# Investigation of Exam Questions Enriched with Visual Materials According to Various Variables[1]

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**Abstract**

The objective of this study was to investigate whether there is a statistically significant difference between the scores of exam questions enriched with visual materials and without visual materials in middle school students. In addition, it was to investigate whether students' scores from exam questions enriched with visual materials and without visual materials and test anxiety scores make a difference according to gender. Achievement Tests (AT) and Test Anxiety Scale (TAS) were used as the data collection tools in the study. The sample of this study was 28 middle school students. In the analysis results of the study, it was found that there was not a statistically significant difference between the scores of the students in the exam questions with visual materials and without visual materials. In addition, the mean scores of the students in the exam questions enriched with visual materials and questions without visual materials did not show a significant difference by gender. Another result obtained was that there was not a statistically significant difference between the test anxiety scores of male and female students. But, it was noticed that as the number of exams students take increases, their test anxiety scores increased, and their exam success scores decreased.

**Keywords:** Exam success, exam question, test anxiety, visual materials.

## Introduction

The interaction of individuals with their environment occurs through the sense organs. In other words, individuals try to understand what is happening around them by seeing, hearing, touching, smelling, and tasting. Therefore, the more a teaching activity in a teaching environment appeals to the sense organs, the more effective and permanent the learning will be. Thus, while explaining concepts that are abstract and difficult to understand, it is necessary to develop and use teaching materials that can activate students' visual, auditory, and intellectual structures, and create interactive learning environments (Mamur Yılmaz, 2014). In this context, the purpose of teaching environments is to bring audio-visual and intellectual elements that will appeal to the sense organs of an individual into the teaching environment and to increase the effectiveness of teaching. Research (Çilenti, 1992) has shown that visuality has a significant place in what we learn through the senses, and accordingly, a large part of what we learn (83%) takes place in learning environments that appeal to our visual senses. As students are frequently subjected to visual materials in teacher presentations, textbooks, and multimedia materials, their capability to comment on and understand, these visual materials have gained more importance in education (Ferk et al., 2003). In a broad sense, visual teaching materials are the expression

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of verbal information through visual pictures. Visual instructional materials play an important role in teaching scientific concepts and supporting textual explanations (Ametller & Pinto, 2002; Mathewson, 1999). According to Genty (1994), visual instructional materials help students motivate, focus, analyze and synthesize. A well-designed schematic representation provides more learning than the meanings of words and makes it easier to remember (Erden, 2012; Mamur Yılmaz, 2014). Research has shown that the use of visual materials in concept teaching is important (Kozma, 2003; Kozma & Russell, 1997; Van Sommeren et al., 1998), and that using materials in science education has positive results (Cook, 2006; Ferk et al., 2003; Peeck, 1993; Slough & McTigue, 2010). Therefore, the focus has been on the advantages of using visual materials to teach notions in the classroom (Van Sommeren et al., 1998).

It is important to determine whether visual materials have an impact on the achievement of students in concept teaching or whether they show changes in which students and at what level. In education and training processes, this need is met by measurement and assessment. For this purpose, measurement and assessment are used to determine the in-class performance of students in education and training processes (Şata, 2016). In class measurement and assessment activities are performed to improve learning in general and to increase the quality of teaching activities. The information obtained, then, is expected to provide opportunities for the continuous development of teaching, materials, and activities. However, large-scale test applications in our country do not allow such interpretation of in-class measurement and assessment results. In our schools, exams are generally used as in-class assessment and measurement, activities with the purpose of grading students (Berberoğlu, 2010).

Besides primary and secondary education, especially in higher education, examinations performed have been seen as an important and powerful tool for evaluating the success, skills, and abilities of people of all ages (Dodeen, 2009). Therefore, the physical dimensions and appearance of the questions asked on exam papers affect the students' perceptions of what is asked of them. For example, in addition to the fact that the position of the question items on the page affects how important certain information is, visual materials such as pictures, tables, figures, and photographs in exam questions can also affect questions' understanding of students (Fisher-Hoch et al., 1997). Therefore, visual materials are included in instructional resources (for example, textbooks, worksheets prepared and distributed by the teacher, exam questions, and homework) to measure students' understanding of materials and their ability to interpret them (Crisp & Sweiry, 2006). Although there has been no research on the effect of visual materials on exam questions thus far, many studies have been conducted to determine the effect of adding pictures to instructional texts on learning. In those studies, it was found that pictures generally have a positive effect on learning and remembering, and texts are better remembered when they are supported by illustrations (Ollerenshaw et al., 1997; Weidenmann, 1989). In addition, Peeck (1993) stated that pictures can help clarify and interpret difficult texts. Among visual materials, graphics have been found to simplify complex texts and embody the abstract (Winn, 1989). These are reasons that justify adding visual materials to the exam questions.

As exams are often viewed as stressful environments for students, visual materials that attract their attention and reduce the complexity of the questions can provide an advantage, especially for lower-level students (Crisp & Sweiry, 2006). However, the main risk of adding visual materials to exam questions is that the visual materials create a mental representation that does not fit the meaning intended by the person preparing the questions. When students read the question, they develop a mental representation in response to the processed text (Pollitt & Ahmed, 1999). This representation

does not consist of real words, but instead images, concepts, emotions, and relationships between emotions, as well as ideas familiar to the student (Johnson-Lairs, 1981). For this reason, students' mental actions of the text may not be the same, and certain elements may come to the fore for each. Much of this process happens unconsciously and spontaneously. Visual materials can play an important role in the student's mental representation of the question, and the ideas conveyed by these visuals can be emphasized rather than the ideas conveyed by the text (Crisp & Sweiry, 2006). Peeck (1987) stated that students can focus a significant part of their attention on visuals instead of related text. There are many reasons for the apparent superiority of visual materials over text. First, processing visual materials require less cognitive effort. Biedermann (1981) stated that the general meaning of a visual can be grasped in a short time. The reason for this is that while the texts should be processed sequentially, elements of the visual source can be processed simultaneously (Winn, 1987). The second is that visual and textual materials can be processed in dissimilar cognitive systems. Accordingly, as a result of two representations of an object, information from visual sources would be more prominent (Schnotz, 1993). Mayer (1989) stated that binary coding of objects facilitates mental model formation because the connections between the two representations will already have been established. However, some researchers have argued that the texts presented with images are not useful because the attention is divided between two different pieces of information, and in this case, the necessity of bringing the two sets of thoughts together emerges (Sweller, 1990). In general, writing any information on top of the page makes it more important (Winn, 1987). However, there is also evidence that visual materials are read and processed before the accompanying text, regardless of their position on the page. Kennedy (1974) explained that occasionally we read a text or title before looking at the picture, but we generally notice the image first and recognize the imaged object without the help of words (Crisp & Sweiry, 2006). In this context, it has been strongly proven that the first element included in a mental model will rule and influence the elements that follow them (Gernsbacher, 1990). The reason for this is that the mental representation begins with the first item processed, and each of the subsequent information adds to the developing representation as the opportunity arises. If the effects of visual materials on mental model development are disproportionate, exam questions enriched with visual materials may negatively affect students' test anxiety (Sarason, 1988).

Anxiety is one of the unpleasant emotional experiences that everyone has at different intensities at different points of time in their life (Syokwaa et al., 2014). Anshel (1995) defined anxiety as a subjective feeling of threat that usually comes with high psychological arousal (Olatoye, 2009). Spielberger (1972) explained that anxiety is a two-component structure considered trait and state anxiety (Başpınar Can et al., 2012). According to Basavanna (2000), anxiety is a state similar to an intense fear that includes threats, restlessness, a state of nervousness, and a general feeling of anxiety, and the effects of anxiety on an individual can vary. For example, while low-to-moderate anxiety is found to be beneficial to performance, high-level anxiety is reported to be destructive because it excites the body above its normal capacity and negatively affects performance (Syokwaa et al., 2014). For many years, theories of anxiety have based this situation primarily on the results obtained from clinical staff and the opinions of researchers. The uncertainties regarding this phenomenon have directed the attention of many researchers to the causes of anxiety in public speaking and exam situations (Sridevi, 2013).

Anxiety is an emotional element of individuals, and when this emotional element manifests itself under the conditions of an exam or assessment, it is considered to test anxiety (Olatoye, 2009). According to

Spielberger and Vagg (1995), test anxiety is an emotion specific to state anxiety rather than trait anxiety. Individuals with test anxiety experience a series of physiological and behavioral symptoms that affect test performance including headache, high blood pressure, tension, anxiety, irritability, and negative thoughts (Zeidner, 1998). In this context, various definitions of test anxiety have been made. Test anxiety is an experience that occurs in the form of negative thoughts about the test result and negative evaluation of the test taker in line with other people's behaviors due to the fear of failure in the mind and behavior of the test taker (Olatoye, 2009). According to another definition, Test anxiety is "the feeling of tension and anxiety that prevents an individual from conveying what they know in an exam" (Austin et al., 1995). In addition, test anxiety is a mood that expresses the level of anxiety, fear, uncertainty, and helplessness experienced by the candidate before, during, and even after the exam (Olatoye & Afuwape, 2003). Test anxiety negatively affects the success of the individual in exams by reducing their concentration, organizing their ideas and thoughts, managing the exam time, and understanding questions and concepts (Chang, 1986). In addition, test anxiety negatively affects students' concentration, organizing their ideas and thoughts, understanding of questions, and identifying keywords (Dodeen, 2009; Mc Keachie, 1984). While a moderate level of test anxiety is necessary to motivate students to do their best, high levels of test anxiety negatively affect their performance (Dodeen, 2009). Results of other studies indicated that test anxiety is a negative effect on students' academic success (Barrows et al., 2013; Chapell et al., 2005; Sridevi, 2013).

Exams are usually implemented to measure students' knowledge of a particular topic or material. Since the major objective of exam questions is to evaluate what is learned rather than teaching, it has been stated in relevant studies that the use of visual materials in exam questions can be explained by the visual materials used in the teaching of texts (Crisp & Sweiry, 2006; Ollerenshaw et al., 1997; Peeck 1993; Weidenmann, 1989; Winn, 1989). Studies have shown that visual instructional materials have a positive effect on learning and remembering, can help clarify and interpret difficult texts, simplify complex texts, and embody the abstract. In addition, it is believed that the use of visual materials plays a motivating role in teaching texts (Peeck, 1993), and this motivating role may also apply to exam questions. From this point of view, the use of clear visual materials instead of a textual explanation can shorten the exam questions and help students understand questions containing abstract concepts (Crisp & Sweiry, 2006). In addition, visual materials such as pictures, tables, figures, and photographs included in the exam questions can affect students' understanding of the questions, their responses to the questions (Fisher-Hoch et al., 1997), their anxiety levels toward the exam, and their academic success (Sarason, 1988). In this context, the problem of this study is to determine how the scores obtained from the exam questions enriched with visual materials and questions without visual materials and test anxiety change according to the gender of the students and the number of exams. Therefore, the objective of this study is to investigate whether there is a statistically significant difference between the scores of the exam questions enriched with visual materials and without visual materials in middle school students. In addition, it is to investigate whether students' scores from exam questions enriched with visual materials and without visual materials and test anxiety scores make a difference according to gender. Accordingly, answers are sought for the following questions in this study.

**1)** Is there a significant difference between the scores of the students in the exam questions with visual materials and without visual materials?

**2)** Do students' scores on the exam questions with visual materials and without visual materials differ according to gender?

**3)** Do students' test anxiety scores differ according to gender?

## Method

### Research design

This study was conducted according to the single-group pretest-posttest model, which is one of the experimental methods. An experimental design has many different implementations. One of these, which is the single-group pretest-posttest experimental design used in this study, is applied to a group with an independent variable, and a pre-experimental and post-experimental measurement is performed (Gay & Airasian, 2000). Creswell (2012) stated it is the nature of the research to prefer the single-group experimental design in studies where a new training module is developed and applied.

### Research sample

The sample of this study was 28 middle school students (20 males, 71.4%, and 8 females, 46.3%) who take science lessons. Their ages ranged from 14 to 16 years, with a mean age of 15 years. The sample of the study was selected using the convenient sampling method. The selection of this sampling method was based on time, economy, and reducing the loss of labor (Büyüköztürk et al., 2011). These students were administered the AT and TAS.

### Research instruments and procedures

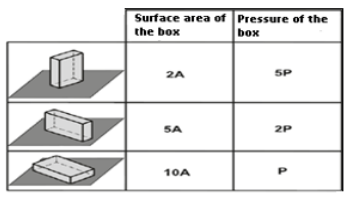
### Achievement Test (AT)

In this study, prior to the preparation of exam achievement tests, units related to learning areas and learning outcomes were determined (Table 1). Three different AT were prepared, consisting of questions that were enriched with visual materials and that did not contain visual materials in accordance with the units and outcomes related to the learning areas. These are: "Cell Division and Genetics AT-I" for the first exam, “Force and Motion AT-II” for the second exam, and “Structure and Properties of Matter AT-III” for the third exam. Each AT prepared accordingly contains 20 questions (10 of which are enriched with visual materials, and 10 of which do not include visual materials. Achievement test questions were selected from the questions prepared by the Ministry of National Education, whose reliability and validity were determined. Two sample questions were given in figure 1.

**Figure 1**

*Exam Question Enriched with Visual Materials (Q-1) and Exam Question without Visual Material (Q-2)*

**Question-1:** Placing a rectangular prism-shaped box on three different surfaces, Pınar calculates the pressure values of this box on the ground.




Recording the values obtained in the table below, Pınar can reach which of the following comments using this table?

**A)** As the force acting on the ground increases, the pressure decreases.
**B)** When the force acting on the ground decreases, the pressure increases.
**C)** As the base area of the object increases, the pressure decreases.
**D)** As the base area of the object decreases, the pressure also decreases.

**Question-2:** The atmospheric pressure (**P**) is measured with a barometer. Which of the following processes does not change the liquid height (**h**) in the glass pipe?

**A)** Experiment, done at different heights.
**B)** Experiment with different types of liquids.
**C)** Experiment by putting more of the same type of liquid in the container.
**D)** Experiment with the same type of liquid at different temperatures.

**Test Anxiety Scale (TAS)**

The Test Anxiety Scale (4-point Likert) revised by Benson and El-Zahhar (1994) and translated into Turkish by Akın, Demirci, and Arslan (2012) was used to define the test anxiety levels of students. The TAS is a 20-item, four-point Likert rating scale, ranging from 1 (almost never) to 4 (almost always). The TAS includes 20 items and the reliability coefficient of the scale was .89, while it was calculated to be .88 for the middle school students in our study.

Prior to data collection, first, the Cell Division and Genetics unit was taught. At the end of the unit, the TAS was implemented as a pre-test to determine the test anxiety levels of students. After the unit was taught, AT-I for the first exam and the first TAS-I were applied to the students. After teaching the Force and Motion unit, AT-II for the second exam and the second TAS-II were implemented. Then, following the teaching of the Structure and Properties of Matter unit, AT-III for the third exam and the third TAS-III were implemented. Students were given approximately one lesson hour (40 minutes) to respond to each AT and TAS. The data collection process continued for one semester. Learning areas, data collection tools, and processes are given in Table 1.

**Table 1**

*Learning Areas, Data Collection Tools and Process*

| Month | Week | Hour | Learning Area | Units | Method | Measurement and Assessment |
|---|---|---|---|---|---|---|
| Sept-Nov | Week 1–7 | 28 | Living creatures and Life | Unit 1: Cell Division and Genetics | 5E | Pre-TAS<br>AT-I<br>TAS-I |
| Nov - Dec | Week 8–12 | 20 | Physical Phenomenon | Unit 2: Force and Motion | 5E | AT-II<br>TAS-II |
| Dec - Feb | Week 13–21 | 36 | Matter and change | Unit 3: Structure and Properties of Matter | 5E | AT-III<br>TAS-III |

TAS: Test Anxiety Scale

**Data analysis**

Whether the data met the normality assumptions were calculated using the Kolmogorov-Smirnow significance test and kurtosis-skewness values. According to these calculations, the Kolmogorov-Smirnow significance test is significant at the p< 0.01 level. Since the kurtosis-skewness values are between -1.5 and 1.5, the data are considered to have a normal distribution (Tabachnick & Fidell, 2013). In testing the research problems, the "t-Test" was used for dependent samples as the data showed normal distribution.

## Findings

This study was conducted to determine whether there is a statistically significant difference between the scores obtained by middle school students in the exam questions that were enriched with visual materials and that did not include visual materials. Another purpose was to determine if the scores achieved on the exam questions with and without visual materials and whether the test anxiety scores show any difference by gender. The collected data was analyzed and interpreted in line with the research questions. The t-Test analysis was completed to determine whether there was a significant difference between the mean scores of the students in the exam questions enriched with visual materials and those that did not include visual materials, and the results are presented in Table 2.

**Table 2**

*The t-Test Results on the Mean Scores Obtained by the Students in the Exam Questions Enriched with Visual Materials and Without Visual Materials*

| Exams | Question type | $\bar{X}$ | N | SD | df | t | p |
|---|---|---|---|---|---|---|---|
| AT-I | VM | 29. 82 | 28 | 9. 86 | 27 | 1.89 | .07 |
| | wVM | 25. 89 | 28 | 8. 72 | | | |
| AT-II | VM | 21. 96 | 28 | 10. 83 | 27 | -.26 | .79 |
| | wVM | 22. 68 | 28 | 12. 21 | | | |
| AT-III | VM | 27. 86 | 28 | 11. 09 | 27 | .87 | .39 |
| | wVM | 26. 07 | 28 | 8. 09 | | | |

Visuals Material: Questions including VM, without Visuals Material: Questions including wVM

As shown in Table 2, there was not a statistically significant difference between the mean scores obtained by students in the exam questions with and without visual materials in AT-I, II, and III ($p$>.05). However, in general, the mean scores of the exam questions enriched with visual materials (26.54) were higher than the mean scores of the exam questions (24.88) without visual materials. These results may indicate that adding visual materials to the exam questions causes an increase in the success of the

students in the exam. The t-test was completed to determine if the difference between the scores obtained in the exam questions with and without visual materials was significant and the results are presented in Table 3.

**Table 3**

*The t-Test Results of the Mean Scores Obtained by in Exam Questions with and Without Visual Materials by Gender*

| Exams | Question Type | Gender | $\bar{X}$ | N | SD | df | t | p |
|---|---|---|---|---|---|---|---|---|
| AT-I | VM | Male | 28.0 | 20 | 10.69 | 26 | -1.59 | 0.12 |
| | | Female | 34.4 | 8 | 5.63 | | | |
| | wVM | Male | 25.7 | 20 | 8.78 | 26 | -0.13 | 0.89 |
| | | Female | 26.2 | 8 | 9.16 | | | |
| AT-II | VM | Male | 20.5 | 20 | 10.99 | 26 | -1.14 | 0.27 |
| | | Female | 25.6 | 8 | 10.16 | | | |
| | wVM | Male | 23.7 | 20 | 13.17 | 26 | 0.73 | 0.47 |
| | | Female | 20.0 | 8 | 9.64 | | | |
| AT-III | VM | Male | 26.2 | 20 | 11.68 | 26 | -1.22 | 0.23 |
| | | Female | 31.9 | 8 | 8.84 | | | |
| | wVM | Male | 25.7 | 20 | 8.63 | 26 | -0.33 | 0.75 |
| | | Female | 26.9 | 8 | 7.04 | | | |

$p<.01$**; $p<.05$*

As shown in Table 3, there was not a significant difference between the mean scores of the students in the exam questions with and without visual materials by gender ($p>.05$). However, female students' scores in exam questions enriched with visual materials are higher than male students. In addition, male students' scores in exam questions that do not include visual material (AT-I, II, and III: 75.1) are higher than female students (AT-I, II, and III: 73.1). The t-Test was completed to define whether the difference between the test anxiety mean scores of the students by gender was significant, and the conclusions are given in Table 4.

**Table 4**

*The t-Test Results of the Mean Scores Obtained by Students in Test Anxiety Scale by Gender*

| Test Anxiety | Gender | $\bar{X}$ | N | SD | df | t | p |
|---|---|---|---|---|---|---|---|
| Pre-TA | Male | 58.05 | 20 | 12.66 | 26 | -.01 | .98 |
| | Female | 58.13 | 8 | 7.99 | | | |
| TA-I | Male | 57.20 | 20 | 12.39 | 26 | .04 | .96 |
| | Female | 57.00 | 8 | 10.15 | | | |
| TA-II | Male | 57.75 | 20 | 14.34 | 26 | -.39 | .69 |
| | Female | 59.88 | 8 | 8.18 | | | |
| TA-III | Male | 63.40 | 20 | 9.29 | 26 | 1.09 | .28 |
| | Female | 59.00 | 8 | 10.28 | | | |

$p<.01$**; $p<.05$*, TA: Test Anxiety

As shown in Table 4, there was not a significant difference between the mean scores of testanxiety by gender ($p>.05$). However, while the mean anxiety scores of female and male students before and after the first exam do not change, after the second exam, the test anxiety mean scores of female students (59.88) increased in comparison to male students (57.75); and after the third exam, the mean scores of test anxiety of male students (63.40) increased compared to the female students (59.00).

## Discussion

In this study, it was investigated whether there is a statistically significant difference between the scores of secondary school students from multiple choice exam questions enriched with visual materials and without visual materials. In addition, it was investigated whether the scores obtained by the students from the exam questions enriched with visual materials and without visual materials and whether their test anxiety scores make a significant difference according to gender. The data taken from the sample were analyzed and interpreted according to the following research questions.

The first finding of the study showed that there was no statistically significant difference between the scores of middle school students in the exam questions enriched with visual materials and those without visual materials ($p>.05$). However, in general, the mean scores obtained in the exam questions enriched with visual materials (26.54) were higher than the mean scores obtained in the questions without visual materials (24.88). This finding shows that adding visual materials to exam questions increases the academic achievement of students at a certain level. Studies have shown that visual materials have a positive effect on learning, understanding, and remembering (Fisher-Hoch et al., 1997; Ollerenshaw et al., 1997; Weidenmann, 1989). According to the results of these studies, when the textual expressions in the exam questions are supported by visual resources such as pictures, tables, figures, and photographs,

it is easier for students to understand and remember the questions. Additionally, the findings obtained are in line with the findings of studies showing that teaching with visual tools has a significant effect on students' academic achievement (Begoray, 2001; Stokes, 2002).

The second finding of the study showed that there was no statistically significant difference between the mean scores of the students in the exam questions enriched with visual materials and questions without visual materials by gender ($p$>.05). However, in general, it was observed that female students were more successful in exam questions enriched with visual materials (30.6) than male students (24.9). In addition, it was observed that male students were more successful in exam questions (25.03) that did not include visual materials than female students (24.36). Karaca (2013) stated that the effects of the use of visual materials in teaching physics on student achievement do not differ by gender.

The third finding of the study showed that there was no statistically significant difference between the test anxiety mean scores of the students by their gender ($p$>.05). However, after the second exam, the mean scores of test anxiety of female students (59.88) increased compared to male students (57.75), and after the third exam, the male students' mean scores of test anxiety (63.40) were higher than that of the female students (59.00). When the literature is examined, there are various studies showing that there is no significant difference in general between the gender of students and their test anxiety (Muola et al., 2009; Nadeem et al., 2012). However, it was observed that as the number of exams students take increased, their test anxiety scores increased (TA-I: 57.14; TA-II: 58.35; TA-III: 62.14) and their exam achievement scores decreased (AT-I: 55.71; AT-II: 44.64; AT-III: 53.93). There are studies showing a negative relationship between anxiety and academic achievement (Adigwe, 1997; Faroooqi et al., 2012; Nadeem et al., 2012; Syokwaa et al., 2014; Tomljenove & Nikcevic-Milkovic, 2005). The results of these studies support the findings of the current study.

As a result, it was seen that students were more successful in multiple-choice exam questions enriched with visual materials, female students were more successful in exam questions enriched with visual materials, and male students were more successful in exam questions that did not contain visual materials. Additionally, the anxiety scores of female and male students in exams show differences, and as the number of exams increased, their anxiety scores increased while their exam achievement decreased. Similar studies can be done by increasing the number of samples. In addition, it is recommended to practice at different grade levels.

## References

Adigwe, J. C. (1997). Ethnicity, test anxiety and science achievement of Nigerian students. *International Journal of Science Education, 9*(7), 772-780. Erişim Adresi: https://doi.org/10.1080/0950069970190703

Akın, A., Demirci, İ., & Arslan, S. (2012). Revised test anxiety scale: The validity and reliability study. *Educational Sciences and Practice, 11*(21), 103-118. http://www.ebuline.com/pdfs/21sayi/ebu21_6.pdf

Ametller, J., & Pinto, R. (2002). Students' reading of innovative images of energy a secondary school level. *International Journal of Science Education, 24*, 285-312. https://doi.org/10.1080/09500690110078914

Anshel, M. H. (1995). *Psychology from theory to practice*. Arizona: Gorsugh Scanbrick.

Austin, J. S., Partridge, E., Bitner, J., & Wadlington, E. (1995). Prevent school failure: Treat test anxiety. *Preventing School Failure, 40*(1), 10-13. https://doi.org/10.1080/1045988X.1995.9944644

Barrows. J., Dunn, S., & Lloyd, C. A. (2013). Anxiety, self-efficacy, and college exam grade. *Universal Journal of Education Research, 1*(3), 204-208. DOI: 10.13189/ujer.2013.010310

Basavanna, M. (2000). *Dictionary of psychology*. New Delhi: Allied publishers (P) Ltd.

Başpınar Can, P., Dereboy, Ç., & Eskin, M. (2012). Comparison of the effectiveness of cognitive restructuring and systematic desensitization in reducing high-stakes test anxiety. *Turkish Journal of Psychiatry, 23*(1), 9-17. https://www.researchgate.net/publication/221870598

Begoray, D. (2001). Through a class darkly: visual literacy in the classroom. *Canadian Journal of Education, 26*(2) 201-217. https://doi.org/10.2307/1602201

Benson, J. & El-Zahhar, N. (1994). Further refinement and validation of the revised test anxiety scale. *Structural Equation Modelling, 1*(3), 203-221. https://doi.org/10.1080/10705519409539975

Berberoğlu, G. (2010). Dimensions reflected in practice of measurement and evaluation. *Cito Education: Theory and Practice, 10*, 10-14. http://www.ogretmen.info/makale/32.pdf

Biedermann, I. (1981). On the semantics of a glance at a scene. M. Kubovy & J. R. Pomerantz (Eds.), *Perceptual organization* (pp, 213-253). Hillsdale, NJ: Erlbaum.

Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2011). *Scientific research methods.* Ankara: Pegem-A Publishing.

Chang, M. (1986). Text anxiety and academic achievement. *Paper presented at the Second Regional Conference on University Teaching*, Las Cruces, NM.

Chapell, M. S., Blanding, Z. B., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. *Journal of Educational Psychology, 97*(2), 268-274. https://doi.org/10.1037/0022-0663.97.2.268

Cook, M. P. (2006). Visual representations in science education: the influence of prior knowledge and cognitive load theory on instructional design principles. *Science Education, 90*, 1073-1091. http://dx.doi.org/10.1002/sce.20164

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five approaches* (Third edition). Los Angeles: Sage Publications.

Crisp, V., & Sweiry, E. (2006). Can a picture ruin a thousand words? The effects of visual resources in exam questions. *Educational Research, 48*(2), 139-154. https://doi.org/10.1080/00131880600732249

Çilenti, K. (1992). *Educational technology and teaching*. Ankara: Kadıoğlu Printing House.

Dodeen, H. (2009). Test-related characteristics of oUAEU students: Test-anxiety, test-taking skills, guessing, attitudes toward tests, and cheating. *Journal of Faculty of Education, 26*, 31-66.

https://www.researchgate.net/publication/241590301

Erden, O. (2012). The effect of computer aided visual teaching materials on learning. *Journal of the Faculty of Commerce and Tourism Education, 2*, 102-111. https://pdfhoney.com/pdf-to-docx.html

Farooqi, Y. N., Ghani, R., & Spielberger, C. D. (2012). Gender differences in test anxiety and academic performance of medical students. *International Journal of Psychology and Behavioural Sciences, 2*(2), 38-43. http://dx.doi.org/10.5923/j.ijpbs.20120202.06

Ferk, V., Vrtacnik, M., Blejec, A., & Gril, A. (2003). Students' understanding of molecular structure representations. *International Journal of Science Education, 25*(10), 1227-1245.

https://doi.org/10.1080/0950069022000038231

Fisher-Hoch, H., Hughes, S., & Bramley, T. (1997). What makes GCSE examination questions difficult? Outcomes of manipulating difficulty of GCSE questions: *a paper presented at the British Educational Research Association Annual Conference,* University of Cambridge Local Examinations Syndicate, Cambridge.

Gay, L. R., & Airasian, P. (2000). *Educational research: Competencies for analysis and experience.* (10th edition). United States of America: Edwards Brothers.

Genty, C. G. (1994). *Introduction to instructional development: Process and technigue*. Belmont California: Wadsworth Puplishinch Company.

Gernsbacher, M. A. (1990). *Language comprehension as structure building*. (1st edition). New York: Psychology Press.

Johnson-Laird, P. (1981). Mental models of meaning. A. K. Joshi, B. L. Webber, & I. A. Sag (Eds), *Elements of discourse understanding* (pp. 106-126). Cambridge: Cambridge University Press.

Karaca, K. (2013). *Examination of the contribution of using visual materials on physics education* (Masters Thesis). Accessed from YÖK Thesis Center database (Thesis No: 333516).

Kennedy, J. M. (1974). *Psychology of picture perception.* Oxford, England: Jossey-Bass.

Kozma, R. (2003). The material features of multiple representations and their cognitive and social affordances for science understanding. *Learning and Instruction, 13*(2), 205-226. DOI:10.1016/S0959-4752(02)00021-X

Kozma, R. & Russell, J. (1997). Multimedia and understanding: Expert and novice responses to different representations of chemical phenomena. *Journal of Researchin Science Teaching, 34*(9), 949-968.

https://doi.org/10.1002/(SICI)1098-2736(199711)34:9<949::AID-TEA7>3.0.CO;2-U

Mamur Yılmaz, E. (2014). *Teaching material design processes of visual arts teacher candidates for teaching artistic arrangement principles to primary school students.* Accessed from YÖK Thesis Center database (Thesis No: 354650).

Mathewson, J. H. (1999). Visual-spatial thinking: An aspect of science overlooked by educators. *Science Education, 83*(1), 33-54. https://doi.org/10.1002/(SICI)1098-237X(199901)83:1<33::AID-SCE2>3.0.CO;2-Z

Mayer, R. E. (1989). Systematic thinking fostered by illustrations in scientific text. *Journal of Educational Psychology, 81*(2), 240–246. https://doi.org/10.1037/0022-0663.81.2.240

McKeachie, W. J. (1984). Does anxiety disrupt information processing or does poor information processing lead to anxiety? *International Review of Applied Psychology, 33*(2), 187-203. DOI:10.1111/j.1464-0597.1984.tb01428.x

Nadeem, M., Ali, A., Maqbool, S., & Zaidi, S.U. (2012). Impact of anxiety on the academic achievement of students having different mental abilities at university level in bahawalpur (southern punjab) Pakistan. *International Online Journal of Educational Sciences, 4*(3), 519-528.

https://www.acarindex.com/dosyalar/makale/acarindex-1423904276.pdf

Ndirangu, W.G., Muola, J. M., Kithuka, M. R., & Nassiuma, D. K. (2009). An relationship between test anxiety and academic performance in secondary schools in Nyeri district, Kenya. *Global Journal of Educational Research, 8*(1-2), 1-7. DOI: 10.4314/gjedr.v8i1-2.53761

Olatoye, R. A. (2009). Students' test anxiety, motivation for examinations and science achievement in junior secondary schools in Ogun State, Nigeria. *International Journal of Psychology and Counselling, 1*(10), 194-198. https://www.academicjournals.org/app/webroot/article/article1380358855_Olatoye%20Pdf.pdf

Olatoye, R. A., & Afuwape, M. O. (2003). Test anxiety as a determinant of examination misdemeanor among some Nigerian Secondary School Students. *Ibadan Journal Education Study, 3*(182), 32-39.

Ollerenshaw, A., Aidman, E., & Kidd, G. (1997). Is an illustration always worth ten thousand words? Effects of prior knowledge, learning style and multimedia illustrations on text comprehension. *International Journal of Instructional Media, 24*(3), 227-238.

Peeck, J. (1987). The role of illustrations in processing and remembering illustrated text. D. M. Willows & H. A. Houghton (Eds.), *The psychology of illustration,* Vol. 1: Basic research. New York: Springer-Verlag.

Peeck, J. (1993). Increasing picture effects in learning from illustrated text. *Learning and Instruction, 3*(3), 227-238. https://doi.org/10.1016/0959-4752(93)90006-L

Pollitt, A., & Ahmed, A. (1999). A new model of the question answering process. *Paper presented at the International Association for Educational Assessment Annual Conference,* University of Cambridge Local Examinations Syndicate, Cambridge.

Sarason, I. G. (1988). Anxiety, self-preoccupation and attention. *Anxiety Research, 1*, 3-8. https://doi.org/10.1080/10615808808248215

Schnotz, W. (1993). Some remarks on the commentary on the relation of dual coding and mental models in graphic comprehension. *Learning and Instruction, 3*(3), 247-249. https://doi.org/10.1016/0959-4752(93)90008-N

Slough, S., & McTigue, E. (2010). Introduction to the integration of verbal and visual information in science texts. *Read Psychology, 31*(3), 206-212. https://doi.org/10.1080/02702710903241397

Spielberger, C. D., & Vagg, P. R. (1995). Test anxiety: A transactional process model. C. D. Spielberger & P. R. Vagg (Eds.), *Series in clinical and community psychology. Test anxiety: Theory, assessment, and treatment* (pp. 3-14). Philadelphia, PA, US: Taylor & Francis.

Spielberger, C. D. (1972). Anxiety as an emotional state. C. D. Spielberger (Eds.), Anxiety: *Current Trends in Theory and Research Vol. 1* (pp. 23-49). New York: Academic Press.

Sridevi, K. V. (2013). A study of relationship among general anxiety, test anxiety and academic achievement of higher secondary students. *Journal of Education and Practice, 4*(1), 122-130. https://core.ac.uk/download/pdf/234633887.pdf

Stokes, S. (2002). Visual literacy in teaching and learning: A literature perspective. *Electronic Journal For the Integration of Tecnology in Education, 1*(1), 10-19. https://wcpss.pbworks.com/f/Visual+Literacy.pdf

Sweller, J. (1990). Cognitive processes and instructional procedures. *Australian Journal of Education, 34*(2), 125–130. https://doi.org/10.1177/000494419003400202

Syokwaa, K. A., Aloka, P. J. O., & Ndunge, N. F. (2014). The relationship between anxiety levels and academic achievement among students in selected secondary schools in lang'ata district, Kenya. *Journal of Educational and Social Research, 4*(3), 403-413. DOI: 10.5901/jesr.2014.v4n3p403

Şata, M. (2016). An overview of classroom and large-scale measurement and evaluation in the Turkish education system. *Current Research Education, 2*(1), 53-60. f https://C:/Users/%C4%B0Kurbano%C4%9Flu/Downloads/Turk_Egitim_Sistemi_nde_Sinif_Ici_ile_Ge.pdf

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. Boston, Pearson.

Tomljenovc, Z., & Nikcevic-Milkovic, A. (2005). Self respect, test anxiety and school achievement of elementary school pupils. *Contemporary Psychology, 8*(1), 61-62. https://hrcak.srce.hr/3256

Van Sommeren, M., Reimann, P., Boshuizen, H., & Jong, T. D. (Eds.) (1998). *Learning with Multiple Representations.* Amsterdam: Permagon.

Weidenmann, B. (1989). When good pictures fail: an information-processing approach to the effect of illustrations. H. Mandl & J. R. Levin (Eds.), *Knowledge acquisition from text and pictures: Advances in Psychology* (pp. 58). Amsterdam: Elsevier.

Winn, W. (1987). Charts, graphs, and diagrams in educational materials. D. M. Willows & H. A. Houghton (Eds.), *The psychology of illustration Vol. 1: Basic research* (pp. 152-198). New York: SpringerVerlag.

Winn, W. (1989). The design and use of instructional graphics. H. Mandl & J. R. Levin (Eds.). *Knowledge acquisition from text and pictures: Advances in Psychology* (pp. 58). Amsterdam: Elsevier.

Zeidner, M. (1998). *Test anxiety: The state of the art.* New York: Springer.