Content analysis of the two science books (two chemistry units) for middle school according to visual thinking skills

Ahmed Abdel-Hamza Giyad
ahmdhsnaws@gmail.com
Prof. Dr. Zainab Aziz Ahmed
zainabalamiry2@gmail.com
Department of Chemistry, College of Education Pure Seiences / Ibn AL-Haitham , University of Baghdad

Abstract

The aim of the current research is to identify the extent to which visual thinking skills are included in science books (chemistry units) for the first and second intermediate grades in the Republic of Iraq for the academic year (2020-2021). The analytical descriptive method was used, and a list of visual thinking skills that should be included in the science books for the first and second intermediate stages was used, and then transferred to a content analysis form based on the unit of form as a unit of analysis, and the repetitions as a unit of counting were verified after being presented to a group of arbitrators with Specialization and experience, which obtained more than 80% agreement from the opinions of the arbitrators. The science books (the two chemistry units) for the first and second intermediate grades were analyzed according to visual thinking skills, then the researcher presented a sample of the analysis sample to a number of arbitrators who agreed on the validity of the analysis process. Ensure that the analysis is consistent with the researcher's agreement with himself over time and with outside analysts who are specialized, where he obtained a high agreement rate, and by using the Holsti equation and after collecting and processing data and using statistical methods, the results resulted in the two science books for the first and second intermediate grades were characterized. In contrast to the skills of visual thinking, and based on the research results, the researcher presented a number of recommendations and proposals

Keywords: Content analysis , visual thinking skills

Research problem

We live in an era in which scientific knowledge accumulated, technology advanced, and successive changes in various fields of life and witnessed a revolution flowing with information and techniques, and because the branches of science in general and chemistry in particular are among the branches most related to scientific and technological developments and their direct link with the student's life, as well as the need to focus on employing the mental capabilities of the human being towards confronting Challenge.

And through the first researcher's constant review of chemistry books and the experience he had acquired by virtue of teaching chemistry for the intermediate stage for more than 15 years, he noticed that there is a lack and weakness in devoting images, shapes and symbols in chemistry books to bring information closer to the student. Work to consolidate the information in the mind of the student for the longest period of time.

And from the researchers 'knowledge of previous studies in Iraq, they did not find a local study that dealt with the analysis of chemistry books for the middle stage according to the visual thinking skills of the researchers' knowledge, while they found local studies such as the study (Fayyad, 2016), (Abboud, 2017) that emphasized the weakness of Books (Physics and Biology) for these skills.

Therefore, the research problem can be determined in the answer to the following question :

1-What are the visual thinking skills included in the two science books (chemistry units) for the first and second intermediate stages ?

Research importance

The current era is characterized by a number of features, perhaps the most important of which is the accelerating information flow, which is one of the components of scientific and technological progress, which has thrown many challenges to the countries of the world that want to catch up with global progress, and perhaps the most important of these challenges is the need to keep pace with this accelerated information flow.

(Al-Munir, 2015: 9

From the standpoint that keeping up with the information flow is not limited to merely gathering the available information, but rather requires processing this information in ways that include its use in achieving specific goals in the field of scientific and technological progress . (Al-Haila , 1999 :9)

And the acquisition of thinking skills has become an urgent need in our times. Thinking is the entrance to the acquisition of knowledge, and knowledge cannot be acquired without thinking, and this is what made educational institutions assume the development of thinking of all kinds and its different image in practical thinking and critical, contemplative, historical and visual thinking with great interest by providing an educational environment that inspires Thinking and teaching students how to think, rather than focusing on teaching what they should think about . (Saadeh ,2004 :83)

The researchers believe that visual thinking is one of the types of thinking, and it is a pattern through which meanings are extracted and abstract images are clarified, which should be concerned with different school curricula in general and chemistry in particular for all educational stages, as visual thinking provides a mental image that helps in solving problems and arriving at results .

As for visual thinking skills, and by looking at a number of previous studies, it is known as a set of skills that encourage the learner to visual distinction of scientific information by integrating his visual perceptions with his cognitive experiences to reach the language of the form, where visual thinking skills help in developing the language of education and attracting his interest And to increase his motivation, organize his ideas, train him to express his opinion, develop imagination and higher mental processes, and acquire visual language that increases the ability to communicate and interact with others and create a mental image and organize it at work . (Amer and Ihab ,2016 :76)

From the foregoing, it becomes clear the importance of the current research derived from the importance of the topic of thinking and that the school curricula should be concerned with it, as it is necessary that the contents of books, including chemistry, be rich in various mental skills, and among these skills are visual thinking skills with the following :

* Theoretical importance

 1- This study deals with one aspect of thinking .

2- The research is the first scientific attempt (according to the researcher's knowledge)   concerned with analyzing the content of the two science books (the two chemistry   units) for the first and second intermediate stages according to the visual thinking skills.

3-This study may help in increasing the awareness of chemistry teachers of the importance   of visual thinking skills.

4-In line with modern trends in teaching and learning

*Application importance

1-This study may help by providing information to those responsible for the curricula and   developing them on the extent to which these curricula incorporate visual thinking skills.

2-This study may help to understand the role of images and shapes in developing visual   thinking and their importance in the content of science books .

3-The study provides tools to detect visual thinking skills .

4- It may help in identifying the ratios of thinking skills in the two science books (the two   chemistry units for the first and second intermediate grade) .

Research goal

The current research aims to analyze the content of the two science books (the two chemistry units) for the first and second intermediate stages, according to visual thinking skills .To verify the aim of the research, the following questions were formulated :

1-What are the visual thinking skills that should be included in the content of the two   science books (chemistry units) for the first and second intermediate grades

2-What are the visual thinking skills included in the content of the two science books (chemistry units) for the first and second intermediate grades ?

Research limits

The limits of the current research were limited to :

1-Objective limits : The two science books (two chemistry units) for the first and second intermediate grades in Iraq, which are :

A- The Science Book for Intermediate First Grade (the first unit that includes the first and   second semesters, and the second unit, which includes the third and fourth   semesters), third edition, for the year 2019 .

B- Science Book for the second intermediate grade, (the first unit, which includes the first   and second semesters, and the second unit , which includes the third and fourth   semesters , the third edition, for the year 2019 .

2-Time limits: the academic year 2020-2021 AD

3-Standard limits: It is limited to visual thinking skills, which is the skill (recognition of the visual shape, analysis of the visual shape, linking relationships in the visual form, perception and interpretation of ambiguity, visual discrimination, extracting meanings.

Defining terms

1-Content Analysis

"One of the methods of scientific research where communication in an objective, systematic and quantitative manner, the content is determined as the means of communication to answer questions related to that content according to a system of classifications related to the research hypotheses " (Zangana and Anwar Hussain ,2207)

Procedural definition of content analysis

It is a systematic method through which the content of middle school science books is analyzed according to the criteria prepared for this purpose to see the extent to which these books include visual thinking skills .

2-Visual thinking skills

(Razooqi and Abdel-Karim, 2015) define it as "it is a system of processes consisting of a set of skills that encourage the learner to visual thinking, contemplation, translating these images into an intelligible written or spoken language and extracting information" (Razooqi and others . 2015: 311)

Procedural definition of visual thinking skills

It is a set of skills that encourage the student to recognize and analyze visual shapes, link relationships between them, perceive ambiguities, distinguish images, extract scientific meanings and concepts, and must be included in middle school chemistry textbooks .

Theoretical background

Textbook content

This is what is presented in terms of information, skills, values, trends and tendencies in order to change the behavior of the learner and be modified in the desired direction .

)Sid, 2017: 75(

The content of the textbook in the educational institution is the most important educational source because it represents the largest possible educational curriculum as it provides the highest level of educational experiences

directed to achieving the desired educational goals, as it occupies an important place in the educational system and the reason for this is the easiest and easiest resources that can be available to the student.

)Al-Hashemi and Mohsen, 2009: 313(

We can know the textbook, despite its different definitions from time to time, as that traditional form that is distributed to students and that includes the content of one of the academic proposals .

The importance of textbook content analysis

The process of analyzing the textbook content is an important and necessary process that emerges in determining the points and locations of strengths and weaknesses in the textbook, as curriculum and textbook planners benefit from the results obtained by using the content analysis method in order to stand on the strengths and weaknesses that exist within the components of the textbook, starting from the book's shape, introduction, objectives and educational activities in it, which helps in re-establishing Authoring to make the book more useful and scientific value .

)Al-Jadry and Al-Hilo, 2009: 21(

From this it becomes clear that the analysis is a descriptive method through which the content of the material can be deconstructed and placed in lists prepared by the researchers for this purpose and according to a pre-agreed unit of analysis, where the researchers determine the occurrences contained in each category to produce an accurate and specific quantitative and qualitative description .

The researchers used the method of content analysis because it suits the purpose of the current research and achieves the required goals and answers his questions, and selects the appropriate unit of analysis for the analysis process .

Visual thinking

Through the researchers reviewing the literature that dealt with visual thinking skills, they have found several classifications developed by the researchers, and the reason for this is that visual thinking skills work on an integrated systemic pattern, but their order and classification differs from task to task and from content to another and in this field the researchers tried to collect classifications for viewing On it and benefiting from it, and from these studies :

(Mahdi, 2006), (Tafesh, 2011), (Fayyad, 2016) and (Abu Al-Hamail, 2019)

As these studies relied on the following skills :

1-Shape recognition skills and description: This is the ability to determine the dimensions   and nature of the displayed figure.

2-Shape analysis skills: the ability to see relationships in shape and to identify and classify   characteristics.

3-The skills of linking relationships with the form: the ability to relate the elements of the   relationship in the form and to find correspondences and fallacies in it .

4-Skills of perception and interpretation of ambiguity: Explanation and clarification of gaps   and fallacies in relationships and approximation

5-Meaning-extracting skill: the ability to deduce new meanings and arrive at concepts and   principles, taking into account the inclusion of this step and the previous steps.

As for the study of (El-Kabbani, 2011) (Saleh, 2013) and (Al-Ghazal, 2015), they relied on another classification of skills, namely :

1-Visual translation: the ability to express verbal symbols in an equivalent way and to   express visual symbols in a verbal equivalent form .

2-Visual visualization: the ability to visualize objects and models after adding or deleting   parts or surfaces thereof .

3-Visual distinction: the ability to analyze the visual symbol to extract the basic idea and general content of the symbol and extract the similarities and differences between the   visual symbols .

4-Visual analysis: it means the ability to analyze the elements of the visual stimulus presented in front of him and describe those elements .

5-Deducing meaning from symbols and visual shapes

The two researchers agreed with the study (Abu Al-Hamail, 2019) and (Fayyad, 2016) for reasons including the logical sequence of these skills and clarity, and in addition to that, another skill was added by the researchers, which is the skill of visual discrimination .

The researchers believe that the intensification of displaying images, shapes and models within the content of the curriculum facilitates the learner's understanding and improves his performance and achievement. Because the visual approach to classroom education is an influential strategy in the comprehension process. Where these shapes and pictures and drawings bring the concept closer to the student and develop his visual thinking skills.

Research methodology and procedures

Research Methodology :

The researchers used the descriptive and analytical approach to achieve the research objectives, represented by the content analysis method as it does not consist in collecting data and information, classifying and presenting them, but rather it also includes an accurate analysis of these data and information and a deep interpretation of them. New facts and generalizations that help in the accumulation and development of human knowledge . (Obaidat et al. , 2005 :43)

This approach has been used specifically, due to its suitability to the nature of the research and its set goals, which are to reveal the visual thinking skills that should be included and the extent to which these skills are included in the two science books (the two chemistry units) for the intermediate stage in Iraq .

Research community

The research community includes the following :

Two science books (chemistry units) for the first and second intermediate grades in the Republic of Iraq for the academic year (2020-2021) AD .

The following table represents the two science books for the first and second intermediate grades, the number of local and excluded pages and their editions as follows :

Table No.1 Intermediate chemistry textbooks

No.	Book	Class	Edition	Number of Pages	Number of pages analyzed	Number of pages excluded
1	Sciences of two chemistry units	First	Third 2019	96	45	51
2	Sciences of two chemistry units	Second	Third 2019	60	35	25
Total				156	80	76

It is noted from this table (1) that the total of the pages that will be subject to analysis is (80) pages after reviewing the topics of these books and excluding book introductions, activities and evaluation questions .

The research sample

The research sample consisted of the sample books and included :

My Science Book for the academic year (2020-2021 AD), for the first and second intermediate grades, while the introductions, activities and evaluation questions for each chapter of the books were excluded from the analysis process .

Search tool

The researchers used a tool to analyze the content of the two science books for intermediate (first and second) grades in light of visual thinking skills .The two researchers prepared a standard for visual thinking skills that should be included in the content of the science books for the first and second intermediate grades . And based on previous studies, educational literature, and the nature of the science subject, the list was initially built based on the six skills, which contained indicators below each skill .

After making the amendments referred to by the arbitrators, the list was finalized, which represents a tool for analyzing books according to visual thinking skills, which included six skills with sub-indicators for each skill, as in the following table :

Table No.2 Clarify the main thinking skills and sub-indicators

Visual thinking skills	No.	Sub-indicators
Firstly \ The skill of recognizing the visual shape	1.	Identify the displayed figure by its external appearance .
	2.	A visual figure expresses the information it represents
	3.	Determine the nature and description of the visual shape .
	4.	The possibility of knowing the dimensions of the visual shape .
Secondly \ The skill of analyzing the visual shape	1.	The ability to divide the visual shape into its basic components .
	2.	View and understanding the subtle parts of a visual shape .
	3.	Identify the properties of the visual elements .
	4.	The ability to see the relationships between elements of a visual shape .
	5.	The clarity of the scientific significance of the presented figure .
	6.	The ability to assemble parts in visual form .
Thirdly \ The skill of linking relationships in the visual shape.	1.	The figure shows the ability to relate its elements .
	2.	Find the synergies between the relationships in the visual shape .
	3.	The possibility of finding differences between the relationships in the visual shape .
Fourthly \ The skill of perceiving and explaining the ambiguity .	1.	The ability to interpret every part of the visual shape .
	2.	The ability to identify deficiencies and defects in the visual shape .
	3.	Mental treatment of visual subjects .
Fifthly \ The skill of distinguishing the visual shape .	1.	Distinguish the shape from other visual shapes.
	2.	The ability to know similarities and differences between visual shapes.
	3.	The ability to compare and distinguish between visual shapes .
Sixthly \	1.	The ability to infer new meanings in the visual

| The skill of extracting meanings | | shape . |
| | 2. | Reaching scientific concepts and principles from the visual shape . |

Validate the analysis tool

The validity of the analysis tool can be found by presenting it to a specialized jury, and this has been confirmed by presenting it to the arbitrators and specialists in the field of teaching methods .

The lists obtained agreement with a percentage of more than (80%) and this value is considered acceptable according to what was mentioned in (Abu Saleh and others, 1995: 213), which indicates the suitability of the tool for the purpose for which it was set, and thus the validity of the analysis tool has been achieved .

Procedures for the science content analysis process (the two chemistry units) for middle school :

In analyzing the content of the two science books (the two chemistry units), the researcher relied on several steps, as follows :

1-Determine the purpose of the analysis

The analysis process aims to reveal the extent to which the content of the two science books includes the first and second intermediate stages of visual thinking skills .

2- Determine the sample analysis

The two researchers specified the science subject (two chemistry units) for the intermediate stage for the academic year (2020-2021 AD), excluding introductions, activities and semester questions .

3-Determine the unit of analysis

The two researchers have used (the visual shape) as a unit of analysis and it includes the image, diagrams and geometric shapes, for their suitability in the procedures of this research .

4-Determine the categories of analysis

The analysis categories represent all the major and minor elements on which science textbook content is analyzed and are all specific visual reasoning skills .

5-Determine the enumeration unit

Repetition was used as a unit of counting, where repetition means the number of times a certain value is repeated in the analyzed topic (Al-Tamimi, 2009: 25)

6-Analysis controls

The two researchers have taken several controls when conducting the analysis process, which contribute accurately and clearly to the analysis of visual thinking skills as it increases the proportion of stability of the analysis and among these controls :

A- Analyzing the content of all science books for the first and second intermediate stages   approved by the Ministry of Education for the academic year (2020-2021 AD)

B - The analysis covered the content and visuals included in the books, while the   introduction, activities and questions at the end of each chapter were excluded.

C- The two researchers use analysis lists for each book and monitor the results and repeat   the emergence of the skill .

D - Give a repetition of each indicator that has been repeated in the chapters of the book.

7-Validity of the analysis

The validity of the analysis was verified by presenting the two researchers a sample of the analyzed material to a group of referees and specialists in chemistry and its teaching methods, and they agreed on the validity of the analysis with a high agreement rate, and this is what the researchers prepared for the analysis .

8-Stability of analysis

The consistency in content analysis research is achieved by two types of consistency :

A- Consistency among analysts :

It is intended for two researchers to analyze the same material, by applying it to a small sample of the subject of study, before starting the extensive analysis of the large sample that the researcher studies . (Taaima ,2004 :225)

Where the researchers sought the help of external analysts with experience and competence in curricula and teaching methods and in analyzing books. A sample was taken, not on recruiting, estimated at 20% of the material analyzed. The coefficient of agreement between the two analyzes was calculated by adopting the equation (Holsti, 1969)

Where the correlation coefficient between the results of the analysis of the researcher and the first analyst was (88%) and between the researcher and the second analyst (91%) and between the first analyst and the second analyst (80%), so the average of the correlation coefficients is (86%) and this is an indication of the stability of the analysis process .

B - stability through time

It means that the analyst obtains the same results when applying the same classification categories to the same content over a varying period of time (Holsti, 1969: 118) (Burleson, 1959: 514). (30) days from the first analysis process, and the reliability coefficient between the two analyzes was calculated according to the Holste equation, so the value of the reliability coefficient obtained was (93%) for the first intermediate grade and (95%) for the second intermediate grade. These values   are considered high, which reflects a high level of Consistency with the results of the analysis .

Table No.3 The clarify the values of the stability parameters of the analysis process

The type of constancy of the analysis	Stability between….	Stability coefficient
Stability between analysts	Between the researcher and first analyst.	88%
	Between the researcher and second analyst.	91%
	Between the first analyst and the second analyst .	80%
Stability through time	Between the analyst and himself after 30 days	94%

We note that the stability coefficients between the researcher and himself over time and the researcher and other analysts range between (80% - 94%) and are within the required level, and thus the stability coefficient is good, as the literature indicates that the stability ratio of more than (70%) is good (Stmbly (Kenneth, 1972: 10) thus achieving reliability for the analysis .

Dr. Abbas FadelKazem / Ph.D. Methods of Teaching Chemistry / General Directorate of Education, Wasit Governorate

M. Mustafa Khaled Hamid / Master of Methods of Teaching Chemistry

Statistical means

The researchers used different statistical methods such as percentages, frequencies used in analyzing content results, and Holste equation to calculate the instrument reliability.

Presentation and interpretation of results

The following is a detailed presentation of the findings of the research, discussion of it, and then the presentation of recommendations and proposals for the research.

First: Show results related to the first question, which states :

What are the visual thinking skills that should be included in the content of the science books (the two chemistry units) for the first and second intermediate stages?

To answer this question, the two researchers reviewed the educational theoretical literature and reviewed books that dealt with visual thinking and some previous studies that were referred to in the previous chapters of the research during which a list of visual thinking skills needed to be available in the science subject (the two chemistry units) for the intermediate stage was determined after being presented to a group of specialists and experts, as the list contained in its final form (21) sub-indicators distributed on (6) six main skills for visual thinking as mentioned. Previously in Table No. (3)

Thus, the two researchers believe that he has answered this goal, seeing that the skills of visual thinking are varied . However, by reviewing the theoretical literature and previous studies, almost complete agreements emerge on these main skills adopted by the research, which are closest to the subject of chemistry, as they include a logical sequence from the simplest to the most complex and from the closest to the observation to the one that requires mental treatment .

Findings related to the second question, which states :

What are the visual thinking skills included in the content of the two science books (the two chemistry units) for the first and second intermediate stages ?

To answer this question, the two researchers applied the content analysis tool that was prepared for this purpose and analyzed the images, shapes, charts and drawings that were mentioned in the science books prescribed for the intermediate stage and which were applied in the academic year (2020-2021) AD, after which the frequencies and percentages of visual thinking skills were calculated. , And he presented the results of the books individually, and then presented them together .

1-Results of analyzing the science book (the two chemistry units) for the first intermediate grade :

The science book and the two chemistry units were analyzed according to the content analysis tool, as the two chemistry units included (48) a visual form distributed in (96) pages, and the following table shows the results of the analysis :

Table No.4 Repetitions , Percentages , spoken and ranks of visual thinking skills in the science book for the first intermediate grade

No	Visual thinking skills	Repetitions	Percentage	Spoken ratio	Arrangement
1.	Recognize the visual shape	110	26%	20%	2
2.	Visual shape analysis	116	27%	20%	1
3.	Connect relationships in visual shape	57	13%	20%	3

4.	Perception and interpretation of ambiguity	58	13%	15%	3
5.	Distinguish the visual shape	52	12%	15%	4
6.	Extraction of meanings	37	9%	10%	5
	Total	430	100%	100%	

The most important results obtained, shown in the table, are :

*The science book for the first intermediate grade obtained (430) iterations distributed into (six skills) .

*The skill of analyzing the visual shape came first with (116) iterations and proportion

)27% , (which is higher than the spoken rate

*The skill of recognizing the visual shape is obtained in the second order by (110) repeatedly, at a rate of (26%), which is higher than the spoken percentage as well.

*The two skills of linking the relationship in visual form and the skill of perception and interpretation of ambiguity converged and were equal in rank in the third order and B (57) iterations for the skill of linking the relationship and (58) iterations for the skill of perception and interpretation of ambiguity, at a rate of (13%) for each of them, which is less than the spoken ratios .

*While the skill of visual discrimination ranked fourth, B (52) iteratively and proportionately which is less than the spoken percentage ,(12%)

*And finally, the skill of extracting meanings, which ranked fifth and B (37) iterations

and by (9%), which is less than the spoken rate .

We notice that the skill of recognizing the visual shape and the skill of analyzing the visual shape has been acquired by the largest number of iterations, with a large difference from the rest of the skills, as this difference reflects the large and clear discrepancy between the skills in terms of their inclusion in the book of the first intermediate grade .

2- The results of analyzing the science book (two chemistry units) for the second grade intermediate :

The science book (the two units of chemistry) was analyzed according to the analysis tool, as this article included (39) a visual form distributed over (60) pages of the book and the following table showing the results of the analysis :

Table No.5 The results of the science book analysis (two chemistry units) for the second intermediate grade

No	Visual thinking skills	Repetitions	Percentage	Spoken ratio	Arrangement
1.	Recognize the visual shape	81	29%	20%	2
2.	Visual shape analysis	92	33%	20%	1
3.	Connect relationships in visual shape	38	13%	20%	3
4.	Perception and interpretation of ambiguity	28	10%	15%	4
5.	Distinguish the visual shape	23	8%	15%	5
6.	Extraction of	20	7%	10%	6

	meanings				
	Total	282	100%	100%	

Frequencies and percentages of visual reasoning skills in the science book for the second intermediate grade

The most important results that have been obtained, shown in the table, are :

*The science book for the second intermediate grade obtained (282) iterations distributed over six skills .

*The skill of analyzing the visual shape came in the first order with (92) iterations and a percentage of (33%) which is higher than the spoken percentage .

*Then the skill of recognizing the visual shape was followed by (81) repeatedly, at a rate of (29%), which is also higher than the spoken percentage.

*Then came the skill of linking relationships in the visual form in the third order, with (38) iterations and a percentage of (13%), which is less than the spoken percentage.

*The skill of perception and interpretation of ambiguity came in the fourth order, B (28) iterations, at a rate of (10%), which is less than the spoken percentage.

*After that, the skill of distinguishing the visual shape came in the fifth order, as it was repeated (23) times, at a rate of (8%), which is less than the percentage spoken.

*Finally, and in the sixth order, the skill of extracting meanings came in (20) iterations with a percentage (7%), which is also less than the spoken percentage.

It is noticeable in the above table that it becomes clear that the skills of both the recognition of the visual shape and the skill of analyzing the visual shape were repeated more than the rest of the other skills, with percentages higher than the rest of the skills, with a large difference from the spoken ratios, as for the rest of the skills, their percentages were less than the percentages spoken .

Conclusions

Through presenting the results, the researcher reached the following conclusions :

*Imbalance in including visual thinking skills and increased interest in some skills, such as the skill of visual shape recognition, the skill of analyzing the visual shape, and neglect of   other skills, as the rates of their inclusion were very few, such as the skill of linking the   shape, the skill of perception and interpretation of ambiguity, the skill of discernment   and the extraction of meanings.

*Through the results obtained, we note that the (two chemistry units) science book for the   first intermediate grade is more concerned with including visual thinking skills compared   to the two chemistry units of the science book for the second grade intermediate .

Recommendations

Based on the results and conclusions reached by the study, the researchers recommend the following :

1-Paying attention to visual thinking skills and the need to include them in a balanced way in chemistry textbooks for the middle school stage .

2-Paying attention to the enrichment of books with appropriate visual forms that achieve the goals for which they were set .

3-Providing teachers with a booklet that explains visual thinking skills, and introducing courses to clarify the importance of visual thinking and the importance of its development for the learner .

The proposals

1-Conducting similar studies in different educational stages .

2-Conducting studies to measure teachers 'possession of visual thinking skills .

3-Conducting studies to evaluate chemistry textbooks in light of visual thinking skills .

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