

**CORE THINKING SKILLS INCLUDED IN THE MATHEMATICS TEXTBOOK  
FOR THE INTERMEDIATE THIRD GRADE**

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**Corresponding Author:** Dr. Hassan Kamil Risen; Email: hasan.k.r@ihcoedu.uobaghdad.edu.iq; doi:10.46360/cosmos.ahe.xxxxxxx**Abstract**

The current research aimed to determine the extent to which core thinking skills are included in the mathematics textbook for the intermediate third grade of the academic year (2019-2020) by answering the main research question:

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

The descriptive analytical method was used in this study. The research sample consisted of the mathematics textbook for the intermediate third grade. To achieve research objective, a list of the main core thinking skills and their sub-skills was prepared, and then the textbook was analyzed according to these skills. The reliability of results was verified through applying test-retest and inter-rater methods. The reliability value was greater than 86 % using Holsti equation. The research found the inclusion of all of the main core thinking skills in the textbook. The sequence of these skills was as follows: first, organizing skills by (25.4%); second, generation skills by (20.5%); third, analyzing skills by (16.8%); followed by remembering skills by (11.5%); then evaluating skills by (8.6%); integration skills by (7.6%); focusing skills by (6.7%); and finally, information gathering skills by (2.5%). This indicates the availability of pivotal thinking skills in the content of the mathematics textbook for the intermediate third grade with varying percentages.

**Keywords:** Core Thinking Skills, Mathematics, Textbook.

**Introduction**

The issue of including thinking skills occupies an important place in the development of the curriculum, especially the mathematics curriculum. The National Council of Teachers of Mathematics (NCTM) called for the necessity to pay attention to the development of thinking among learners through the optimal selection of educational tasks and activities in mathematics curricula, which help to motivate them to acquire skills, and to focus the teaching procedures constantly on the learners thinking and criticism more than just acquiring information. This is attributed to that mathematics is a subject that is concerned with thinking skills and deepening the experience of the learner to be active in his environment in particular and in society in general. Therefore, educational institutions were interested in renewing ideas when forming modern curricula for mathematics at all levels of study, especially the intermediate level, to make the learner the most important axis in the educational process.

Through reviewing the mathematics textbook for the intermediate third grade in its first and second parts, it is observed that its development is based on global guidelines that call for making the learner think and be the effective axis of the educational process. Since thinking skills are the main tools for effective thinking, the learner must acquire

cognitive skills, such as core thinking skills, in order to be mature and effective in the educational process Sa'adah (2009) [25]. This is confirmed by studies Al-Khafaji (2016) [11] & Omar (2019) [23], which showed that the acquisition and use of core thinking skills enable the learner to reach a good degree of interaction, achievement and processing of information. According to the researchers' knowledge, there is no study determining the extent of the inclusion of these skills in the mathematics textbooks in Iraq. Based on the importance of the mathematics textbook and its role in the educational process, especially in the intermediate stage, this research thus aims to highlight pivotal thinking skills and the extent to which they are included in the textbook for the intermediate third grade in particular. Therefore, research problem is identified in the following question:

- What core thinking skills are included in the mathematics textbook for the intermediate third grade?

**Research Objectives**

The current research aims at:

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

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## Research Significance

The importance of this research lies in the following points:

1. There is a need to follow up on the mathematics textbooks developed because of the importance of this subject in our daily life.
2. It comes in response to the global trends in modern education calling for curriculum evaluation and development.
3. There is an increasing interest in different types of thinking and this interest stems from its importance in how to deal mentally with information and its processing.
4. It may meet the needs of researchers and those interested in studies on core thinking skills.

## Research Scope

This research is confined to:

1. Core thinking skills, including eight main skills: focusing, information gathering, remembering, organizing, analyzing, generation, integration and evaluation, as well as twenty-one sub-skills.
2. The content of the mathematics textbook for the intermediate third grade (Parts 1 and 2), second edition of 2019, in Iraq.

## Definition of Terms

- a. **Core Thinking Skills** refer to cognitive processes that are the bases of the thinking structure. Marzano and his colleagues identify them by twenty-one skills classified into eight categories (Al-Absi, 2009: 219). [4]
- b. **The Content of the Mathematics Textbook for the Intermediate Third Grade** is the scientific subject for the intermediate third grade of the mathematics curriculum and all its objectives, examples and educational activities of exercises and life problems, approved by the Ministry of Education, Directorate General of Curricula, and adopted for the academic year (2019-2020).
- c. **Content Analysis** is defined as a method or tool for scientific research that can be used in various research fields to describe the apparent and explicit content of the subject to be analyzed in terms of form and content and to meet research questions or its basic hypotheses (Attia, 2009: 143). [9]

## Research Background and Literature Review

### a. Mathematics

Mathematics is one of the great achievements of humankind due to addressing important and necessary issues, which are inevitably real. This has prompted those interested in mathematics and specialists to study it as being a very precise science (Ibrahim, 2006: 113). From the perspective of educators and specialists, mathematics is an

important tool to organize ideas as well as a correct understanding of the environment in which we live. In addition, it is a subject that helps the learner to understand and control the surrounding nature. It becomes growing and developing through the physical experience acquired in reality through our physical needs and motives to solve our problems and increase our understanding of this reality (Abu Zeina, 2010: 24) [3]. It has entered all life fields and extended to be used in many applied fields like humanities, politics, economics, aviation, satellites and computer etc. Additionally, the development of science depends on mathematics due to the increasing reliance on mathematical methods (Al-Bakri and Al-Kiswany, 2002: 105). [6]

### b. Textbook

Textbook represents the container of the educational material as one of the important means of achieving the objectives of the educational curriculum. Its importance is demonstrated by its active role in the success of the educational process and the achievement of the desired objectives because it contains all the basics of the course. Additionally, it teaches students what they should learn and the teachers what they should teach. It is a tool rich in all information, facts, drawings, images and educational activities. This does not mean to make it the only source of knowledge, but it must be considered as the main motivator of thinking and supporting it, as well as the framework from which students are inspired to learn. Therefore, textbook designers and specialists should take into account students' tendencies and interests through various activities and develop their abilities to thinking and innovation (Attia, 2009: 313-314). [15]

### c. Analysis of the Textbook Content

Analysis of the textbook content is represented by a set of procedures and technical methods organized to interpret and classify the content of the study material, including drawings, written texts and images in addition to the ideas contained in the book. The skills of analyzing the content are characterized by two characteristics:

1. Focusing on the analysis of texts and topics and their interconnection without addressing the hidden intentions of the author, i.e., it focuses on description and avoids issuing judgments.
2. Using the scientific orientation and structured method of analysis so that the analyzed topic is objectively described as stated in the book (Al-Zuweini et al., 2013: 106). [13]

### d. Objectives of Content Analysis

Objectives of content analysis are:

1. Understanding the ideas, concepts, principles, trends and skills contained in the content.

2. Discovering strengths and weaknesses with the intention of modifying and improving them.
3. Providing the authors of the curriculum with the topics and ideas that should be included in the cognitive content of the textbook (Stern & Ahigren, 2002: 891). [26]

#### e. Core Thinking and Its Skills

thinking is a kind of thinking that should be developed in the early years for learners in order to enable their better access to information through the experiences they go through, as well as the knowledge they can get from their peers. This type of thinking consists of a set of skills which in turn includes sub-skills that are interrelated and inseparable (Oxman & Michell, 2005: 123). [24] Marzano believes that core thinking is one of the mental processes that we deliberately use to process the information (Marzano et al., 1988: 69) [20]. According to Marzano, the skills of core thinking are identified by eight main skills and twenty-one sub-skills. They are as follows:

##### 1. Focusing Skills

Focusing skills refer to drawing the attention of learners to certain environmental stimuli rather than other stimuli. They are observed among learners when they feel that there is a problem or a certain educational situation may be confusing for them, or they lack of some information. These skills can be used at the end of the problem solution, or during processes that require moving to other steps in the solution. They include two sub-skills:

- a. **Defining Problems Skill** means being able to clarify questionable situations by the learner. This usually includes answering the following questions: What is the problem? When can solutions be found to this problem? Is it necessary to solve this problem?
- b. **Setting Goals Skill** is to identify all the desired goals and educational products that the learner is expected to achieve after passing through the educational experience and experiencing a confusing scientific situation. The teacher can train his students to set goals by enabling them to work on developing specific and short-term goals (Al-Absi, 2012: 221).

##### 2. Information Gathering Skills

These skills are related to the subject or problem and represented by the ability of the learner to access the cognitive content of the problem (Attia, 2015: 79). They include:

- a. **Observing Skill** is represented by the ability of the learner to access the information from the environment by employing one or more human senses. The human senses are the window to the

outside world through the systematic and frequent observation of a phenomenon (Atifa and as-Sror, 2011: 78). [14]

- b. **Formulating Questions Skill** refers to the ability of clarifying and identifying issues and meanings by surveying. Hence, the good questions draw attention to important information. Students can be trained to employ this skill by:
  - Converting lesson titles into questions.
  - Deriving sub-questions from the main questions.
  - Formulating questions from the main ideas (Al-Absi, 2012: 223).

##### 3. Remembering Skills

They represent a set of strategies and activities performed by learners to store and retain information in long-term memory. They include:

- a. **Encoding Skill** is the process of connecting small parts of information together to keep them in long-term memory.
- b. **Recovery Skill** is an organized and conscious process of storing information so that it is easy to be recovered. Among the strategies that help to apply this skill is the strategy of activating the previous information in order to use it in solving or interpreting a new situation (Al-Absi, 2009: 220).

##### 4. Organizing Skills

These skills are represented by a set of procedures to arrange information in order to understand it. This information becomes more effective in the organization process. They include four sub-skills:

- a. **Comparison Skill** means the ability of the individual to organize information and identify the similarities or differences between information through examining the relationship between them in one way or another (Al-Bhdal, 2019: 23). [7]
- b. **Classification Skill** means the ability of the learner to organize information or things and classify them into categories based on common characteristics or trends. This requires the learner to develop information and its relevant concepts sequentially. This skill includes ascending and descending order, sequence and other forms of sequence (Al-Bhdal, 2019: 22).
- c. **Arranging Skill** means the ability of the learner to arrange the information or elements according to a particular criterion or is a sequence of vocabulary according to a particular criterion (Mustafa, 2013: 47). [22]
- d. **Representation Skill** enables the learner to change the form of the information received from the external environment by establishing relationships between the

specific elements so that they are easily represented in a graphic, schematic or table form. Representation takes other forms, such as symbolic, verbal or visual representation (Al-Absi, 2012: 231).

### 5. Analyzing Skills

These skills means the ability to examine the available parts of the information and their relationships. This means investigating the internal characteristics of ideas. They include:

- a. **Identifying Attributes and Components Skill** means the ability of the learner to identify the characteristics or parts of something by employing the rules of knowledge stored in his mind and then clarify the parts that form the solution.
- b. **Identifying Relationships and Patterns Skill** means the ability of the learner to determine the internal relationships that determine patterns and relationships, and this relationship may be a cause and effect, a vertical relationship, a temporal relationship, a partial relationship, a whole to part relationship, or a transformative relationship.
- c. **Identifying Main Ideas Skill** is a case of identifying relationships and patterns. Among the necessary strategies used to improve the skill of students in identifying main ideas is the strategy of formulating questions, through which students are trained to formulate a set of questions about specific paragraphs given to them. It is a fact that the skilled teacher plays a role in attracting the attention of students to the importance of searching for reasons behind the work in order to identify the main objectives of a topic.
- d. **Identifying Errors Skill** means the ability of the learner to detect errors during the logical presentation of a set of procedures and thus correct them. This skill enables the learner to think properly in order to achieve acceptable and correct understanding (Abu Jado and Nawfal, 2007: 98-97). [2]

### 6. Generation Skills

These skills refer to the ability to generate innovative ideas, namely, the ability of the student to modify the information to reach a new solution. They include:

- a. **Inference Skill** is a kind of inductive or deductive proof. The deduction is the ability to reach a conclusion by processing information according to specific logical procedures. While induction is the tracking of parts to reach a total result. This skill increases the depth of understanding for the learner as well as

reaching general rules and proper standards (Maamar, 2006: 72). [19]

- b. **Prediction Skill** means the ability of the individual to generate information by predicting in the light of the previous information available to him about the situation. This indicates the ability of the learner to read data and information between the lines and infer the expected result (Abdul Aziz, 2009: 161). [1]
- c. **Expansion Skill** means the ability of the learner to search for the issue as much ideas and information as possible, i.e., search for the full details (Hussein, 2009: 141).

### 7. Integration Skills

These skills refer to the learner's ability to link and standardize information. They include:

- a. **Summarizing Skill** means the learner's ability to extract the information available in the text effectively and rationally.
- b. **Reconstructing Skill** means the learner's ability to change the available cognitive structure in order to integrate it with the new information (Al-Qawasmeh and Abu Ghazalah, 2013: 245). [12]

### 8. Evaluating Skills

They indicate the ability to take decision, judge the validity of information, then detect fallacies and identify generalization errors. They include two skills (Al-Bhdal, 2019: 72):

- a. **Establishing Criteria Skill** indicates the ability to make judgements and take a set of criteria for issuing decisions and judgments on the validity of information.
- b. **Verification Skill** means the learner's ability to provide proof on the validity or accuracy of the information.

## Literature Review

This section deals with previous studies that dealt with the analysis of the content of mathematics textbooks according to pivotal thinking skills. Due to the lack of a local or Arabic study that deals with the analysis of the content of mathematics according to pivotal thinking skills, studies that used pivotal thinking skills in the analysis of the content of other subjects are reviewed as follows:

### a. Studies Dealing With Content Analysis According to Core Thinking Skills in Other Subjects

Al-Atiki's (2011) study aimed to identify core thinking skills included in the textbooks of social studies in the primary stage in Syria. Research sample consisted of the social studies textbooks for the primary first, second and third grades. The researcher used the descriptive analytical method, and prepared a list of core thinking skills, then analyzed the content of the textbooks mentioned according

to these skills. The study found that the textbooks mentioned included core thinking skills with varying percentages.

Fayyad's (2016) study aimed at identifying core and visual thinking skills included in the physics textbooks and the extent to which students acquire them in Iraq. The researcher used the descriptive analytical method. Research sample consisted of the mathematics textbooks for the high school level. The researcher prepared a list of core thinking skills and analyzed the content of the textbooks mentioned according to them, as well as two tests to determine the extent to which students in the secondary sixth grade acquired these skills. The study found a weakness and difference in the percentages of inclusion of core and visual thinking skills. The results of the two tests were consistent with the results of the content analysis.

**b. The Similarities and Differences between Previous Studies and the Current Study**

The current study has agreed with previous studies on the use of descriptive analytical method in content analysis as a research method.

The current study differed with that of Al-Atiki (2011) and Fayyad (2016) in research sample. The current study agreed with that of Fayyad (2016) in relation to the intermediate stage only, and differed in relation to the educational level.

The current study agreed with that of Al-Atiki (2011) and Fayyad (2016) in relation to the tool of the content analysis, which included a list of core thinking skills.

**c. Benefits Obtained From Previous Studies**

The benefits obtained from previous studies are summarized as follows:

Determining the objectives of current research, the theoretical background of its variables, as well as the appropriate method and procedures. Benefiting from the analysis tool according to core thinking skills to determine the main and sub-skills and preparing a list of analysis for the current study, as well as the statistical methods used in data processing.

**Research Method and Procedures**

**a. Research Method**

The descriptive analytical approach was used as it is designed to identify and describe the facts related to the current situation and to clarify the aspects of the reality by surveying and describing them interpretively through the significance of the available facts (Melhem, 2005: 112). [21]

**b. Research Sample**

Research sample was represented by the mathematics textbook approved by the Iraqi

Ministry of Education for the intermediate third grade of the academic year (2019-2020), second edition. The mathematics textbook for the intermediate third grade consists of two parts, the first part includes three chapters (first, second, third), while the second part includes three complementary chapters (fourth, fifth, sixth). The following table clarifies the content of the textbook:

**Table 1: Description of Research Sample**

Part one	Chapter	Title of chapter	Number of pages
	First	Relationships and variations in real numbers	28
	Second	Algebraic expressions	32
	Third	Equations	32
Total			92
Part two			
	Fourth	Coordinate geometry	32
	Fifth	Geometry and measurement	32
	Sixth	Statistics and Probabilities	28
Total			92

**c. Research Tool**

In order to prepare the analysis tool and identify the categories of analysis, the following procedures were followed:

Identifying the analysis tool

The researcher prepared a list of analysis consisting of categories of analysis represented by core thinking skills. The list included (8) main skills and (21) sub-skills as follows:

**Table 2: List of Core Thinking Skills**

No.	Main skills	Subskills
1	Focusing	Defining problems
		Setting goals
2	Information gathering	Observing
		Formulating questions
3	Remembering	Encoding
		Recovery
4	Organizing	Comparison
		Classification
		Arranging
		Representation
5	Analyzing	Identifying attributes and components
		Identifying relationships and patterns
		Identifying main ideas
		Identifying errors
6	Generating	Inference
		Prediction
		Expansion

7	Integration	Summarizing
		Reconstructing
8	Evaluating	Establishing criteria
		Verification

**d. Validity of Analysis Tool**

To confirm the validity of analysis tool, the list of analysis above was presented to a jury committee and was approved by more than (80%) of the committee members. Then, a random unit of the target textbook was analyzed, demonstrating the inclusion of core thinking skills. Thus, the tool was appropriate for the analysis process.

**e. Analysis Procedures**

- Determining the objective of the analysis, which is to reveal core thinking skills included in the mathematics textbook for the intermediate third grade, the first and second parts, to be taught to students in the academic year 2019-2020.
- Determining analysis Sample, which is the content of the mathematics textbook for the first and second parts after excluding the classroom exercises at the end of each part, the pre- and post-tests, the review of the chapter, and test at the end of each chapter. Analysis sample included the content of each chapter, which is the idea of lesson, examples, make sure you understand, practice the exercises and life issues.
- Determining the unit of analysis: the idea unit was used as being appropriate for the nature of the analysis of the content of the mathematics textbook for the intermediate third grade. This idea might be explicit or implicit.
- Determining the unit of calculation: the frequency was relied upon as a unit of calculation.
- Preparing the analysis card in order to monitor the results of analysis of the content of the textbook, which included the main and sub-skills of pivotal thinking, the analysis unit, page, frequency and percentages.
- Steps of the analysis process: the analysis was carried out according to the following steps:
  - Reading the content of the mathematics textbook, its first and second parts, analytically.
  - Analyzing each example, activity, question, exercise and extracting the skill used or is required to be used in the solution in the analysis form prepared for this reason.
  - Adopting the exercise as a single analysis unit regardless of the number of its paragraphs.

- Classifying the analysis results into the list designed to monitor the results.
- Converting the results into frequencies and percentages.

**f. Validity of Analysis**

A sample was taken from analysis sample and presented to a jury committee. The opinions were consistent with the analysis process. Therefore, validity of analysis was achieved.

**g. Reliability of Analysis**

Reliability means the process of obtaining the same results when reapplying the analysis tool to the same sample several times (al-Hashimi and Attia, 2009: 50). There are two ways to find the reliability coefficient: test-retest reliability, which means reanalyzing after a period of time; and inter-rater reliability, which indicates analyzing the sample by two raters according to the instructions given to them regarding the analysis mechanism and the method used to monitor the results. The rate of agreement in both methods was more than (77%). The reliability coefficient is good if it reaches 70% or more (Al-Dulaimi, 2015: 120). [8]

**h. Statistical Means**

The following statistical means were used due to being appropriate for data processing:

- Frequency and percentage as a unit of calculation.
- Holsti equation to find the reliability coefficient by finding the ratios of agreement between different raters

$$CR = \frac{2M}{N_1 + N_2}$$

Where CR refers to the reliability coefficient, M is the number of categories agreed upon by one researcher or two researchers, N<sub>1</sub> indicates the total categories analyzed by the first researcher, N<sub>2</sub> refers to the total categories analyzed by another researcher, N<sub>1</sub>+N<sub>2</sub> represents the total answers analyzed by the two researchers (Al-Hashimi and Attia, 2014: 229).

**Results**

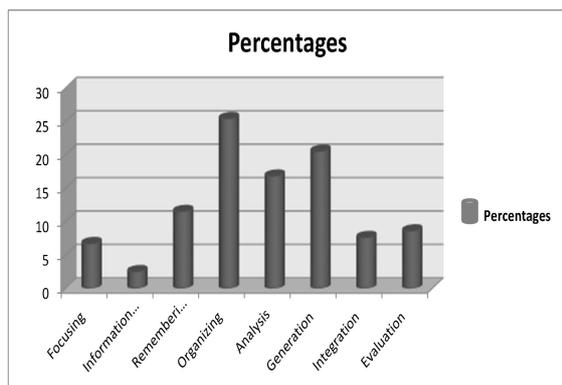
After analyzing the content of the mathematics textbook according to core thinking skills, the frequency and percentage as well as the rank were calculated as shown in the following table:

**Table 3: Percentages of The Inclusion of Core Thinking Skills**

No.	Main skills	Subskills	Frequency	Percentage	Rank
1	Focusing	Defining problems	14	6.7%	7
		Setting goals	40		
2	Information gathering	Observing	20	2.5%	8
		Formulating	0		

		questions			
3	Remem bering	Encoding	43	11.5%	4
		Recovery	49		
4	Organizi ng	Comparis on	10	25.4%	1
		Classific ation	25		
		Arrangin g	110		
		Represen tation	58		
5	Analyzi ng	Identifyi ng compone nts	77	16.8%	3
		Identifyi ng relations hips	29		
		Identifyi ng main ideas	0		
		Identifyi ng errors	28		
6	Generati ng	Inference	98	20.5%	2
		Predictio n	44		
		Expansio n	22		
7	Integrati on	Summari zing	49	7.6%	6
		Reconstr ucting	12		
8	Evaluati ng	Establish ing criteria	30	8.6%	5
		Verificati on	39		
Total			797	99.6%	-

The following chart shows the distribution of core thinking skills in the mathematics textbook for the intermediate third grade according to the results abovementioned:



**Chart 1: Distribution of Pivotal Thinking Skills Based on Percentage of Inclusion**

## Discussion

Based on the results shown in table (3), it is clear that organizing skills ranked first and that the sub-skill of arranging was the highest in terms of inclusion, while the comparison sub-skill was the lowest rate of inclusion. Ranking these skills in the first place was reasonable. This is attributed to that most of the mathematics content of examples and educational activities depends on certain criteria of solution and representation of mathematical issues and examples whether it is a graphic or another form is of important subjects focused on in mathematics. However, generation skills ranked second. Generation skills are important in clarifying the ability of students to predict, infer and expand the presentation of information related to the previous knowledge so that the percentage of their inclusion was good. Analysis skills got the third rank, which means that the content of the textbook was focused on identifying the relationships and attributes that link information to each other, identifying their components as well as identifying errors skill because of its importance in directing students' attention to the error and then work to correct it. Additionally, there were remembering skills, especially encoding which represents the ability to represent information with mathematical codes that are easy to memorize for a long time. Since evaluation is an important process in the learning process, evaluation skills ranked fifth and its sub-skill of verification was the highest in terms of inclusion, which means that the verification process is available when solving examples and exercises to verify the validity of the solution. Concerning integration skills, represented by the sub-skills of summarizing information and important points in any subject and reconstructing knowledge, they were available but with a low percentage. The inclusion of focusing and information-gathering skills was low because of the lack of availability of mathematical problems in the content of the textbook, as well as the lack of focus on setting goals. As for the information-gathering sub-skills represented by observing and formulating questions, they were not available to the required degree.

## Conclusion

In the light of the results presented and discussed above, the following conclusions were reached:

1. The mathematics textbook for the intermediate third grade includes all the main core thinking skills, but with varying percentages.
2. Some sub-skills, particularly identifying main ideas and formulating questions, were not included in the content of the mathematical textbook.

## Recommendations

Based on the results obtained, this study recommends the following points:

1. Paying attention to the skills that are not included in the mathematics textbook for the intermediate third grade.
2. The need to include core thinking skills in the content of mathematics textbooks for intermediate stage in a balanced way.

## Suggestions

This study suggests:

1. Analyzing the mathematics textbooks for the intermediate stage according to core thinking skills.
2. Conducting experimental studies to determine the extent of having core thinking skills among students.

## Conflict of Interest

There is no conflict of interest between the authors.

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