent trends towards the mathematics curriculum and its teaching methods confirm that mathematics is a way of thinking based on understanding and logic. The aim of teaching mathematics is not limited to training students to perform mathematical operations and solve abstract problems that may not be related to reality like the traditional view of it, but rather the aim becameto impartingstudents different thinking skills to be able to face the various problems they meet (Al-Khatib, 2015: 24).

Amongthe types of thinking that received great and clear attention by ancient and contemporary researchers are divergent thinking,which characterized by authenticity with a focus on the diversity of outcomes, and convergent thinking, which is a mental activity that searches for the best answer within the limits of the information available to the learner and this answer be the correct answer without going into the search for alternative answers that require the learner to be creative (Rzouki&Aestbrq, 2019: 22).

The problem of the research emerged after the researcher prepared a questionnaire to survey the opinions of (25) sixth scientific-grade mathematics teachers who have servedfor at least five years, as 84% did not know the convergent and divergent thinking skills,and 21% of them knew some convergent skills and some divergent skills, this shows that the research problem can be determined by answering the following question:

What are the convergent and divergent thinking skills included in the sixth scientific-grade mathematics book?

The research importance

The research importance can be determined by the following:

1. The importance of thinking and its necessity in the contemporary ageis a primary aim that educational and teaching institutions seek to impartand develop its skills among learners.
2. The importance of the textbook, as the main reference for both the teacher and the student, as well as the vessel that containsthe educational materialwhich considers one of the important meanstoachieve the educational curriculum aims.
3. Determine the strengths in the textbook and work on developing them, and determine weaknesses and work to address them.
4. Make way for researchers to make researches and studies address how mathematics books include other divergent and convergent thinking skills.

Research objective

The current research aims to recognize the availability of divergent and convergent thinking skills in the content of the sixth scientific-grade mathematics book by answering the following question:

- What is the percentage of the availability of divergent and convergent thinking skills in the content of the sixth scientific-grade mathematics book?.

Research limitations

The researchis limited by the content of the sixth scientific biological-grade mathematics book for the academic year 2020-2021,and that issued by the Ministry of Education, General Directorate of curricula.

Terms identification:

1. Content analysis

Hussain, 2011: it is to dismantling and dividing its wordsand choosing what suits the student's abilities, interests, and desires to achieve the aims of the state or educational institution (Hussain, 2011:100).

The researcher defines it procedurally as the research method that is taken by the researcher in monitoring the repetitions contained in the content of the sixth scientific biological-grade mathematics book which issued by theIraqi Ministry of Education, the General Directorate of Curricula,for the academic year 2020-2021, written by a committee in Ministry of Education, tenth ED , 2019 AD, to reach an inclusivenesspercentage of divergent and convergent thinking skillsand describe it quantitatively and qualitatively.

2. Textbook:

Laqad, 2021: it is an educational document written for education and learning, and it is a corner stone in the education process as it explains the main lines of the subject, as well as includesthe main information,

ideas, and concepts in a certain curriculum, along with Values, skills, and attitudes meant to get it to learners (Laqad, 2021: 27).

The researcher defines it procedurally asthe sixth scientific biological-grade mathematics textbookby the Iraqi Ministry of Education, the General Directorate of Curricula, for the academic year 2020-2021, written by a committee in the Ministry of Education, tenth edition , 2019 AD.

3. Divergent thinking skills

Jerwan, 2007: it is a set of Competencies that direct the individual desire to seek solutions and reach authentic outcomes wasn't known before (Jerwan, 2007: 77).

The researcher defines it procedurally asa set of skills (fluency, flexibility, authenticity, elaboration, and problem sensitivity) mentioned in the lists prepared to analyze the content of the sixth scientific-grade mathematics book.

4. Convergent thinking skills

Qatami, 2007: it is a set of skills used to answer the questions which included comparison or explanation or deduction of a principle or publication related to previous information (Qatami, 2007: 516).

The researcher defines it procedurally as a set of skills (deduction, induction, reasoning, comparison, and classification) mentioned in the lists prepared to analyze the content of the sixth scientific-grade mathematics book.

Chapter (2): Theoretical background and previous studies:

First: Thinking and mathematics

Mathematics is a fertile field for training on sound thinking methods. Therefore, mathematics is considered a constructive build that starts from recognized introductions, and the results derived from it using logical rules, this is the basis of sound logical thinking (A Amer, 2010: 9-10), as well as it characterized, In terms of its substance, by logical and not subject to emotions in judge the validity of issues or the way it derived its results, this makes students have objectivity in their thinking and judgment onthe things and other issues.In this sense, it can be one of the objectives of teaching mathematics to provide the student with a logical thinking method so that they can judge the validity of the results in light of the available information (Madi, 2011: 139).

Second: the textbook

The textbook is one of the main elements on which the curriculum is based, and it is the vessel that contains the educational material, and it is the basic referencefrom which the learner derives his information more than other sources, and it is the basis on which the teacher relies in preparing his lessons before he addresses the learners in the class, as it helps him in defining the general goals and behavioral goals, and bringing into view the main concepts, proposing activities and exercises, and choosing educational and evaluation aids (Khater & Fathi: 2010: 97).

Third: Content analysis

Content analysis is a method of scientific research that falls under the descriptive research method, and its purpose is to know thecharacteristics of communication material or textbooksand to describe these characteristics quantitatively expressed in quantitative symbols in addition to the results obtained by other methods that are indicators determine the direction of the required development, the success of the textbook depends on the analysis of its multiple elements for successful practical planning of the school curriculum, and recognize the features and characteristics of these elements,and the nature of the relationships that exist between them; To get valid inferences and conclusions (Asiri, 2018: 75).

Fourth: Divergent thinking skills:

(Al-Fakhry, 0224) refers to the following divergent thinking skills:

1- Fluency: it means the ability to generate a large number of alternatives, synonyms, ideas, problems, or uses when responding to a specific stimulus, and the speed and fluidity of its generation, which in essence is a memorize and an optional recall of information, experiences, or concepts previously mentioned.

2- Flexibility: It is the ability to use more than one method in work and look at things, meaning it represents the ability to direct or shift the direction of thinking with the change of the stimulus or the requirements of the situation.

3- originality : The ability of the individual to come up with rare thoughts and responses that are often repetitive in the statistical sense within the group to which the individual belongs.
4- Eliaboration or expandation : It means the ability to add new and varied details to an idea or solution to a problem, and helps in its development, advancement , implementation, and accurate and comprehensive adress that highlights the details and dimensions of the issue.
5- Sensitivity to problems: it means the ability to see faults, needs, shortcomings, and weaknesses in the various topics and situations that a person interacts with in his public surroundings. (Al-Fakhry, 2018: 28)

Fifthly: Convergent **thinking skills**

(Al-Ashqar (2011) refers to the following convergent thinking skills:

1. deduction: It is the ability to draw a conclusion from several introductions, facts, or statements.
2. Induction skill: It is the ability to move from particles to quantities.
3. Interpretation skill: It is represented by the ability to give justifications or draw a specific conclusion in light of the available incidents. It is also represented by the ability to determine the causes responsible for a particular case.
4. Comparative skill: is the ability to recognize the similarities and differences between two or more things by examining the interrelationships between them.
5. Classification skill: It is the process in which specific observed features or characteristics are used to divide objects or parts into groups or classes.(Al-Ashqar 2011:55)

Sixthly: Pervious studies:

Imai, 2000 study aimed at identifying the effectiveness of a proposed teaching strategy based on mathematical problems with open intentions in developing divergent thinking skills. The study sample consisted of students aged between (11-12 years) from the seventh grade in middle schools in three schools in Wakayama, Japan, with a sample number of (073) students. The divergent thinking skills test (originality, flexibility and fluency) was built, and the results showed the effectiveness of the strategy used in developing divergent thinking skills.

Sak & Maker, (2005), this study was conducted in the United States and aimed at investigating the relationship between convergent thinking and divergent thinking, with a focus on the relationship between convergent thinking with each of the divergent thinking skills, which is fluency, originality, flexibility in the mathematical field, through Mathematical tasks and problems, and observing the students 'answers to them, and grades from the first to the sixth were chosen. The sample of the study was (427) students of different origins in four schools participating in the (Discover) project in the southern Arab region of the United States, and the results of the study showed that There is a large correlation between convergent and divergent thinking in mathematical performance.

The study (Al-Buqami, 2019) The study aimed to identify the effect of using divergent thinking strategies on developing convergent and divergent thinking skills in mathematics among elementary school students, and the results of the study showed statistically significant differences between the mean scores of the two groups' students. The experimental group and the control group in the post application of the convergent and divergent thinking test in mathematics for the benefit of the experimental group.

t he current study differed with previous studies in that it was the first study that dealt with content analysis.

Chapter Two:
Research Methodology and Procedures

First: Research methodology

The researcher followed the descriptive and analytical approach using the content analysis method for its suitability for the current study, and the content analysis method is considered one of the most appropriate methods for addressing such type of studies. This is due to his ability to identify the directions of the subject that is being studied (Al-Hassamouti, 2019: 12).

Second: the research community and its sample

The research sample represents the same research community, which is represented by the mathematics book scheduled for sixth-grade science book students by the Iraqi Ministry of Education, General

Directorate of Curricula, for academic studies 2021-2020 AD, by a committee in the Ministry of Education, 10 editions, 2019 AD.

Third: the search tool

It is a set of means that the researcher adopts in obtaining the information and data that are necessary for him to answer his research questions (Abdul-Raouf and Al-Masry, 2017: 22). One of the requirements of the current research is the preparation of a content analysis tool according to its divergent and convergent thinking skills. In order to prepare this tool, the researcher carried out the following procedures

1-Prepare a list of divergent and convergent thinking capabilities, as follows:

Review the previous research and studies that dealt with Divergent and Convergent thinking.

2-Determine a list of divergent thinking skills, asymptotic thinking skills, and their sub-elements . After taking into account the content of the mathematics textbook for the sixth grade, science, biology and their age stage

3. Distributing the initial list of divergent and convergent thinking skills that were referred to in the previous paragraph to a group of experts and specialists in the teaching of mathematics; To determine whether the sub-components of the divergent and convergent thinking belong to the basic skills that branched from them

.Modify the formulation of some the sub-elements of the basic skills after adopting an agreement percentage (42%) from the experts. , Table (2) illustrates the analysis tool

Table (2): A list of the main and secondary divergent and convergent thinking skills

Main skills	**Order**	**Sub-skills**
Fluency	1	Giving the largest possible number of solutions and alternatives to a given issue at a specific time
	2	Speed and fluidity in generating different ideas or solutions to a problem
Flexibility	1	Show problems that can be solved in more than one way
	2	Change the direction of mind Depending on the situation or the problem being discussed
	3	Linking two or more ideas to reach a solution
Originality	1	introduce unfamiliar ideas and solutions
	2	Developing existing ideas to generate new ideas and products
Elaboration	1	Adding details to an idea to develop or enrich it to make it clearer
	2	Build meaningful complex themes from simple shapes
Sensitivity to the problem	1	Identify the weaknesses, shortcomings, and fallacies of mathematics
	2	Direct students to formulate questions related to a mathematical problem
Deduction	1	Provide mathematical information and ideas from the general to the private
	2	deduce new information from a previous generalization
Induction	1	Provide information and sports ideas from the private to the public
	2	Access to a specific generalization from individual facts
***Interpretation*.**	1	Track a mathematical situation and explain it
	2	Determine the causes Related to a specific case
Comparison	1	Identify similarities between two ideas or information
	2	Identify the differences between two ideas or generalities
Classification	1	Classification of data into groups according to inter-shared

		properties
	2	Divide things according to more than one characteristic

Fourth: Validity of the analysis tool:

The validity of the analysis tool means that the instrument measures what it was designed to measure, and it does not measure anything else. (Tammam and Salah,2016 ,397),

To ensure the validity of the analysis tool, the researcher performed the following steps:

1-Introduce the list of divergent and convergent thinking skills to a group of arbitrators and specialists in teaching mathematics to make sure of its validity and relevance. The results of the questionnaire revealed the agreement of the arbitrators after making some adjustments to the sub-indicators branching from the basic skills to complete the validity analysis tool.

2-The researcher analyzed one of the chapters of the mathematics book for the sixth grade in the scientific biology, as it was randomly selected, and the analysis showed that it included most of the indicators specified in the analysis tool.

Fifth: steps of analysis:.

1. Perform an accurate reading of the divergent and convergent thinking skills.
2. Read the content of the mathematics book for the sixth academic year, which is prescribed to students for the academic year
3. Conduct the analyzing process for the content of the mathematics book for the sixth grade according to the divergent and convergent thinking skills.
4. Dump the results of the analysis into a form to convert them to these skills.

Sixth: the reliability of the analysis too

The researcher calculated the reliability of the analysis in two ways:

1- Reliability across time: The researcher re-analyzed the content of the book, thirty days after the first analysis, and the researcher used the Holsti equation to calculate the reliability coefficient, as its value reached (0.96).

2- Reliability across individuals: The second analyst analyzed the content of the book, and the reliability coefficient was calculated for the two analyzes using the Holsti equation, with a value of (0.94)

Chapter Four: Presentation and interpretation of results

First: Presenting the results and interpreting them

After analyzing the content of the mathematics book for the sixth grade, it was found that the deduction skill was in the first order in relation to divergent and convergent thinking skills by (50%) The researcher believes that the reason for this is that the curriculum developers have taken into consideration clarifying the topics in some detail and clarification to remove all obstacles that prevent the learners from understanding and taking into account the disparity between them. As for the skill of interpretation it ranked second at (16%)

The researcher believes that the skill of interpretation requires the learner to follow the mathematical situation and accurately identify the details of mathematical topics and identify the reasons responsible for the different cases of the different positions of these topics. Therefore, this skill has great importance in increasing students' understanding of mathematical topics, knowing their details and dealing with various mathematical problems .

The use of observations related to a specific topic to reach a solution and enable them to explain the acceptability of the various results and generalizations for various mathematical topics. As for the induction skill, it came in third order (11%) .The researcher believes that the reason for this is that the inductive study is based on the study of partial cases in order to reach a judgment on a basic problem, and therefore the mathematical laws require the learner time and good time in order to arrive at it and discover it through some examples or partial cases presented if in The content of the curriculum, and this is in contrast to the skill of deduction that requires the learner to apply some laws or reach conclusions through some generalizations,

The fluency skill came in fourth order with a rate (6%). The researcher believes that the content of the mathematics book for sixth grade science lacks divergent thinking skills, and the distribution of skills was not equal, and the focus was on the skills of fluency and flexibility because they require mental operations. They are less complex and depend mainly on the student's intellectual framework and because they are closely related to academic achievement, as fluency refers to the learner's ability to remember and recall all the ideas stored in his memory, but they fall within a divergent framework

As for the fifth order , the flexibility and classification skills came at a rate of (5%) each, and with regard to the skill of flexibility, this percentage is low for this skill, because this skill requires the learner to relate the different ideas and approach the topic from several aspects or behavior more than one way to reach Most of the topics of the mathematics curriculum depend on the direct solution and not thinking of multiple paths in order to reach the solution.

With regard to the classification skill, the researcher attributes its lack of it being one of the basic skills in mathematics, and the need to use this skill in the elementary stages is more and less than in the intermediate stages, and the need for it is scarce in the preparatory stage. The skill of originality came at a rate of (3%), and the researcher believes that the reason for this is because the skill of originality requires the learner to present rare and unfamiliar ideas and solutions. As is well known, individual differences play an important role in this because the learners who present original solutions and ideas have a small percentage. Compared to their peers, they can offer both traditional and familiar solutions.

As for elaboration skill In comparison, they were ranked seventh by (2%), and with regard to the skill of elaboration or expansion, this skill requires from the learners to add new details to the diary or ideas presented, complete ideas that seem incomplete, or work on building meaningful complex topics from simple forms, The height of this skill in the content of the curriculum may be attributed to the fact that it is one of the skills that require depth in thinking.

As for the skill of comparison, it is mentioned in the second chapter because it requires comparison or identification of similarities or differences between a specific mathematical situation and a general mathematical formula. The skill of sensitivity to problems came in last order, at a rate of (0%), and this skill requires the learners to have the ability for exploring the defects and shortcomings in some areas and work on changing them .The researcher believes that the reason for the lack of emergence of the skill is because it is one of the skills that require higher mental processes, and it is one of the most important aspects of divergent thinking. It is the necessity of preserving, understanding and applying the academic subject , Thus, the importance is focused on the lower levels of thinking and thus the primary goal is a achievement

Third: the conclusions

1-The mathematics book for the sixth grade of the scientific specialization contains the skills of convergent thinking in varying proportions, as some of the convergent thinking skills were of good repetition, such as the skill of deduction, the skill of interpretation and the skill of induction, while others had a small percentage, such as the skill of classification and the skill of comparison.

2-The mathematics textbook for the sixth academic year contains the potential of divergent thinking in small proportions

Fourth: Recommendations

In light of the findings of the current research, the researcher recommends the following:

1-Reconsidering the content of the mathematics book for the sixth grade, so that its topics contribute to the development of divergent and convergent thinking skills.

2-the content of the mathematics book for the sixth grade must include the skills of divergent and convergent thinking in a balanced manner

. 3. Educating teachers about the potential of divergent and convergent thinking, and the importance of their development among their students.

2. Train teachers in modern teaching strategies; Which would develop students' divergent and convergent thinking skills.

Fifth: The Proposals:

In light of the findings of the current research, the researcher suggests the following:

Conduct more studies in order to know the scope to which mathematics books include from divergent and convergent thinking in the other stages
Conduct experimental studies to identify the factors that contribute to the development of divergent and convergent thinking skills and the factors that hinder the development of these skills among students.
Perform a relational study to find out the correlation relationship of the divergent and convergent thinking of teachers on the one hand and their students on the other hand.

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