

Comparison of Test Scores Obtained by Eighth Graders on Illustrated and Abstract Content Questions: A Quantitative

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Abstract

The purpose of this study is to investigate whether students are more successful on abstract or illustrated test questions. To this end, the questions on an abstract test were changed into a visual format, and these tests were administered every three days to a total of 240 students at six middle schools located in the Erzurum city center and surrounding districts. After the data obtained from the study were examined, it was concluded that students were more successful in illustrated (visual) tests.

Keywords: Illustration, Achievement, Concrete, Abstract

1. Introduction

Sciences have grown in importance in equal proportion with the rapidly evolving technology of today. To date, the studies conducted in the field of educational science have aimed to increase achievement in science courses. Logical thinking, visual intelligence, mathematical skills and problem solving ability are considered to be the most significant factors influencing the achievement levels of students in sciences (Delialioğlu, 1996).

In the studies conducted by Tracy (1990) and Pallrand and Seeber (1984), a direct relationship was shown between visual intelligence and sciences. An experimental study conducted by Lord (1985) shows a similar result and suggests that the visual intelligence of students can be improved through teacher-provided activities.

Teaching materials are the instruments that help with mental activities of the learning process. Visual teaching materials are the visual illustrations of the verbal knowledge in the most general sense (Düzgün, 2000). They include charts, photographs, concept maps, slides, movies, computer and television screen captures and more. Visual teaching materials help in directing students and assisting them in focusing their attention and in conducting analysis and synthesis. A well-designed schematic demonstration provides comprehension that is unable to be carried by words alone and facilitates recollection (Düzgün, 2000).

Permanent retention of the learning material can be better ensured by displaying visual teaching materials with sound and animation. Seeing comprises 83% of learning methods, hearing 11%, smelling 3.5%, touching 1.5% and tasting 1% (Festo, 1994). More importantly, people remember 10% of what they read, 30% of what they see, 20-25% of what they hear, 60-65% of what they see and hear, 70% of what they hear, and 90% of what they do and say (Çilenti, 1998). The fact that seeing and hearing have such a strong effect on learning makes the designing of visual materials quite important. A well-designed 25 or 30-second television commercial can do as much as it takes one month's time to do in the teaching process (Kılıç, 1997).

Illustrations (picturing) are designed to assist the text in transferring a specific idea or message. They are entertaining and leave a strong impression. Knowing this, it is safe to say that education materials on which illustrations are utilized along with texts can be both motivating and appealing for students.

The use of illustrations (picturing) for educational purposes and the primary role they can play in discussions related to problem solving processes has been well-established. For this reason, the education materials on which illustrations are utilized along with texts can increase the comprehension level of the intended verbal thoughts.

Illustrations (picturing) mean a lot to the people interacting with them. They can also assume the role of a stimulus for the "discussion platform". Therefore, the education materials on which illustrations are utilized along with texts are part or continuation of the "interactive" educational process.

Simple and clear illustrations remain in the mind for a longer time, and they can be recalled easily when necessary. Arnheim (1979) stated that the knowledge stored in different parts of the brain is recalled and that the emotions and feelings stored along with this knowledge arrive earlier. In that case, it can be argued that illustrations composed of design elements, such as colors, forms, lines or textures, are more effective than texts in driving emotions and feelings. With that said, education materials on which text-supportive illustrations are used appropriately and effectively can serve as a bridge for visual recollection (İşler, 2003).

2. Method

2.1 Research design

To fulfil the purpose of this study on determining the achievement levels of students according to the scores they

obtained on the abstract and illustrated (pictured) questions, the research employed a survey method. The research began with a scanning of the science course curriculum programs of 6th, 7th and 8th graders, followed by the preparation of relevant tests that covered all the subjects as well as formed their essential parts. Each test included 10 questions with two different question types (Appendix 1). The first test consisted of no shapes, diagrams or charts and included only questions with textual content. The second test had the same content as the questions on the first test, but it was recomposed with illustrations, charts and diagrams supporting the texts. In an effort to control the validity and reliability of the tests, a pilot study was conducted in a pilot school with the participation of 150 students, and both tests were administered to these students. Cronbach's Alpha method was used for measuring the reliability of the tests. Accordingly, the reliability coefficient for the abstract test was found to be ($\alpha = 0.67$) and the reliability coefficient for the visual test was found to be ($\alpha = 0.72$). The tests were reviewed by five experienced science teachers and revised according to their opinions. Once the tests were put into final form according to this revision, they were administered to a selection of students enrolled in the schools shown in Table 1. A total of 40 students were selected from each school. In cases where class sizes were below this number, the missing number of students were selected from other 8th graders and added to these classes, and likewise, in cases where the class sizes were above this number, the excess number of students were omitted. The tests were administered in the first term of the 2015-2016 academic year. Prior to the tests being conducted, the researchers consulted with the science teachers in these schools to ensure that the subjects included in the questions on the tests were taught. After securing this understanding, the tests were then administered to the students in these schools. The students were provided with a sufficient amount of time to complete each test. In evaluating the tests following their completion, each correct answer was given 1 point and each wrong answer was given 0 points. The total points of each student were then calculated. The data obtained from the tests were evaluated using the SPSS software package.

2.2 Study group

This study was conducted with the participation of 240 students (8th graders) from six middle schools in the province of Erzurum.

Table 1. Schools and number of students comprising the research sample

School	Gender		Total
	Female	Male	
İspir Boarding Middle School	15	25	40
Tekman Boarding Middle School	13	27	40
Ilıca Yavuz Selim Boarding Middle School	8	32	40
Şair Nefi Middle School	19	21	40
Şükrüpaşa Middle School	16	24	40
Sabancı Middle School	22	18	40
Total	92	148	240

3. Findings

This study aimed to discover whether any achievement differences were able to be discerned according to the scores obtained by the students on the abstract test questions versus those obtained on the illustrated test questions. The means and standard deviations of the correct answers the students gave for the abstract and illustrated test questions are indicated in Table 2. From the table, it can be clearly seen that the mean of the points obtained for the visual content questions were quite higher than the mean of the points obtained for the abstract content questions.

Table 2. The means and the standard deviations of the scores obtained for both test questions

	Mean	N	Standard Deviation
Visual	9.8917	240	4.907
Abstract	5.0083	240	2.103

Within the scope of the study, the dependent samples t-test was conducted to find out whether there was a significant difference between the correct answers the students gave for both tests. According to the results of this test, it was determined that there was a significant difference between the points the students gave for both tests (Table 3).

Table 3. T-test results of dependent groups

Visual Abstract	Matched Differences				
	Mean	Standard Deviation	Standard Error of the Mean	t	P
	4.8833	4.29300	.2771	17.622	.00

Here, the result $t = 17.62$ was found to be at the $p < 0.05$ significance level, which suggests that the students answered the visual content questions more easily. Since the questions prepared under visual content necessitated the use of a higher number of sense organs, the students were able to understand them easier and thereby answer them more comfortably.

Table 4. The correct answer rates of the students in the schools where each of the tests were administered

Student Number	İspir Boarding Middle School		Tekman Boarding Middle School		Yavuz Selim Boarding Middle School		Sabancı Middle School		Şükrüpaşa Middle School		Şair Nefî Middle School	
	Abstract	Concrete	Abstract	Concrete	Abstract	Concrete	Abstract	Concrete	Abstract	Concrete	Abstract	Concrete
1	%63	%90	%36	%100	%21	%54	%90	%100	%81	%100	%45	%100
2	%45	%36	%36	%100	%18	%72	%90	%100	%45	%45	%54	%100
3	%27	%9	%27	%63	%18	%36	%72	%100	%27	%36	%27	%100
4	%45	%27	%36	%54	%45	%100	%81	%100	%9	%45	%9	%100
5	%45	%45	%36	%100	%18	%100	%72	%100	%27	%36	%72	%100
6	%54	%45	%36	%100	%45	%81	%45	%100	%27	%18	%36	%100
7	%45	%54	%63	%100	%27	%63	%90	%100	%27	%45	%45	%100
8	%72	%81	%27	%54	%36	%27	%72	%100	%81	%100	%72	%100
9	%63	%81	%36	%100	%36	%45	%45	%100	%27	%100	%90	%100
10	%54	%81	%9	%81	%27	%45	%54	%100	%45	%54	%54	%100
11	%63	%54	%45	%90	%45	%45	%63	%100	%9	%54	%72	%100
12	%45	%90	%45	%81	%36	%100	%54	%100	%9	%54	%45	%18
13	%45	%100	%36	%81	%27	%45	%81	%100	%36	%100	%9	%54
14	%63	%36	%27	%81	%27	%18	%81	%100	%9	%63	%72	%100
15	%54	%45	%63	%100	%20	%20	%54	%45	%18	%45	%72	%100
16	%54	%45	%18	%100	%54	%100	%81	%100	%27	%54	%63	%45
17	%45	%36	%36	%100	%45	%18	%63	%100	%45	%100	%54	%100
18	%36	%36	%54	%54	%18	%45	%54	%100	%9	%81	%54	%90
19	%54	%63	%45	%90	%9	%54	%63	%100	%18	%45	%45	%100
20	%54	%54	%27	%45	%27	%27	%81	%100	%54	%100	%18	%54
21	%27	%18	%36	%100	%9	%36	%81	%100	%81	%90	%54	%100
22	%54	%63	%36	%100	%27	%72	%81	%100	%36	%81	%18	%63
23	%54	%100	%81	%100	%54	%100	%63	%100	%27	%45	%27	%63
24	%63	%54	%63	%100	%27	%100	%72	%100	%27	%36	%54	%100
25	%54	%54	%45	%100	%18	%54	%45	%100	%81	%100	%36	%27
26	%36	%100	%27	%27	%9	%27	%63	%100	%36	%54	%54	%100
27	%45	%72	%63	%100	%9	%100	%72	%100	%54	%81	%54	%100
28	%54	%63	%27	%63	%18	%45	%63	%100	%45	%100	%63	%45
29	%72	%100	%63	%100	%27	%100	%63	%100	%63	%36	%54	%100
30	%45	%100	%27	%100	%27	%45	%45	%81	%36	%54	%36	%72
31	%45	%100	%36	%100	%36	%45	%45	%100	%63	%100	%45	%100
32	%54	%63	%27	%100	%45	%90	%81	%100	%45	%72	%45	%45
33	%54	%63	%54	%72	%27	%90	%45	%100	%63	%36	%27	%81
34	%54	%36	%27	%54	%45	%100	%63	%100	%27	%63	%36	%63
35	%45	%45	%54	%81	%54	%72	%45	%100	%54	%54	%45	%72
36	%54	%36	%54	%54	%45	%100	%54	%36	%45	%27	%45	%45
37	%54	%27	%54	%81	%63	%45	%27	%27	%45	%63	%45	%100
38	%63	%54	%9	%54	%36	%36	%72	%100	%45	%54	%45	%54
39	%54	%54	%36	%100	%18	%72	%72	%100	%54	%45	%54	%100
40	%63	%45	%54	%63	%36	%100	%72	%100	%45	%81	%36	%100

As can be seen from the table, the percentages of correct answers given for the visual content questions prepared for each school were higher. These rates were much higher particularly in the Sabancı and Şair Nefî middle schools. This can be attributed to the fact that the students who attend these schools come from a higher socio-economic background and have higher academic skills.

4. Conclusion and Recommendations

With the purpose of this study being to determine student levels of achievement based on the scores they obtained on abstract and visual content test questions, it was concluded that the students were more successful in visual content tests.

According to İşler (2003), the use of illustration in education provides many opportunities, including help with comprehension activities, visualization of motivating, abstract and complex concepts in a more effective and impressive manner, easy interpretability resulting from strengthened presentation of information, potential development of materials for higher number of interactive educational settings and facilitation of recollection. The following recommendations are presented in light of this information.

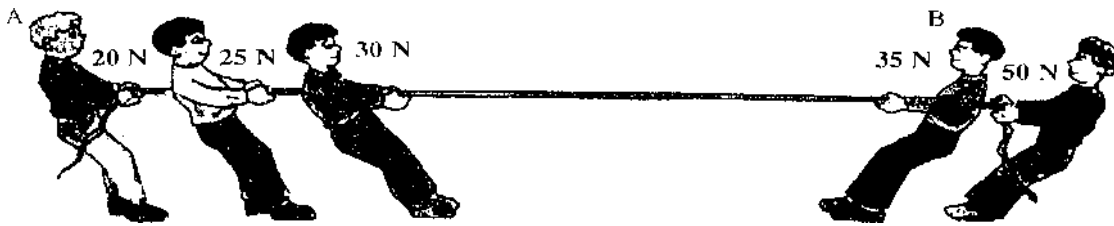
1. In primary and secondary schools, teachers should lecture on science course subjects in order to stimulate as much as possible a higher number of sense organs in the students.
2. Education materials, such as computers, education sets, slides and interactive boards should be utilized as much as possible during the lecturing process.
3. Considering the fact that illustration-supported education is more effective in teaching abstract subjects, teachers should acquire the skills necessary for using and applying this technique as part of their pre-service training. In this context;
 - a) It can be recommended that lectures conducted during instruction-oriented courses for pre-service teachers apply the illustration technique in order that the pre-service teachers can be prepared to employ the skills for developing illustration-supported materials.
 - b) Teachers should be enabled to acquire the skills for developing illustration-supported materials during in-service training. Additionally, science laboratories should be developed in the schools to give the teachers the opportunity to practice what they learn.
4. Given that pre-service teachers who are not familiar with the process of obtaining knowledge in science education nor with the use of visual teaching materials will have great difficulty in understanding the nature of sciences, the faculties of education should include illustration-supported education programs, and pre-service teachers, in particular, should be enabled to acquire these skills.

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Appendix 1. Sample questions used in the study

Sample question 1. Which one of the following groups in the illustration will win the tug of war game and by how many points will the winning group outscore the other?



- A) Group A 5 N B) Group B 10 N C) Group A 15 N D) Group B 8 N

Sample question 2. A force (F_1) is applied to the left and a force (F_2) is applied to the right on a mass (m) object standing on a horizontal plane. Assuming that the object is moving in the direction of F_1 , what will the size of the resultant force be?

- A) f_1+f_2 B) f_1/f_2 C) f_2/f_1 D) F_1-F_2

Sample question 3. Which one(s) of the following atoms was(were) ionized?

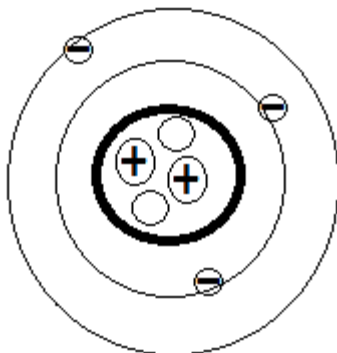


Figure I

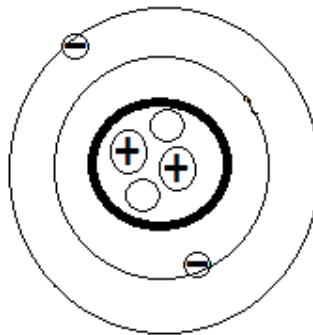


Figure II

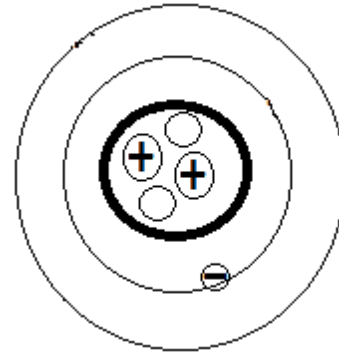


Figure III

- A) Only I B) Only III C) I and II D) I and III

Sample question 4. If each of x^{+2} and y^{-1} receive 2 electrons, which one of the following options will indicate their final states?

- A. $x-y^3$ B. $x^{+4}-y^{+1}$ C. $x-y^{+1}$ D. $x^{+4}-y^{-3}$