Criteria for Designing and Producing the Infographics Represented in the Shapes Included in the Chemistry Book for the Science Fourth Grade

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Abstract

The current research aims at identifying criteria for designing and producing the infographics represented in the illustrations included in the chemistry book for the science fourth grade. To achieve the goal, the researcher adopted a list of criteria for designing and producing infographics prepared by Al-Tamimi (Al-Tamimi, 2021). They consist of an educational field that includes three main criteria with their sub-indicators and a technical field that includes seven main criteria with their sub-indicators after verifying their validity and suitability for the goal of the research. The research sample of the 27 shapes included in the fourth-grade chemistry book was subjected to analysis using the list of adopted criteria. After processing the results statistically, main findings were reached. First, the chapters of the fourth science chemistry book achieved the criteria for designing and producing infographics in varying proportions. Second, the criterion of "simplicity in design" ranked first in the total shapes included in the chemistry book for the science fourth grade. Third, the criterion of "using the text properly" ranked last in the total shapes included in the chemistry book for the science fourth grade.

1. Introduction

The current era has witnessed rapid scientific and technological progress and development in various different fields of life. In order to keep pace with this progress and the resulting issues, it is necessary to build the individual and prepare him scientifically and technologically in line with these changes and continuous global developments in the field of science and technology. This can be done by responding to the calls of educators demanding the necessity of rebuilding the curricula, especially the scientific ones, in a way that brings them closer to reality and makes them touch the needs of learners. Moreover, education assumes its responsibility in preparing learners who are able to adapt to these changes. This is consistent with what has been confirmed by recent trends in the field of scientific education that the learner must possess the minimum amount of the scientific and technological knowledge to be aware and understanding of the nature of the issues and problems facing him in his practical life.

In line with those calls, and based on the researcher’s experience of the chemistry curricula for the preparatory stage by virtue of his teaching of these stages in the Iraqi Ministry of Education for more than (10 years), he felt the existence of a large gap between the chemical concepts that are being studied and the way to link them to the reality of learners and

transform them from being abstract concepts to solutions to issues and problems facing them in their lives. The shapes included in the chemistry curricula for the preparatory stage suffer from some shortcomings, as they are often supposed to be an alternative to the practice laboratories that a large percentage of government schools in Iraq lack, especially in the villages and rural areas where the researcher has worked for years several.

In light of the foregoing, the research problem is crystallized to subject the pictures, drawings and shapes included in the chemistry book for the preparatory fourth grade to analysis to ensure their conformity with the criteria of design and production of the infographics.

2. Research Objectives and Significance

The current research aims at identifying the criteria for designing and producing the infographics represented in the shapes included in the chemistry book for the science fourth grade.

Studies have confirmed that the infographic has a role in increasing understanding and simplifying complex information. This importance necessitates subjecting the illustrations to continuous review to ensure their effectiveness and achievement of the goals for which they were designed. This in turn is achieved through the textbook as the executive tool for the curriculum and the container whose content includes those drawings, pictures and shapes, especially chemistry books that are the most important pillars of scientific subjects in the preparatory stage in Iraq. Moreover, these books are closely related to many university disciplines, especially medical ones. Therefore, these books must be subjected to objective analysis and evaluation processes according to specific foundations and criteria. Also, those in charge of education curricula must be provided with a clear picture of their quality and suitability for the specific goals. This must be done in order to work on developing and improving the content of those books, and in particular what they contain of drawings, pictures and shapes that are the subject of the current research.

From the above, the importance of the current research becomes clear as follows:

1. As far as the researcher's knowledge can reach, this research is the first of its kind that deals with the analysis of the chemistry book for the fourth grade of middle (preparatory) school according to the criteria of designing and producing infographics.

2. The importance of the chemistry book for the fourth grade of middle school, as it is a link between basic education and university education.

3. It is possible to benefit from the results of the current research in developing and improving the existing graphic designs.

4. Work on the production of other designs that meet the criteria of the design and production of infographics in a large proportion.

The current research is limited to the illustrations that carry sequential numbers within the curriculum books for chemistry for the preparatory stage and issued by the Ministry of Education in Iraq. The limits are as follows:

1. Objective limits: represented by the illustrations included in the fourth-grade chemistry book

2. Temporal limits: represented by the latest editions of the books issued by the General Directorate of Curricula in the Iraqi Ministry of Education (Science Fourth Grade, tenth edition 2019).

Definition of terms

i. Analysis

Lexically, language means to analyze a thing, to return it to its elements, to study it, and to reveal its secrets (Ibn Manzur, 1994). Terminologically, Shehata and Zainab (2003), language is "one of the methods of judging the comprehensiveness of the content of the educational material and its integration vertically at the level of education stages and horizontally at the level of other curricula for the same grade, and its adequacy to achieve the goals" (Shehata and Zainab, 2003: 93).

ii. **Criterion**

Lexically, "criteria are a plural of criterion, and the criterion is the thing by which others are measured and leveled" (Al-Bustani, 1977: 647).

Terminologically, criteria are defined as "opinions sum up many psychological, social, scientific and educational dimensions. Through the application of these criteria, it is possible to identify the true picture of the subject to be evaluated or to reach judgments on the thing we do" (Al-Laqani and Al-Jamal, 279: 2003).

iii. Infographics

The term infographic is an Arabization of the English term (Infographic), which is a combination of the two terms (Information) which means facts, and (graphic) which means visualization, i.e. the meaning of the infographic becomes in Arabic "visual data" (Ibrahim, 2019: 19).

Idiomatically, Shaltout (2016, 2016: 111) defined infographics as "the art of transforming complex data, information and concepts into images and graphics that can be understood and understood clearly and interestingly. This method is characterized by presenting complex and difficult information in a smooth, easy and clear way".

3. Theoretical and Methodological Framework

3.1 Content Analysis

Concept of content analysis

The concept of content analysis was primarily limited to describing and the media materials that constitute the focus of the communication processes. It reflects the communicative behavior and it reveals the intellectual, cultural or political background of those in charge of it. After adopting the theory of communication in the field of education to describe the textbook and the means of education as means of communication for what they transmit from

content to learners, the concept of content analysis was extended to include the educational field (Al-Hashimi and Attia, 2009: 142).

The concept of content analysis in the field of education varies according to the definitions of those who touched on it. Some of them see that it includes all the procedural steps that aim to analyze the content of the curricula into its components and know the relationship between them and the goals for which it was set and what was achieved. Others see its concept is narrow and does not go beyond being a tool of scientific research (Al-Hashimi and Attia, 2014: 173).

The importance of content analysis

The importance of content analysis in the field of education lies in the roles it plays and its importance in the educational field. Its results are closely linked with development programs that target various aspects of the educational process. Its importance is represented in several aspects, including:

1. Preparing annual, quarterly and daily educational plans.

2. Identify the characteristics and components of textbooks.

3. Determining the strengths and weaknesses in the content of textbooks in order to reach a comprehensive evaluation of the textbook.

4. Determining the most important problems that hinder the achievement of the desired educational goals.

5. Analyzing the linguistic and semantic characteristics of the content vocabulary and the frequency of its occurrence.

6. Making a balance between school content and students' tendencies and needs (Al-Hashimi and Attia, 2014: 177).

Forms of content analysis

There are many types of content analysis depending on the nature of the study, the objectives of the analysis, and the content of the content. The literature indicates that content analysis can generally be categorized into:

1. Analyzing the pragmatic content (applied)

This type includes the procedures carried out by the researcher in order to classify the phenomena contained in the content to be analyzed into their possible causes and consequences, and the resulting positive or negative trends.

2. Semantic content analysis

It means the procedures by which the phenomena and vocabulary contained in the content are categorized according to the meanings denoting them. An example of this is to know the number of words or sentences referred to by the content for the concept of metal rust even if

the author does not explicitly use the word rust, where the researcher looks closely at the words, sentences and structures that indicate the concept of rust. It is called semantic because it looks at the significance of the structure regardless of the significance of the single words contained in the content.

3. Structural analysis

A set of actions taken by the researcher or the person conducting the analysis for the purpose of classifying the content on the basis of the physical and metaphorical characteristics of its components and parts, such as facts, concepts, generalizations, trends, values and skills. The purpose of this type of analysis is to observe the number of times each component of the content is repeated. The aim may be to benefit from its results in the process of planning and implementing the curriculum, or identifying the educational means and activities appropriate for its items (Abu Amsha, 2015: 14).

Content analysis units

Units of analysis are meant to be divided into certain categories or units that help the researcher in studying each unit by calculating the frequencies of each unit (Abdul-Rahman and Adnan, 2007: 214), where the units of analysis depend primarily on the research objective, in addition to the nature of the material under analysis (Burleson,1959: 508).

The units of analysis are divided into the following:

1. Recording unit: It is the smallest part of the analyzed content, through which the repetition of the phenomenon that the researcher studies and aims to measure and count. It includes:

-Word unit: the smallest unit used in the content analysis process, as it may express a symbol, concept, character, place....etc.

-Idea unit: one of the most important units of analysis and it is a simple or complex sentence that deals with a specific idea. The idea expressed may be explicit and referred to directly, and sometimes it is understood from the context of speech, that is, the meaning is implicit and not explicitly indicated (Al Kubaisi, 2011: 254:)

-Personality unit: It is used in analyzing stories, novels, history books and autobiographies. The researcher uses people instead of words or topics.

-Unit of the item: It is the means of communication itself, as it may be a book, an article, a talk, or a directed speech.

-Unit of distance or time: Physical measures that the researcher resorts to if he wants to estimate the space occupied by the research subject, such as calculating the number of pages or lines occupied by a particular topic (Hamza, 2012: 128).

2. Context unit: It is the structure surrounding the recording unit, which should be examined in order to arrive at a diagnosis of the recording unit. It is usually the paragraph or topic that contains the idea, where the meanings of the studied material are searched within.

3. Census unit: Repetition is used as a census unit in order to monitor phenomena that express a specific idea that matches in its content and meaning one of the paragraphs of the tool used in content analysis, and then converts the repetitions into percentages for the purpose of analysis. It is one of the most widely used methods in content analysis studies. Repetition is "the number of times a given value is repeated in the subject being analyzed" (Al-Tamimi, 2011: 277).

The infographic

i. The history of the infographic

The graphic is as old as man. The first one who coined the term (Designer Graphic) was the American designer William Edison Doigens in (1922). The truth of this matter can be confirmed through the drawings and sculptures that we have received, which date back to very old periods. The main motive for these designs and sculptures is the thinking of the individual, that is, in a spontaneous way. Among these drawings that we have received are archaeological discoveries belonging to the “Lascaux” caves in southwest France, which are complex caves containing many animal drawings on their walls and are estimated to be 16,000 years old (Al-Arabi, 2008: 7).

ii. The educational importance of the infographic

The infographics provide many advantages to the educational process in general and to the learner in particular. The information provided by the infographics such as drawings, pictures and shapes enables the learner to analyze, understand and assimilate the information through a distinctive and attractive presentation method away from the abstract image and the huge information that distracts the learner from its main objective.

Dai (2014) pointed out a number of benefits of infographics in the educational process, including:

1. Contributing to the delivery of the educational message in a correct and understandable manner by providing information in a clear and easy to understand and read manner. This encourages learners and increases their interaction and integration in the classroom.

2. Improving educational outcomes and increasing its effectiveness by providing a link between information, images and symbols indicating them, and thus gaining the greatest amount of knowledge with the least effort (Dai, 2014:12)

Moreover, Ali (2018) also indicated that the infographics work on:

3. Creating effective and continuous learning through its contribution to storing information in long-term memory, which facilitates its retrieval when needed.

4. Providing the learner with the ability to analyze the data and information provided to him and to reach the causes and results.

5. Providing an enjoyable, non-boring and repulsive study environment for the learner by increasing the interaction of learners with the graphic information provided to them.

6. Forming a sound mental perception or modifying the erroneous perceptions of the learners. One of the conditions for designing the infographics is clarity, simplicity and scientific accuracy, while ensuring proper linguistic expression within the infographic, in addition to subjecting it to continuous revision and modification even after its final output (Ali, 2018: 195).

From the foregoing, the educational importance of the infographics becomes clear. Infographics are considered an important means that can contribute to improving the educational process and increasing learners' achievement. Infographics present complex information through drawings, images and diagrams, as it helps the learner to generate mental images that are easy to understand and remember. As a result, the impact of learning increases.

iii. Components of an educational infographic

There are a set of components that must be present in the educational infographic. Khalifa (2020) refers to these components as follows:

1. Textual content: All written texts that must be brief and consistent with the visual element.

2. The visual component: It includes all shapes, drawings, pictures and charts that express information.

3. Knowledge or concept: It is what distinguishes the infographic by presenting it in an organized and specific way of the concept or knowledge to be communicated to learners more than it is a collection of texts and images together (Khalifa, 2020: 524).

2.3.12 Infographic design and production criteria

The design of a distinctive infographic capable of achieving the goal set for it is very important. This requires certain skills and capabilities that are not easy to possess, but are acquired through continuous practice and adherence to certain criteria that contribute to the production of a distinctive design. Khalifa (2016) sees that there are a set of educational and technical criteria that must be followed in order to reach a distinctive infographic, among which are:

- To take into account the educational objectives for which it was prepared.

- The content of the infographic should be appropriate to the characteristics of the learners and their previous experiences.

- Focusing on a specific idea and presenting it in a way that attracts the learner's attention.

- Choosing the right colors and avoiding bright colors that distract the learner.

- There should be consistency and integration between the texts, shapes and emojis (Khalifa, 2020: 529).

3.2 Previous studies

Yildirim's Study (2016)

The educational effects of the educational infographic and its preferred types from the point of view of the learners

The study aimed to identify the learners' point of view regarding the infographic used in their teaching and which types are more effective. The study was conducted in Turkey and used the descriptive approach. The sample size was 64 male and female students from Ataturk University. The study used statistical methods (a questionnaire directed to students, arithmetic mean, standard deviation, standard deviation and t-test. The study reached some results. It emphasized the role of infographics in learning basic materials and increasing the impact of learning. The interactive animated infographics receives more superiority over static ones. It is not preferable to use infographics crowded with designs and texts.

Abu Oreiban's Study (2017)

The effectiveness of employing static and animated infographic technology in developing genetic problem-solving skills in the life sciences of tenth grade students in Gaza

The study aimed to know the effect of infographic technology in developing genetic problem-solving skills. The study was conducted in Palestine and used the experimental method on a sample of 116 students in the tenth grade.

The following methods were used (achievement test, coefficient of ease and difficulty, Kuder-Richardon formula, Eta square to measure the effect size). The results showed that teaching using infographics is effective in developing genetic problem-solving skills, in addition to achieving animated infographics more effective than static ones.

Hassan's Study (2021)

The interaction between the vertical and horizontal infographic display pattern in cloud computing applications and mental capacity (high, low) and its impact on developing scientific concepts and engaging in education for middle school students

The study aimed to reveal the role of vertical and horizontal infographics in the development of scientific concepts. The study was conducted in Egypt and used the experimental method. The sample size was 120 students from the middle stage. The following statistical methods were used (achievement test, Holsti equation, Pearson correlation coefficient, Alpha Cronbach equation). The results showed the superiority of the experimental group that studied using infographics. This superiority is due to the interaction between the style of static infographic presentation and mental capacity

3.3 Research methodology and procedures

Research methodology

The researcher used the analytical descriptive research method to identify the extent to which the illustrations included in the chemistry book for the preparatory fourth grade achieve the

criteria for designing and producing infographics. Among the functions of this approach are description, analysis and interpretation using clear and specific terms.

Research procedures

1. Research community

The current research community consists of all shapes included in the chemistry book for the preparatory fourth grade for the academic year (2021-2022) prepared by the General Directorate of Curricula in the Iraqi Ministry of Education. Table (2) presents the research community.

Table (2) Research community by chapter and number of shapes

Chemistry book for the science fourth grade				
Edition no.	Publication year	Chapter sequence	Chapter pages no.	Total shapes no.
Tenth edition	2019	First chapter	22	6
		Second chapter	28	10
		Third chapter	19	6
		Fourth chapter	27	7
		Fifth chapter	20	18
Total		5	116	47

2. Research sample

The research sample consisted of all numbered and sequential shapes within each chapter of the chemistry book for the preparatory fourth grade. That is the unnumbered shapes were excluded because they were not indicated when displaying the academic content. Table (3) presents the research sample.

Table (3) The research sample

Chemistry book for the science fourth grade						
Edition no.	Publication year	Chapter Sequence	Chapter pages no.	Total shapes no.	Analyzed shapes no	Excludes shapes no.
Tenth Edited	2019	First chapter	22	6	1	5
		Second chapter	28	10	4	6
		Third chapter	19	6	0	6
		Fourth chapter	27	7	5	2
		Fifth chapter	20	18	17	1
Total		5	116	47	27	20

3. Research tool

After reviewing the previous literature with the research variable (infographic), the researcher adopted the research tool prepared by Al-Tamimi (2021), which consisted of two fields. The

first is educational and includes three main criteria and (14) sub-criteria, and the second is technical, which includes seven main criteria and (37) sub criterion.

Validity of the search tool

To ensure the validity of the adopted tool and its suitability to the research problem, the tool (Appendix 3) was presented to a group of (19) specialists (Appendix 4) in the methods of teaching chemistry, science, measurement, evaluation and educational psychology.

The researcher reviewed the observations and amendments of the experts represented by deleting three sub-indicators for not obtaining an agreement rate of 80% or more, in addition to amending the wording of some other indicators. Moreover, the researcher took all the experts' observations. Therefore, the research tool is ready and consists of (10) main criteria and (48) sub-criteria. Appendix (5) explains this.

Analysis procedures and steps

In analyzing the content, the researcher relied on the following steps:

- The purpose of the analysis

Knowing the extent to which the content of chemistry books for the preparatory stage of drawings, shapes and images matches the criteria for designing and producing infographics according to the final list whose validity has been verified.

Determining of the analysis sample

The researcher limited his research sample to the numbered and sequential shapes included in the chemistry books for the preparatory stage, excluding the unnumbered shapes because they are not directly related to the presented content.

Defining units of analysis units

The units of analysis units represent the elements on the basis of which the content is analyzed (Obaidat et al., 1999: 56). The researcher used the explicit idea as a unit of analysis on which to base the monitoring of the categories of analysis because it fits with the nature of the content of chemistry books for the preparatory stage in addition to its use by many researchers in textbook content analysis studies.

Census unit

The researcher used repetition as a unit of enumeration.

Analysis tool application

The researcher followed a number of steps in the process of analyzing chemistry books for the preparatory stage according to the list of criteria in its final form, which included (10) main criteria and (48) sub-criteria. These steps can be summarized as follows:

1 - Reading the chemistry book for each stage and identifying the shapes it includes.

2- Determining the shapes that are directly related to the provided academic content and are referred to in the body of the content.

3- Reading the list of the main and subsidiary final criteria in a focused and accurate manner.

4- Subjecting the figures in each chapter and each of the analyzed books to the main and sub-indicators to determine their availability and recording the recurrence for each indicator.

5- Unpacking the results of the analysis for each book into tables designed for this purpose in order to be processed statistically as shown in Appendices (6), (7), (8) and (9).

Stability of the analysis tool

For the purpose of achieving objectivity in the analysis and moving away from the subjectivity of the analyst, the stability of the analysis tool was calculated in two ways:

- **Stability of the analysis tool over time**

The researcher re-analyzed the book at an interval of 21 days in order to ensure the extent of compatibility and consistency between the two analyzes. The percentage of agreement between the results of the two analysis processes was calculated, using Cooper's equation, and the percentage of agreement ranged between (95.5% - 98%). This percentage indicates the stability of the two analysis processes.

Second: The stability of the analysis tool across individuals

To ensure the stability of the analysis, the researcher analyzed the book of chemistry prescribed for fourth-grade students according to the analysis card prepared previously. Moreover, others analyzed the same book (Appendix 10). The percentage of agreement between the analysis of the researcher and the other analyst was calculated using the Holsti equation, which is the simplest and most common equation in use and to extract stability across individuals, and it is as follows:

- The stability coefficient between the first analysis of the researcher and the first analyst of the chemistry book for the fourth preparatory grade amounted to (99%).

-The stability coefficient between the first analysis of the researcher and the second analyst of the chemistry book for the fourth grade of middle school reached (99%).

- The stability coefficient between the analysis of the first analyzer and the second analyst of the chemistry book for the preparatory fourth grade amounted to (99%).

It is clear from the above that the stability coefficients are acceptable, which means that the analysis is accepted. As studies indicate that the acceptable stability coefficient exceeds (80%).

Statistical means

The researcher used the following equations:

1. Cooper's equation to extract stability over time, by extracting the percentage of agreement between the two analyzes with a time interval

$$Cooper\ equation\ \frac{Agreement\ times\ number}{Non-Agreement\ times\ number+greement\ times\ number}\ x\ 100$$

2- Holsti equation to extract stability across individuals:

$$Holisti\ equation\ \frac{\text{Agreed upon units number x 2}}{\text{Units number in first analysis} +\ \text{Units number in second analysis)}}\ x\ 100$$

3- The Law of Percentage: To extract the percentage of each criterion according to the book, chapter and form

$$Percentage = \frac{Part}{Whole}\ x\ 100$$

4. Presentation, Interpretation and Discussion of Results

First Objective: Criteria for designing and producing infographics for the shapes included in the chemistry book for the science fourth grade

The researcher used the infographic analysis tool (Appendix 6) to analyze the shapes in the chemistry book for the science fourth grade. The frequencies and percentages for each of the main infographic criteria were extracted, and for each chapter of the book. Table (4) and the graph (1) illustrate this.

Table (4)

Frequencies and percentages of the main criteria for the shapes included in the fourth grade chemistry book according to the chapters

N0.	Criteria	Shapes in the chemistry science fourth grade book												
		First Chapter		Second Chapter		Third Chapter		Fourth Chapter		Fifth Chapter		**Total**		**Order**
		Shapes no. (1)		**Shapes no. (4)**		**Shapes no. (No shapes)**		**Shapes no. (5)**		**Shapes no. (17)**		**Total shapes no. (27)**		
		F	**Perc**	**F**	**Perc**	**F**	**Perc**	**F**	**Perc**	**F**	**Perc**	**F**	**Perc**	
1	**Specific educational objectives**	**3**	**2.94**	**15**	**14.71**	/	/	**16**	**15.69**	**68**	**66.67**	**102**	**12.39**	**Fourth**
2	**Providing Specific**	**3**	**2.59**	**18**	**15.52**	/	/	**17**	**14.66**	**78**	**67.24**	**116**	**13.09**	**Second**

	Clear content													
3	**Consistent with Learner's characteristics**	**3**	**4.76**	**12**	**19.05**	/	/	**15**	**23.81**	**33**	**52.38**	**63**	**7.65**	**Seventh**
Total frequencies and percentages of the first field		**9**		**45**				**48**		**179**		**281**	**34.13 %**	
4	**Simplicity in its design**	**1**	**0.76**	**20**	**15.27**	/	/	**32**	**24.43**	**78**	**59.54**	**131**	**15.92**	**First**
5	**Good production**		**0.00**	**13**	**3.61**	/	/	**21**	**25.30**	**49**	**59.04**	**83**	**10.09**	**Fifth**
6	**Properly Employing fonts**		**4.11**	**7**	**17.07**	/	/	**9**	**21.95**	**25**	**60.98**	**41**	**4.98**	**Eighth**
7	**Using colors appropriately**	**3**	**4.11**	**10**	**13.70**	/	/	**14**	**19.18**	**46**	**63.01**	**73**	**8.87**	**Sixth (repeated)**
8	**Correctly employing drawings and shapes**	**2**	**2.74**	**16**	**21.92**	/	/	**12**	**16.44**	**43**	**58.90**	**73**	**8.87**	**Sixth (repeated)**
9	**Using text correctly In design**		**0.00**	**4**	**12.12**	/	/	**9**	**27.27**	**20**	**60.61**	**33**	**4.01**	**Ninth**
10	**Design structure of its elements**	**4**	**3.70**	**17**	**15.74**	/	/	**22**	**20.37**	**65**	**60.19**	**108**	**13.12**	**Third**
Total frequencies and percentages of the second field		**10**		**87**				**119**		**326**		**542**	**65.87 %**	
Total		**19**	**2.30**	**132**	**16.03**	/	/	**167**	**20.29**	**505**	**61.36**	**823**		

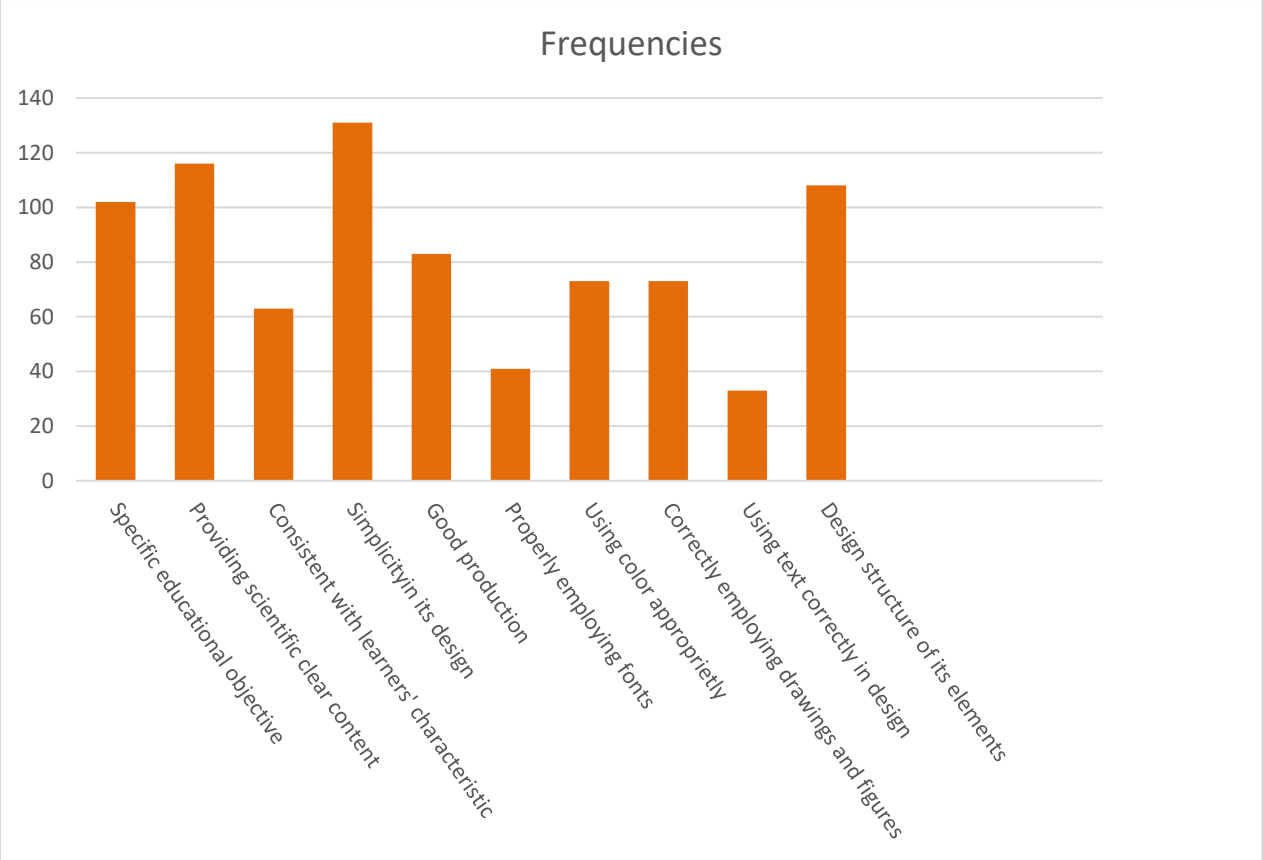

Figure (1)

Frequency of the infographic criteria for the shapes included in the chemistry book for the science fourth grade

The results in terms of the infographic criteria for the shapes in the chemistry book for the science fourth grade

It is clear from the previous table and the above graph that the first field of infographic design and production criteria (the educational field) scored 34.13%. The second criterion achieved the highest ranking within the same field, followed by the first and then the third criterion. The second field of infographic design and production criteria (technical field) scored a percentage of 65.87%. The fourth criterion got the highest percentage, and the ninth criterion the lowest. The following is a statement of the sequence, frequencies and percentages of each major criterion of the design and production of infographics and for the educational and artistic fields:

The criterion of "simplicity in design" ranked first with a total of (131) recurrences and a percentage of (15.92%) in the total shapes included in the chemistry book for the science fourth grade. This criterion appeared in the first chapter with a percentage (0.76%), and in the second chapterby (15.27%). It did not appear in the third chapter because there were no shapes, in the fourth chapter by (24.43%), and in the fifth chapter by (59.54%).

Then the criterion of “providing specific clear content” came in second place with a total of (116) recurrences and a percentage of (14.09%) in the total shapes included in the chemistry

book for the science fourth grade. This criterion appeared in the first chapter at a rate of (2.59%), in the second chapter (15.52%), did not appear in the third chapter because there were no problems, in the fourth chapter (14.66%), and in the fifth chapter (14.09%).

The "Design Structure of its Elements" criterion ranked third with a total of (108) recurrences and a percentage of (13.12%) in the total shapes included in the science fourth chemistry book. It appeared in the first chapter by (3.70%) in the second chapter by (15.74) %), and it did not appear in the third chapter because there were no problems, in the fourth chapter by (20.37%), and in the fifth chapter by (60.19%).

The "Specific Educational Objectives" criterion ranked fourth with a total of 102 recurrences and a percentage of (12.39%) in the total shapes included in the chemistry book for the science fourth grade. It appeared in the first chapter at a rate of (2.94%), in the second chapter by (14.71%), it did not appear in the third chapter because there were no problems, in the fourth chapter by (15.69%), and in the fifth chapter by (66.67%).

The "good production" criterion ranked fifth with a total of (83) recurrences and a percentage of (10.09%) in the total shapes included in the chemistry book for the science fourth grade. It did not get any frequency in the first chapter and therefore its percentage was (0.0 %), while it appeared in the second chapter by (3.61%). It did not appear in the third chapter because there were no problems. The percentages in the fourth chapter and fifth chapter were (25.30%), and (59.04%), respectively.

The criterion of “using colors appropriately” and the eighth criterion of “using drawings and shapes correctly” got the same rank, which is the sixth, with a total of (73) recurrences and a percentage of (8.87%) in the total shapes included in the chemistry book for the science fourth grade. In the first chapter by (4.11%), and in the second chapter by (13.70%), it did not appear in the third chapter because there were no problems, and in the fourth chapter by (19.18%), and in the fifth chapter by (63.01%), while the eighth criterion appeared in The first chapter with a percentage of (2.74%), and in the second chapter with a percentage of (21.92%), and it did not appear in the third chapter because there were no problems, and in the fourth chapter with a percentage of (16.44%), and in the fifth chapter by (58.90%).

The criterion “consistent with the characteristics of the learners” ranked seventh with a total of (63) recurrences and a percentage of (7.65%) in the total shapes included in the chemistry book for the science fourth grade. It appeared in the first chapter by (4.76%), and in the second chapter by a percentage (19.05%), and it did not appear in the third chapter of the presence of shapes, in the fourth chapter (23.81%), and in the fifth chapter (52.38%).

As for the criterion of "properly employing fonts", it ranked eighth with a total of (41) recurrences and a percentage of (4.98%) in the total shapes included in the chemistry book for the science fourth grade. It did not get any frequency in the first chapter and therefore the percentage was (0.0%). It appeared at a rate of (17.07%) in the second chapter, and did not appear in the third chapter because there were no problems, while reached (21.95%) in the fourth chapter, and (60.98%) in the fifth chapter.

The ninth criterion of "using the text correctly" came in the last rank with a total of (33) recurrences and a percentage of (4.01%) in the total shapes included in the chemistry book for the science fourth grade. In the first chapter there was no frequency and therefore the percentage was (0.0%), while it appeared in the second chapter with a percentage of (12.12%). It did not appear in the third chapter because there were no problems, and it appeared in the fourth chapter by (27.27%), and in the fifth chapter by (60.61%).

5. Conclusions

1. There is a discrepancy in the distribution of illustrations for each chapter of the chemistry book for the preparatory fourth grade.

2. Although the infographic consists of two parts, the figure and its explanatory text, it is noticed in the infographic designs for the preparatory stage that the focus is on the shapes and their appearance in a simple way, and the neglect of the second aspect, which is the texts that explain these shapes.

Recommendations

1. Directing the teachers' attention and urging them to employ different infographic patterns, especially the animated ones in the classroom situation.

2. Using illustrations that suit the learners' age and previous experiences.

Suggestions for further research

1. Conducting an empirical study to compare the two types of static and animated infographics and knowing their impact on clarifying abstract concepts and increasing achievement.

2. Conducting a similar study on chemistry books for the middle stage.

References

1. Abu A., Hussein, K. (2015) *Content analysis, its concept, its importance, its characteristics, its objectives, its types and conditions*. Riyadh: Dar Al-Alukah.
2. Abu Oriban, A. (2017) The effectiveness of employing static-animated infographic technology in developing the genetics problem solving skills in life sciences for tenth grade students in Gaza. Master’s thesis, College of Education, Islamic University of Gaza.
3. Al-Arabi, R. (2008) *Graphic Design*, 2nd ed. Beirut: Dar Al-Youssef for printing, publishing and distribution,.
4. Al-Bustani, A. B. (1977) *Ocean's Ocean*. Beirut: Library of Lebanon.
5. Al-Hashimi, A. R., and Attia, M. Ali (2009) *Analysis of the content of the Arabic language curricula,: Aan applied theoretical vision*, 1, Amman: Dar Safaa for Publishing and Distribution.
6. ------- (2014) *Analyzing the content of school curricula*. 2nd ed., Amman :Dar Safaa for Publishing and Distribution.

7. Ali, N. A. K. (2018) Developing some economic concepts for kindergarten children using infographics, *Reading and Knowledge Magazine*, No. (198), Egypt.
8. Al-Kubaisi, W. M. (2011) Methods of scientific research between theory and practice, 1st ed. Baghdad: Al-Yamamah Library.
9. Al-Laqani, A., Al-Jamal, A. (2003) *A Dictionary of Educational Terms Known in Curricula and Teaching Methods*. 3rd ed. Cairo: World of Books.
10. Al-Tamimi, R. Q. H. (2021) Evaluation of physics books for the preparatory stage according to the criteria of design and production of infographics. An unpublished master's thesis, College of Education, Ibn Al-Haytham, University of Baghdad.
11. Al-Tamimi, A. J. (2011) *Curriculum and Book Analysis*, 2nd ed., Baghdad: House of Books and Documents.
12. Burleson, B. (1959) *Content analysis, in Grander Lindzey Handbook of Social Psychology*. London: Addison Wesley publishing Comp. Inc.
13. Dai, S. (2014) Why Should PR Professionals Embrace Infographics? Faculty of the usc Graduate School, University Of Southern California.
14. Hamza, K. M. (2012) Analysis of the book's content as a research material, 1st ed. Beirut: Al-Baseer Library.
15. Hassan, N. E. M. (2021) The interaction between the vertical/horizontal static infographic display pattern with computing applications and high/low mental capacity and its impact on developing scientific concepts and engaging in learning among middle school students, *Educational Journal*, 88, Egypt.
16. Ibn Manzur, A. J. M. b. (1994) *Lisan al-Arab*, 1st ed., Dar Sader, Beirut.
17. Ibrahim, A. M. (2019) *Infographics and the development of geographical concepts and visual thinking*. Cairo: Al-Bahith Foundation for Research Consultations.
18. Khalifa, A. A. R. M. (2020) The impact of the patterns of presenting the interactive animated/static educational infographic on the development of the concepts of digital citizenship among secondary school students and their attitudes towards it, Fayoum University *Journal of Educational and Psychological Sciences*, 14, Part 5.
19. Obeidat, T., A. a. A., and Kayed A. a. (1999) Scientific Research: Its Concept, Tools, and Techniques, 1st ed. Baghdad: Dar Osama for Publishing and Distribution.
20. Rahman, A. H., and A. H. S. Z. (2007) Methodological patterns and their applications in science. Baghdad: House of Books and Documents,.
21. Shaltout, M. S. (2016) *Infographics from planning to production, King Fahd National Library*, 1st ed., Riyadh, Saudi Arabia.
22. Shehata, H., and Al-Najjar Z. (2003) A Dictionary of Educational and Psychological Terms, 1st ed. Cairo: The Egyptian Lebanese House.
23. Yildirim, S. (2016) Infographics for Educational Purposes: The Structure, Properties and Reader Approaches, *The Turkish Online Journal of Educational Technology*,15 (3), p 110-98.