

The effect of photograph-assisted training in technical drawing lessons at technical high schools

Aslı Dogan¹, ITU Vocational and Technical Anatolian High School, 34349, Besiktas, Istanbul, Turkey.

Huseyin Uzunboylu, Near East University, Lefkosa, North Cyprus, Via: Mersin -10, Turkey. 

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Abstract

There are flawless designs to produce materials used in rapidly developing technology continuously. The drawings of designs are made on paper down to the latest detail and are mostly taught to students at schools. These lessons aim to improve students' three-dimensional thinking abilities. In this study, the topic of perspective and projection in technical drawing lessons that students struggled with is handled. The study aims to show the difference in final achievement between the usage of photograph-assisted training and direct instruction technique in teaching the topic of perspective and projection. The technique of direct instruction is applied to some students at industrial technical school, while photography-assisted training is applied to other students at Anatolian technical high school. According to the exam results at the end of 7 weeks, it is found that the technique of photography-assisted training is very effective in improving perspective and projection technical drawing ability. The usage of this technique by teachers will bring success to technical high school students.

Keywords: High schools; photograph-assisted training; technical drawing.

* ADDRESS FOR CORRESPONDENCE: Aslı Dogan, ITU Vocational and Technical Anatolian High School, 34349, Besiktas, Istanbul, Turkey. E-mail address: aslidogan1007@gmail.com

1. Introduction

Technical drawing is the main lesson in which students at technical high schools have difficulties. This may cause incomprehensibility on the subject of students' understanding of this lesson and connecting topics since it should use the ability of three-dimensional thinking in the mechanical drawing course. It can be said that the usage of photographs among visual materials minimizes this incomprehensibility and improves students' ability to understand and ease the process of learning. Students may have difficulties in concretizing three-dimensional objects, parts to be drawn technically by verbally transmitting the information. In the technical drawing lesson, most of the topics may necessitate the ability of three-dimensional thinking and when trying to deliver just verbally, there may be sufficient understanding. To visualize technical machines, the parts to be technically drawn in which students lack verbal knowledge may be very hard. Teaching topics concretely may facilitate learning in terms of keeping the information in mind (Schmitt, Souidi, Duquesnoy & Donzé, 2023). According to Bloom's taxonomy, the more different sense organs are addressed, the more knowledge will be permanent (Zorluoglu, Kizilaslan & Donmez Yapucuoglu, 2020).

The visual and auditory materials used in teaching may provide faster and more permanent learning (Quintero, Awad & Barazzetti, 2020; Wongvibulsin & Feterik, 2022). The methods and techniques used in teaching are very important in terms of information processing (Bettaieb, Alawad & Malek, 2022). Thus, the selection of method, technique, and strategy is significant in many fields (El-Adl & Alkharusi, 2020; Milkias, 2020; Tavani et al., 2022). Uzunboylu & Kosucu (2020) analyzing the studies of teaching systems emphasize that the effect of visuals is important while preparing teaching materials. Research studies show that visuals among other sense organs play an important role (Kasimatis & Papageorgiou, 2019).

The sense organs, such as the eye and ear, do not have the same impact on learning. The most effective one among sense organs is the eye. The stimulus addressing the eye is more powerful than the others. It is easy to store those visual stimuli in mind and remember them when necessary (Binbasioglu, 1995; Nasim, 2011; Markiewicz, 2022). According to the research findings of the contribution of visuals in learning by Wittrock, visuals ease remembering and learning. The usage of photographs makes it easier to remember topics because this provides verbal statements to be stored more easily (Cilenti, 1979).

Technical high school students have problems comprehending concepts about perspective and projection and transferring to drawings in the technical drawing lesson. Some students may have recourse to rote learning without understanding perspective and projection properly (Akkus et al., 2007). The technical drawing lesson has more topics and applicable information requiring essential capabilities for topics to be understood when compared with other lessons. It is not adequate to apply techniques and define them. The photograph used in technical drawing lessons improves students' three-dimensional ability. The reason for having problems in technical drawing lessons is teaching theoretical knowledge in the syllabus by writing on the board. The traditional lecture method is based on information transfer. The multifaceted information transferring and getting is on the front burner on the base of modern programs.

The drawing of technical parts that students have never seen on the perspective and projection topics in technical drawing lessons is in demand. Students are asked to transfer these parts given two-dimensionally by different views of thinking, the front, side, and out of the mind, according to the technical drawing rules. Students try to draw without understanding the information in the lesson. However, the right drawing is not done because of no exact information processing in students' minds. As a natural consequence of this, students think 'I cannot be successful however I study.' by believing that technical lessons are hard and boring. However, the technical drawing lessons ease students' perception of figures three-dimensionally and drawing. Because students can draw perspective and projection topics, they will love the technical drawing lesson (Begoray, 2001).

According to Edward Dale's cone of experience, a student remembers 10% of what is read, 20% of what is heard, 30% of what is seen, 50% of what is seen with hearing, 80% of what he/she says, 90% of what he/she says with behaviors (Demirel, 2000). The teacher saves students from passive situations by using photographs related to the lesson for effective learning. By this technique, it is provided to understand given figures and transfer them to drawing easily (Bumen, 2004).

Studies show that there has been an attempt to try to connect visual perception with a thought of unity again. The technique of seeing in education and other aims addressed to show that the cognition in the field of art is in solidarity (Arnheim, 2012; Ilhan, 2019). Today, it is said that art is not something consisting of just artworks, artworks are theorems, and the success of students and teachers is up to the training in improving visual perception (Arnheim, 2012). Education with the diversity of art in training leads the students to see rather than just look at the topic, to communicate with their environment constantly and leads us to search for the effect of visual perception on students' learning (Yilmaz, 2010).

1.1. Related research

In Callow's search, whether the pictures in the visual materials given to the students have an impact on students' comprehension topics in classrooms where the achievement of visual literacy is aimed is investigated. At the end of the study with visual materials, the level of students' recollection and use of the target knowledge were tried to be measured by testing photographs, images, figures, and graphs in materials. Exam results show that there has been an improvement in students' comprehension of photographs, figures, graphs, and images they see, the ability to make the connection between these figures, and writing and analyzing figures according to the given writing with the help of training with visual materials. It is tried to seek an answer to the importance of using visual materials and visual literacy in education and to the questions of what students need to use these materials (Callow, 2008).

In the study of 'Instructional Designer's Intentions and Learners—Perceptions of the Instructional Functions of Visuals in a Learning Content, Inha University', the visual materials and students' perceptions are searched. At the end of the study, students' perception increased due to the visual materials (Jin & Boling, 2010). When the concept of visual perception is analyzed, it has been accepted that the ability of visual perception can be developed via education. It has been stated that learners can think innovatively by comprehending images, such as photographs, images, and graphs easily by getting out of stereotypes in their minds.

1.2. Purpose of the study

This study aims to determine the effect of technical high school students' usage of photographs on technical drawing lessons. When this aim is taken into consideration, it is tried to seek an answer to the problems below:

- 1) Is there any learning level difference between the Anatolian technical and Industrial technical high school students?
- 2) What are the learning differences between the direct instruction technique and the photographing technique in the technical drawing lesson?
- 3) What is the effect of photograph usage in teaching perspective and projection on students' success?

2. Materials and method

In this section, the research model, population and sample, data collection tool, data collection (application), data analysis, and the applied statistical method of analysis are discussed.

2.1. Research models

This research model was carried out with the pretest–post-test control group model of the experimental pattern, and a *t*-test was used to analyze the data. The research was conducted with

the 10th-grade Anatolian and Industrial technical students at Sisli Technical High School in Istanbul. One of the groups was selected as an experimental group, while the other was selected as a control group. In the technical drawing lesson, the topic of perspective and projection was taught by using direct instruction techniques with the experimental group with the help of the coursebook, with the control group, the topic was taught by showing photographs about perspective and projection. This application is in harmony with the MEB (Ministry of National Education) curriculum and consists of seven weeks, and fourteen hours in total were done to each group. The researcher tries to carry out his/her studies in an artificial environment (controllable) and to determine the variant effects what and at what rate, and how it changes under which circumstance (Karim & Gide, 2019; Ozcan & Merdan, 2020).

2.2. Participants

This experimental research was conducted with the 10th-grade Anatolian and technical students of the Department of Electric and Electronics at Sisli Technical Anatolian High School in Istanbul. The application was planned with two different student groups from different school types. The first group was of 16 students of Sisli Anatolian Technical High School, while the second group was of 17 students of Sisli Industrial Technical High School.

2.3. Procedure

After 7 weeks of the application process, the differences and the similarities between the two student groups are mentioned.

2.3.1. The pre-test application of the first and the second group students

The pre-test and post-test model was applied to the experimental and control groups. Because there had been no improvements and changes, the pre-test was applied to both groups on different days in the same week. There were 10 questions about technical knowledge, 10 questions about the ability of visual thinking, and 10 questions about the ability to think three-dimensionally. When the pre-test process was analyzed, it was found that there were not any learning differences, and the school types did not affect the basic knowledge levels of students of each group.

2.3.2. The process of application for the first type of school for 7 weeks

The topic of perspective and projection in the technical drawing lesson was explained to the Anatolian technical students by using direct instruction techniques. The topic was told on the board in the classroom, and the drawing papers handed out at the end of each lesson were used as an application for students.

The topic was told on the board in the first hour each week, the teacher made drawings by using rulers, compasses, and templates, and the students were asked to draw what the teacher determined on drawing papers in the second hour.

In the first week, the projection topic in the curriculum was explained by using a direct instruction method on the whiteboard in the classroom. In the following weeks, the perspective topic, the points to be careful while drawing, drawing techniques, and the application methods were instructed by using the direct instruction method, students were asked to draw the pattern which students selected or which is seen on two-dimensional papers, and the drawings were collected and evaluated by the teacher at the end of the lesson.

2.3.3. The process of application of the second type of school

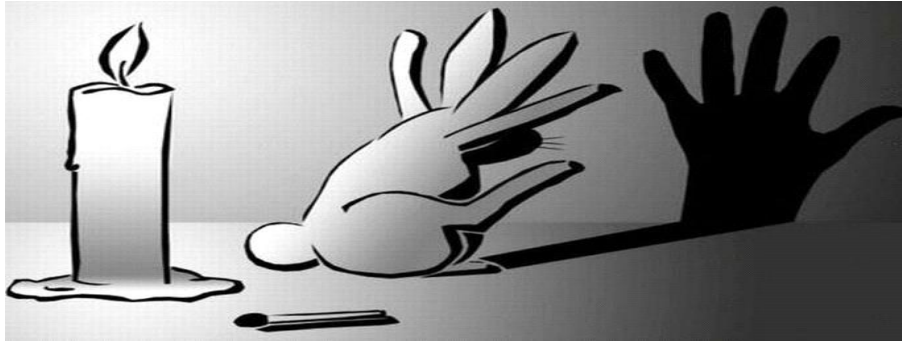
The perspective and projection topic in the technical drawing was instructed to Industrial technical high-school students by using the photographing technique. During the process, the topics were selected and brought to the classroom by teachers, and photographs related to the syllabus and curriculum were used. The photographs brought to the class were uploaded to a Luggable computer at the school and then reflected on the board via projection. The teacher discussed what the

photographs showed, and made changes in students' inner world with students in a chat mood during the lesson. In the second lesson, the technical parts related to the topic to be taught weekly were drawn on the papers.

For the first week, the projection topic was taught with the reflections of hands on the wall by placing them in front of a light source. The necessary elements to form projections and views by using shadows and the places, and their length was explained via photographs. The objects placed between the candle as the light source and the wall were shown in Figures 1 and 2. It says that the length of the objects on the wall increases when they come closer to the light source.

Figure 1

The shadow on the wall



Source: <http://tr.depositphotos.com>

Figure 2

The shadow on the wall.



Source: <http://tr.depositphotos.com>

The photographs used in teaching the topic of perspective and projection are shown in Figures 3 and 4.

Figure 3

The photograph tells the distance of the light source from the object changes the length of the wall



Source: Asli Dogan

Figure 4

The photograph tells that when an object has put in front of the light source, it is seen as a silhouette



Source: Asli Dogan

In other weeks, the topic of perspective was explained in terms of the points to be careful while drawing, the drawing techniques, and the application methods by using the photographic technique. In the first lesson, the perspective was told by the photographs on two-dimensional papers, in the second lesson, students were supposed to draw the figures on the papers that the teacher selected, and the drawing was collected and evaluated at the end of the lesson.

From Figure 5, it is shown that if the incidence angle of the rays from the light source increases, the size of the projection on the plane decreases.

Figure 5

The photograph showing the incidence angle of the rays extends the length of the projection



Source: Asli Dogan

From Figure 6, it is shown that if the light source is placed in front of the objects, there will be no projection in the plane.

Figure 6

The photograph in which the light source is in front of the object



Source: Asli Dogan

2.3.5. The post-test application of the first and the second group students

When the results of the post-test application of the first group of students of the Anatolian technical school were taken into consideration, at the end of the 7 weeks of training with direct instruction technique, the success of students increased just a little. When the student's test results are analyzed one by one, it has been found that the application of perspective drawing, and seeing technical parts in mind in different perspectives by three-dimensional thinking has not improved sufficiently.

When the results of the post-test application of the second group of students of Industrial Technical High School were taken into consideration, at the end of 7 weeks' training with the photographing technique, the success of students increased significantly. When the test results are analyzed, it has been found that there has been a high increase rate compared to the pre-test results. It has been found that there has been permanent learning and the success of students after the training by using the photographing technique is higher than the training by using the direct instruction technique.

2.4. Data collection tool and ethics

First, a detailed literature review of the technical drawing curriculum has been made. The Board of Education and Discipline approved different 10th-grade course books related to the topic of perspective and projection, scientific articles, periodical publications, and different educational books have been analyzed.

Second, the figures, photographs, drawing types of graphs appropriate to the topic to be taught, the aim, the level, and the environment were prepared considering the aim, the content, the teaching processes, and the evaluation in the MEB curriculum.

Third, 30 questions included assessment instruments that were used pre- and post-multiple-choice tests about the topics of perspective and projection were prepared by aiming, the content, and the evaluation in the 10th-grade technical drawing lesson curriculum into consideration. Thirty questions were applied to 13 Anatolian Technical School students and 18 Industrial Technical High School students.

2.5. Data analysis

After the test application, the test results have been analyzed. Each answer by student gave has been examined one by one. It has been determined to give 2 points for 10 questions about technical knowledge, and 4 points for 20 questions about visual thinking ability, and three-dimensional thinking. The results have been obtained by taking the students' answers to the SPSS program, and the findings have been turned into charts by the aim of the study.

3. Results

In this section, the findings of testing collected data in the research are mentioned and different comments have been made according to these findings.

3.1. The results of the comparison of the level of knowledge and three-dimensional thinking

The first student group is from Anatolian technical high school, and their learning abilities, comprehension, three-dimensional perception, and success levels are higher than the other group. The second student group is from Industrial Technical High School. The perspective and projection topic of technical drawing lessons was taught to the Anatolian Technical High School group by using a direct instruction technique and to the Industrial Technical High School group by using a photographic technique.

Before teaching, a *t*-test was applied to determine whether there was a significant difference between the knowledge and three-dimensional thinking levels of the two groups. The data about the knowledge and three-dimensional thinking levels of the Anatolian and Industrial Technical High Schools are illustrated in Table 1.

Table 1

The results of the comparison of the knowledge and three-dimensional thinking levels of the Anatolian and Industrial Technical High School students

Type of School	N	\bar{X}	S	Sd	t	P	Explanation
Anatolian Technical High School	13	9,6923	2,98286	29	0,866	0,394	p>0,00
Industrial Technical High School	18	10,7778	3,73466	28,640	0,899		

From Table 1, the average of the Anatolian Technical High School students is $M = 9,6923$ and the average of the Industrial Technical High School students is $M = 10,7778$.

From Table 1, the numbers are close to each other. It has been found that the difference between the points showing the average knowledge and three-dimensional thinking perception is not significant ($p > 0.00$).

This finding can be interpreted as the school type of students who do not affect a basic knowledge level about perspective and projection topic of the technical drawing lesson.

3.2. What are the learning differences between the direct instruction technique and the photographing technique in the technical drawing lesson?

According to the student training with direct instruction technique and photograph technique, a *t*-test was used to determine whether there was a significant difference between total success scores. The data about students' total success scores after training using the photographing technique are shown in Table 2.

Table 2

The comparison of students' success after using direct instruction technique and photograph technique

Teaching Techniques	N	\bar{X}	S	Sd	t	P	Explanation
Direct Instruction Technique	18	16,2222	4,12390	28			P>0,001
Photograph Technique	12	20,5000	3,84944	24,857	-2,858	0,008	Significant Difference

As seen from Table 2, according to the total success scores, it has been found that the difference between the average of students taught by the photographing technique ($M = 20.50$, $S = 3.84$) and the average of students taught by the direct instruction technique ($M = 16.22$, $S = 4.12$) is significant ($t = -2.857$, $p > 0.001$).

3.3. What are the learning differences between the direct instruction technique and the photographing technique in the technical drawing lesson?

As there are no significant differences between Anatolian and Industrial Technical High School students' learning abilities, it has been observed that there have been differences between the results of different training applied to each group for 14 weeks. The photograph-assisted training has brought permanent learning and more success than the training with direct instruction technique.

3.4. The first and the second exam results of the Anatolian Technical School

The first exam results measuring learning abilities, the level of perception, three-dimensional thinking, and success, and the level of success at the end of the photograph-assisted training of Anatolian Technical High School students are illustrated in Table 3 and Figure 7.

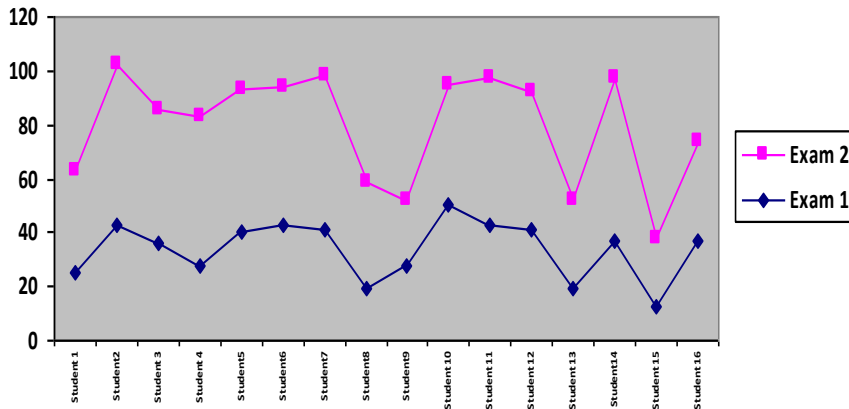
Table 3

The first and the second exam results of Anatolian High School

Student Name Surname	Exam 1	Exam 2
Student 1	25	38
Student 2	43	59
Student 3	36	50
Student 4	28	55
Student 5	40	53
Student 6	43	51
Student 7	41	57
Student 8	19	40
Student 9	28	24
Student 10	50	45
Student 11	43	54
Student 12	41	51
Student 13	19	33
Student 14	37	60
Student 15	13	25
Student 16	37	36

Figure 7

The graph of two exam results of Anatolian Technical High School



3.5. The first and the second exam results of Industrial Technical High School

The first exam results measuring learning abilities, the level of perception, three-dimensional thinking, and success at the end of training with direct instruction technique are illustrated in Table 4 and Figure 8.

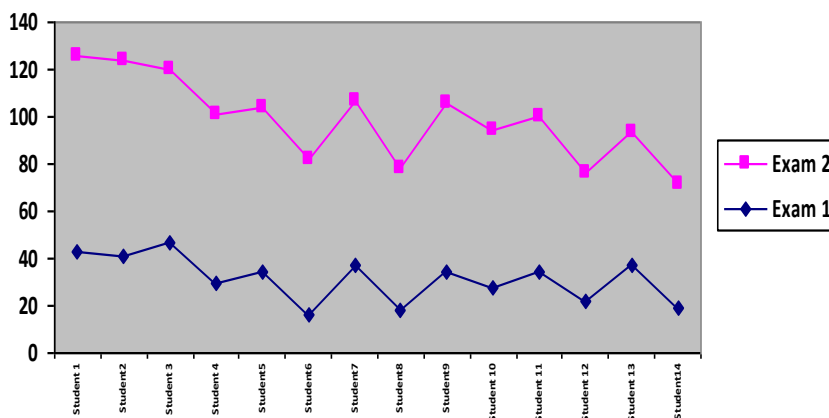
Table 4

The first and the second exam results of Industrial Technical High School

Student Name Surname	Exam 1	Exam 2
Student 1	43	83
Student 2	41	83
Student 3	47	73
Student 4	30	71
Student 5	34	70
Student 6	16	66
Student 7	37	70
Student 8	18	60
Student 9	34	72
Student 10	28	66
Student 11	34	66
Student 12	22	54
Student 13	37	56
Student 14	19	52

Figure 8

The graph of two exam results of Industrial Technical high school students



3.6. The success at the end of the training with direct instruction technique and photograph technique

The comparison of the learning abilities, the level of perception, three-dimensional thinking, and success of Anatolian and Industrial High School students, and the level of success after training with direct instruction technique and photograph technique is seen in Figure 9 and Figure 10.

Figure 9

The success graph at the end of the direct instruction technique

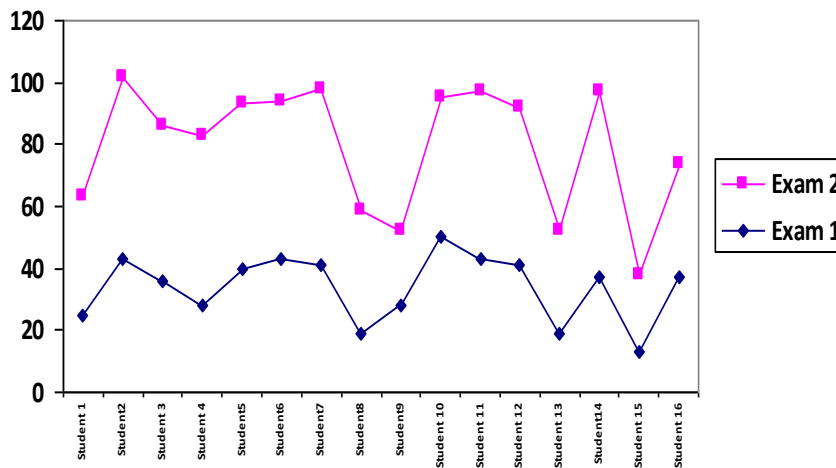
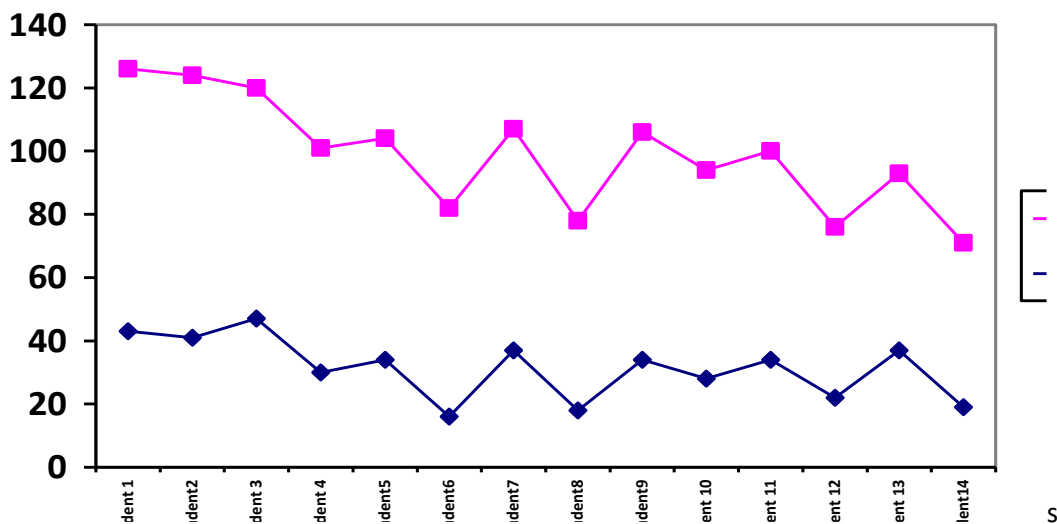


Figure 10

The success graph at the end of the photography technique



4. Discussion

According to the data obtained by the conducted research, the concluded results are as follows. Sisli Industrial and Anatolian Technical High School students are educated according to the types of schools. The Anatolian Technical High School students come to the departments after getting admitted into the school by passing the SBS exam. The class size is less, the curriculum is more expanded, the duration of practical training is, and the student's success is higher due to some reasons for different types of schools. The students are enrolled in the Industrial Technical High School without any terms or conditions depending on the registration priority and the school

capacity. The class size is more, the curriculum is less expanded, and the duration of practical training is less than the Anatolian Technical High School. As a result, the success of students is less, and the problems with students are more. Thus, the Industrial Technical High School student has more difficulties in the technical drawing lesson because it necessitates the ability of versatile thinking, drawing an object on paper by visualizing in mind and logical thinking. In the study conducted by Al Hashimi, Mahdi, Al Muwali, and Zaki, (2019), training provided with the rubric method is one of the methods used in art education. They analyzed what aspects students have difficulties in art and the reasons. They have had research studies on improving students' logical thinking abilities (Al Hashimi et al., 2019)

In the study named 'Turkce Egitiminde Anlatim Tarzlari', (Expression Styles in Turkish Education) the importance of using photographs as visual materials for improving students' expression, and self-acquaintance abilities are emphasized (Karadag, 2003). In the study of 'Manyetik alan kavramlarına yönelik öğrencilerin anlama düzeylerinin incelenmesi' (Examination of students' understanding levels of magnetic field concepts) conducted by Ozcan (2019), students' comprehension levels increased when the teaching is supported with photographs. This study is parallel with the research by Karadag (2003) in terms of the conclusion.

5. Conclusion

In this study, the formation of experimental and control groups has been made according to the school types. First, the test included 30 questions about measuring the ability of versatile thinking, drawing an object on paper by visualizing in mind, and logical thinking was applied. These tests have found that the students' results of these two different school types are very close to each other, and the difference is not very significant.

During 14 weeks of training, the perspective and projection topic was explained to the Anatolian Technical High School students by using direct instruction techniques, and to the Industrial Technical High School students by using the photograph technique. After the training, it has been found that the points of test results of each group of students of each school type have increased significantly. However, when the post-test results of each group of each school type were taken into consideration, the points of the experimental group that is the Industrial Technical High School students applied the photographing technique are higher than the control group. In short, the experimental group is found more successful than the control group.

Therefore, photograph-assisted training has more effect on improving the drawing abilities in the perspective and projection topic of the technical drawing lesson. Using the photograph by the teacher in the technical drawing lesson is highly important for technical high school students and necessitates hard-earned drawing abilities that play a significant role.

Given the results of this study, the suggestions are as follows:

- The teachers of technical drawing lessons should make use of the photographing technique which is proven to be effective in drawing studies.
- There may be research studies on the effectiveness of the photographing technique in improving students' permanent learning in other technical lessons.
- The students' learning and using technical knowledge abilities could be improved by putting visuals like photographs, images, and graphs in the technical course books.
- It should be noted that visual materials, such as photographs, images, and graphs, should be selected as appropriate to students' levels, and their interests.
- The appropriateness of photographs, images, and graphs to the technical topic should be taken into consideration.

- The photograph technique may help students whose abstract thinking abilities are weak to visualize abstract technical knowledge in mind and teachers to teach technical knowledge more effectively.

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