Determining the Mental Images of Fourth Grade Private and Public School Students for Science Learning Environments by Drawing Technique

Sina Şavlı1*, Mustafa Doğru2

1Milli Eğitim Bakanlığı, Turkey
2Fen Bilimleri Eğitimi Bölümü, Eğitim Fakültesi, Akdeniz Üniversitesi, Turkey

*Corresponding Author. syna.1@hotmail.com

ABSTRACT The study aims to examine fourth-grade private and public-school students' images of the science learning environment using their drawings. The survey was conducted in the 2017-2018 academic year, and a descriptive survey model was used. Participant group of this study consist of 357 fourth-grade students. In this study, data were collected by drawing technique. Content analysis, percentage, frequency, and Chi-Square test of independence were used in data analysis. Regarding the study results, although the learning environment in both schools consists of traditional classrooms and laboratories, differences were observed in student drawings according to school type (public-private). The private school students use the laboratory in science lessons, whereas the students in the public school use the teacher's desk as the experiment table. Another significant result of the study is that public-school students' priority is understanding the topic. In contrast, private school students assign more importance to the materials. Regarding the independence test results, founding student behavior, teacher behavior, teacher position, and teaching method to differ in student images according to school type. But no found a significant difference between the place theme images of public school and private school students.

Keywords Science, Science learning environment, Drawing, Image

1. INTRODUCTION

Science is the process of understanding the nature of science, thinking, and discovering new scientific knowledge (Derman, 2019). Therefore, scientific literacy should increase to develop these characteristics in individuals. Many countries are making regulations in their science education programs to increase scientific and technological literacy (Hastürk & Sönmez, 2020). It is known that countries that attach importance to science and technological aim to carry out a qualified education to be at the top (Yasin, Prıma, & Sholhihı, 2018). Therefore, learning environments should be organized by the skills of the individuals, including researching, questioning, producing, and scientific process skills to achieve a qualified science education (Candaş, Kiryak, & Ünal, 2021). It is also known in the literature that organizing the learning environments impacts student achievement (Korkman & Metin, 2021; Salur & Pehlivan, 2021).

Learning environments should be student-centered to discuss the topics, present their ideas comfortably and show their thoughts in practice in the process (Ulu & Ocak, 2018). Besides, it has been found that learning environments that put students in the center increase academic achievement, allow them to develop a positive attitude towards science learning and improve the image, and make the learning permanent (Karadeniz & Doymuş, 2015).

Images are the schemes that occur in the mind about information, concept, or phenomenon. On the other hand, individual images are individual schemas about a subject, concept, or phenomenon, different from each other. These differences vary according to the individuals' lifestyle, prior knowledge, and interests (Ergen, Boyraz, Batmaz, & Çevik Kansu, 2020).

It is known from the literature that the science image that individuals carry in their minds is essential in science learning (Bilir et al., 2020; Dönmez, 2017). The ways students learn science style their images of the science learning environment. Besides, students' science learning environment images can affect their interests, attitudes, thoughts, and motivations towards learning (Gökdaş & Ak,
2019). For this reason, the image of science learning environments that individuals have should be known.

It is thought that learning the mental images of individuals about a subject will be essential to reveal the strengths and weaknesses of that subject. For example, students’ image of science plays an essential role in their attitude, thinking, motivation, and interest in science. Therefore, it is also very effective in learning science (Digilli Baran & Karaçam, 2020).

They are examining mental images in the literature about the science course from many perspectives. For example, studies are available to investigate the lessons taught by teaching methods and techniques on students’ mental images (Çavdar & Doymuş, 2016; Develi, 2017; Parsa, 2016; Zheng & Spires, 2014). These studies’ common point is to determine teaching methods and techniques on students’ mental images. In addition to these studies, studies examine the mental images brought by the individual from the past that is available. Images about ideal learning environment (S. Özdemir & Akkaya, 2013), there is the investigation to compare the images for science learning environments according to education systems of countries (Turkmen & Unver, 2018). In addition to current investigations, (Şahin Akyüz, 2016) compared the actual science learning environments with the ideal learning environments according to the school's quality. As a result, it has been determined that students’ about the ideal science learning environments include intelligent boards, experiment tables, and visuals in the mental images. This result revealed how the science learning environment images of the students studying in the private school are.

Therefore, this study aims to determine whether there is a difference between the student images of the private school science environment and the public school science learning environment. Based on this information, it is thought that this study will be essential to investigate the quality of the science learning environment in students’ science learning process. Based on the literature's information, investigating the importance of the science learning environment's qualities is necessary for the students’ science learning processes. In this context, this study's results will contribute to the institutions and organizations involved in regulating learning environments and researchers who want to work on this issue. Furthermore, the study examines fourth-grade private and public-school students' images of science learning environments using their drawings. Significant differences, if any, between students' images of science learning environment according to the type of their school (private or public) will also be revealed. In this context, the study's main question is "How is the image of the science learning environment of fourth-grade private and public school students?". The following problems have been addressed as the study's sub-questions: (1) How is the image of the science learning environment of fourth-grade public-

2. METHOD
2.1 Research Model

The survey model, one of the descriptive research methods, was preferred. The descriptive method is generally used to clarify a situation, an event, make evaluations within the framework of specific rules, and reveal the relationships between events. The primary purpose of a descriptive study is to provide a deep understanding of the case under investigation and explain it. In a descriptive study, the research field is directly present and evaluated (Acar, 2000, p. 30; as cited in Gay, 1996 ). On the other hand, the survey model serves to reveal the current situation. It deals with the current state of the situation or event under investigation and the position related to the problem (Çepni, 2014). Since the students' existing images will be revealed in this study, the survey model of the descriptive research method was preferred.

2.2 Study Group

In this study, a simple random sampling method was used. The sample of the study consists of private and public school students studying in fourth grade. Science course starts from the third grade in the Turkish education system. Students studying in the fourth grade have two school years of science learning backgrounds. Therefore fourth-grade students were included in this study. One school from each of the Konyaaltı, Kepez, and Muratpaşa districts, the three central districts of Antalya, was included. Still, permission was not granted from the schools in the Muratpaşa district. Therefore, the number of schools from Kepez and Konyaaltı districts willing to participate in the study increased. Therefore, the study was conducted with three schools from each of the two districts. The drawing method, a data collection tool, is applied as a questionnaire, which allowed the number of participants to be 357. Compared to other data collection methods (interview, observation), the mentioned questionnaire can be applied quickly to huge groups from different regions at a meager cost (Büyüköztürk, Kılıç Çakmak, Algın, Karadeniz, & Demirel, 2018). So, the number of participants was kept high to get healthier and more reliable results in revealing students' images of the science learning environment.

2.3 Data Collection Tool

"Actual Science Learning Environment Drawing Test" (Şahin Akyüz, 2016) was used as the data collection tool. Obtained the necessary permissions for the drawing test were from the researchers who developed the test. The test used consists of two sections. In the first part of the test, students are asked to draw following the instructions and
answer four open-ended questions. In the second section of the test, there are 17 items about students’ learning preferences. In this study, students’ learning preferences will not determine the second part of the test has not been using. "Actual Science Learning Environment Drawing Test" administered on 8th graders by the developers overlap with fourth-grade skills, the validity and reliability measurements of the test did not perform again. As a result of the calculation, the reliability of the research was found to be 89%. Since the reliability values above 70% are considered reliable (Miles & Huberman, 1994), the result obtained here indicates the research’s reliability. The Science course begins from the third grade in the Turkish education system.

Students studying in the fourth grade have two school years of science learning backgrounds. Therefore fourth-grade students were included in the study. Various methods, including drawings, word associations, analogies, and metaphors, can reveal students' mental images (Dikmenli, 2010). Collecting data through drawings allows us to analyze social, emotional, cognitive, and motivational dimensions and evaluate them together. Therefore, drawings are a type that can be preferred as a data collection tool (Kiryak, Çandaş, Karanisanoglu, & Özmen, 2019). In interviews and surveys, children may not feel comfortable due to their developmental characteristics and may fail to express themselves correctly. Therefore, the drawing method is a better method for collecting data from children to identify the images' attitudes, interests, and beliefs (Armstrong, 2007). In this study, since it was a desire to collect data about the images of 9-10-year-old children, preferred the drawing method was.

2.4 Data Collection Process

The study's data collection process took place in May-June of the 2017-2018 academic year. In the process, participants filled the actual science learning environment drawing test with their drawings and answered as “What are you doing yourself in this drawing? Explain” “What is your science teacher doing in this drawing? Explain” “What are your friends doing in this drawing? Explain” “What are the most important things for you in your science learning environment?” four questions just below the drawing area prepared for the researcher to better understand the drawing.

2.5 Data Analysis

The content analysis method for the analysis was used of the data. Content analysis is a method that allows working indirectly to determine human nature and behavior; it is a repeatable and systematic method in which some parts of an entity are divided into smaller units and summarized by coding according to specific rules. The primary purpose of content analysis is to explain the collected data. For this purpose, similar information is a group under certain concepts and themes (Yıldırım & Şimşek, 2018) Regarding the above information, and it is seen that the most appropriate method to be used in analyzing the data collected in this study is content analysis. The Chi-Square test has determined a significant difference between the mental images of the science learning environment between private and public school students. Therefore SPSS 21 package program was used in the analysis. The drawing tests of the students and the analysis of four open-ended questions have been carried out together with an expert in science education.

3. RESULT AND DISCUSSION

This section examined whether there is a significant difference between the images of the fourth-grade students in public and private schools regarding the science learning environment and the images of the public and private school students studying in the fourth grade regarding the science learning environment. The resulting results are discussed. Table 1 presents the findings of the 4th grade public and private school students about place sub-themes.

Table 1 presents the findings of the 4th grade public and private school students about place sub-themes. Table 1 presents the findings of the 4th grade public and private school students about place sub-themes. Table 2 presents the findings of the Chi-Square test of independence related to fourth-grade private and public-school students' image of a place.

Table 2 Findings of the Chi-Square test of independence related to 'place' theme images of private and public school students studying in the fourth grade of primary school

| Theme | Sub-Theme | Public f | Public % | Private f | Private % | sd | Calculated Value | Critical Value |
|-------|-----------|----------|-----------|-----------|-----------|----|-----------------|----------------|
| Place | Formal    | 206      | 96.3      | 134       | 93.7      | 1  | 1.8             | 3.8            |
|       | Informal  | 6        | 2.8       | 1         | 0.7       |    |                 |                |

Table 1 Findings of primary school fourth-grade students studying at public and private schools regarding the 'place' sub-theme

| Theme | Sub-Theme | F     | %   |
|-------|-----------|-------|-----|
| Public Place | Formal    | 206   | 96.3|
|          | Informal  | 6     | 2.8 |
| Private Place| Formal    | 134   | 93.7|
|          | Informal  | 1     | 0.7 |
Regarding Table 2, Calculated Value (1.8) < critical value (3.8), therefore there is no significant difference between public and private school students’ images of a place.

In Figure 1, there is a relative drawn by a public school student regarding the ‘place’ sub-theme. According to the visual, the teacher is the person presenting the subject and the student is the person who listens to the teacher during the course. Table 3 presents the findings of the 4th grade public and private school students about student behavior sub-themes.

Regarding Table 3, the theme of student behavior, the drawings of 21.5% of fourth-grade public school students belong to the academic sub-theme, 67.8%, which constitute the majority, to the active sub-theme, 45.8%, which constitutes almost half of them, to the visual-spatial sub-theme. In contrast, very few students’ drawings fall in the sub-themes of Using technology (1.4%) and indifferent-passive (1.4%). Regarding the theme of student behavior, the drawings of 16.1% of fourth-grade private school students belong to the academic sub-theme, the majority of the students (71.3%) to the active sub-theme, 23.1% to the visual-spatial sub-theme, 2.1% to the indifferent-passive sub-theme. Whereas none of them drew a student using technology. Table 4 presents the findings of the Chi-Square test of independence related to fourth-grade private and public-school students’ image of student behavior.

A significant difference was found between the theme images of student behaviors according to the public and private school education status. Academic student behavior has been drawn more of the students studying in public schools. The reason for this may be that students in public schools are usually listening or taking notes. In the theme of student behavior, the visual-spatial sub-theme was found to be the most differentiated sub-theme in terms of significance.

| Theme     | Sub-Theme         | Public f | Public % | Private f | Private % | sd | Calculated Value | Critical Value |
|-----------|-------------------|----------|----------|-----------|-----------|----|------------------|----------------|
| Student   | Academic          | 46       | 21.5     | 23        | 16.1      | 4  | 12.0             | 9.4            |
|           | Active            | 145      | 67.8     | 102       | 71.3      |    |                  |                |
|           | Visual-spatial    | 98       | 45.8     | 33        | 23.1      |    |                  |                |
|           | Using technology  | 3        | 1.4      | 0         | 0         |    |                  |                |
|           | Indifferent-passive | 3     | 1.4      | 3         | 2.1       |    |                  |                |

Table 3: Findings of the Chi-Square test of independence related to ‘student behavior’ theme images of private and public school students studying in the fourth grade of primary school.

Table 4: Findings of primary school fourth-grade students studying at public and private schools regarding ‘student behavior’ sub-theme.
two school types. Visual-spatial student behavior has been drawn much more frequently in the images of students studying at public schools. The reason for this may be the high number of students in the classrooms in public schools, the lack of materials in the laboratory, and the inability of the teacher to do experiments and do experiments with her students. Many studies yield similar results to this result (Koç Ünal & Şeker, 2020; Ürey & Aydin, 2014). For example, Güngör Seyhan & Okur (2020) determined that, as a result of their study, there are no laboratories in many schools and that teachers do not have a place where they can perform their experimental practices (Güngör Seyhan & Okur, 2020). For this reason, they found that science teachers' experiments took place in the classroom. They found that branch teachers used the laboratory environment but mostly performed demonstrations or group experiments. While the image of using technology is not featured in the images of private school students, it has been included in the images of a tiny portion of the public school students. From this perspective, it can be concluded that students in both school types do not use technology sufficiently in science learning environments. This result is incomplete according to the requirements of the 21st century. Because, as required by the century we live in, we use technology in almost every aspect of our lives. For this reason, importance should be given to the use of technology in science education. As a result, it is seen in the studies in the literature that the use of technology is effective in student achievement, teacher-student, and student-student communication (Zhai, Zhang, & Li, 2018; Zydney & Warner, 2016). Figure 2 contains a visual of the sub-theme of student behavior.

Figure 2 shows a drawing of a private school student regarding the theme of the place. According to the drawing, the student is experimenting with his student friends. The teacher follows the lesson away from the students. Table 5 presents the findings of the fourth-grade public and private school students about teacher behavior sub-themes.

Regarding Table 5, 29.9% of fourth-grade public school students drew the teacher as an interactive person, 38.3% as a person presenting the topic, 16.8% as a person directing the learning, 0.5% as a record keeper, 13.1% as a person watching/monitoring whereas 9.8% did not draw a teacher. 28.0% of fourth-grade private school students drew the teacher as an interactive person, 30.1% as a person presenting the topic, 21.0% as a person directing the learning, 0.7% as a record keeper, 14.7% as a person watching/monitoring, and 2.1% did not draw a teacher. Table 6 presents the findings of the Chi-Square test of independence related to fourth-grade private and public-school students’ image of teacher behavior.

Regarding Table 6, Calculated Value (9.4) < critical value (11.0), therefore there is no significant difference between public and private school students’ images of teacher behavior.

| Theme | Sub-Theme | Public | Private | sd | Calculated Value | Critical Value |
|-------|-----------|--------|---------|----|-----------------|----------------|
| Teacher behavior | Interactive person | 64 | 29.9 | 40 | 28.0 | 5 | 9.4 | 11.0 |
| | Presenting the topic | 82 | 38.3 | 43 | 30.1 |
| | Driving learning | 36 | 16.8 | 30 | 21.0 |
| | Keeping record | 1 | 0.5 | 1 | 0.7 |
| | No teacher | 21 | 9.8 | 3 | 2.1 |
| | Watching /monitoring | 28 | 13.1 | 21 | 14.7 |
The theme of ‘teacher behavior’ in science learning environments has similar images for both types of schools. However, the ‘no teacher’ sub-theme in this theme was used more by public school students. That may be that some of the public school students only boots themselves in the science learning environment. In other words, the public school students who experimented with their friends at the table may have only drawn the table, the materials, themself, and their friends, and not the teacher who was elsewhere in that classroom. In both types of school, the teacher is generally drawn as the person presenting the subject. When the literature was examined, it was revealed that the teacher focused on presenting the subject (Baltürk, 2006; Bayındır & Arıcı, 2015; Duru, 2017; Şahin Akyüz, 2016; Tatar & Ceyhan, 2018; Tezci, Dilekli, Yıldırım, Kervan, & Mehmeti, 2017). Image of the person presenting the subject was followed by the images of the interactive person and the person who directed the learning. In learning environments, teachers have roles such as teacher, guide, student, and learner (Çakıcı, 2008). In the research, drawing the teacher as the person presenting the subject in general, drawing the role of the teacher as the instructor, secondly drawing the role of the learner as an interactive person, and drawing the role of the learner as the third person directing the learning may also be a reflection of the guide role of teacher. It has been determined in the literature that teachers use the board frequently (Bayındır & Arıcı, 2015). However, it has been revealed that only one student per school sees the teacher as the record holder. The literature does not support this result of the study. That may be that even if the teacher keeps records during the lesson, it is not reflected in the student’s image.

Figure 3 shows a drawing of a student studying at a public school on the theme of teacher behavior. According to the drawing, students follow the teacher and the experimental table from a distance.

Figure 4 shows a drawing of a student studying at a private school on teacher behavior. According to the drawing, the student performs an activity in the lesson with his friends. The teacher is giving the lesson on the board.

Table 7 presents the findings of the 4th grade public and private school students about the position of the teacher sub-themes.

Regarding Table 7, 35.5% of fourth-grade public school students drew the teacher away from students, whereas approximately half (43.5%) drew them inside the students. 47.6% of fourth-grade private school students drew the teacher away from students, whereas 35.5% drew them inside the students. Table 8 presents the findings of the Chi-Square test of independence related to fourth-grade private and public-school students’ image of teacher position.

Table 7 Findings of the fourth-grade primary school students studying at the public school regarding the ‘position of the teacher’ sub-theme

| Theme                        | Sub-Theme         | f   | %   |
|------------------------------|-------------------|-----|-----|
| Public school position of teacher | Away from students | 76  | 35.5|
|                              | Inside the students | 93  | 43.5|
| Private school position of teacher | Away from students | 48  | 47.6|
|                              | Inside the students | 51  | 35.5|

Table 8 Findings of the Chi-Square test of independence regarding the teacher position theme images of private and public school students studying in the fourth grade of primary school

| Theme          | Sub-Theme       | Public | Private | sd | Calculated value | Critical Value |
|----------------|-----------------|--------|---------|----|------------------|----------------|
| Position of teacher | Away from students | 76     | 68      | 47.6| 1                | 3.8            |
|                 | Inside the students | 93     | 51      | 35.5|                 |                |
Regarding Table 8, Calculated Value (4.1) > critical value (3.8); therefore, there is a significant difference between public and private school students’ images of teacher’s position.

A significant difference was found between the theme images of teacher positions according to the public and private school education status. In the theme of classroom position of the teacher in science learning environments, it was revealed that the teacher was predominantly intertwined with the students in public schools. In contrast, the teacher was distant from the students in the teachers’ images in private schools. That may be that in private schools, teachers provide more opportunities for students to discover and construct information independently. Ministry of Education made a radical change in the science program in 2004 and brought the constructivist learning approach to the program. In 2005, this understanding was put into practice. In the constructivist learning theory, individuals structure the information they obtain through their efforts. The teacher is in the role of a guide in structuring knowledge by the student. It is the active student (Akinoglu, 2018; Kaya & Zengin, 2018). Table 9 presents the findings of the fourth-grade public and private school students about teaching method sub-themes.

Regarding Table 9, 66.8% of the fourth-grade public school students drew a student-centered teaching method, whereas 30.8% drew a teacher-centered method. Fourth-grade private schools, most students (76.9%) drew the teaching method as student-centered and 18.2% as teacher-centered. Table 10 presents the findings of the Chi-Square test of independence related to fourth-grade private and public-school students’ image of teaching methods.

Regarding the above Table 10, Calculated Value (6.5) > critical value (3.8); therefore, there is a significant difference between public and private school students’ images of teaching method.

According to education in private and public schools, a significant difference is found in the ‘teaching method’ theme in science learning environments. However, it has been revealed that the teacher-centered teaching method is used more in public schools than private schools, and the student-centered teaching method is used less than in private schools. That may be because the constructivist approach introduced by the Ministry of National Education in 2005 and the methods suitable for this approach are used more in private schools than public schools. According to the constructivist learning theory, individuals construct their knowledge themselves. The teacher is a guide in the process of structuring the information. Following this approach, teachers can use contemporary methods such as problem-based learning, project-based learning, learning through argumentation, and collaborative learning (Acat, Karadağ, & Kaplan, 2012; Mengi & Sehreglman, 2013; Yilmaz & Akkoyunlu, 2006). Some studies reveal that teachers cannot fully adopt and apply constructivist learning methods that were put into practice throughout the country in 2005 (Güneş, Dilek, Hoplan, & Güneş, 2011; Tatar & Ceyhan, 2018; Yilmazlar, Çorapçıgil, & Toplu, 2014) and those who say they apply it are inadequate (Özdemir & Köksal, 2015). The finding that teacher-centered teaching in public schools is made more than private schools and student-centered teaching less than private schools may be because state schools are not applied as much as these constructivist and individual teaching methods are applied in private schools. In the study, which investigated the constructivist features of the classroom environment in the secondary school science course, it was suggested that cooperative learning in learning environments, learning by doing and experiencing, student-centered activities that include different perspectives will lead learners to think (Eroğlu, Armagan, & Bektas, 2015). Table 11 presents the findings of the fourth grade public and private school students about teaching environment elements sub-themes.

Regarding Table 11, almost all fourth-grade public school students (92.1%) drew tools suitable for the topic, very few students (2.3%) drew technological equipment, 26.6% drew classic student desks, more than half (69.6%) drew experiment table, more than half (73.4%) drew positive experience, and 17.3% drew laboratory material.
contrast, none of the students drew negative experiences. The majority of fourth-grade private school students (86.0%) drew tools suitable for the topic, 14.4% drew technological equipment, 8.4% drew classic student desk, 37.8% drew experiment table, the majority (79.7%) drew positive experience, 60.8% positive experience and 64.3% drew laboratory material. In contrast, only one student drew negative experience (0.7%). Table 12 presents the findings of the chi-square test of independence related to 4th grade private and public-school students’ image of the elements of the teaching environment.

Regarding Table 12, Calculated Value (147.8) > critical value (14.0). Therefore there is a significant difference between public and private school students’ images of the elements of the teaching environment.

A significant difference was found in the images of ‘teaching environment elements’ of the students according to their education status in private and public schools. However, in this theme, in both types of schools, most of the students’ images have a suitable tool in their images. Based on this result, it can be interpreted that teachers want to concretize the subject according to the cognitive characteristics of the students in the concrete operational period. When the literature is examined, it has been revealed that teachers tend to teach their lessons with concrete material (Baltırk, 2006; Pişkin Tunç, Durmuş, & Akkaya, 2012; Şimşek, Hırça, & Coşkun, 2012; Yazlık, 2018). For example, it has been revealing that the technological equipment in the science learning environment is much more in private schools. The reason for this may be that the financial means of private schools are better than public schools. While the classical student desk in the public school is more common in student images, the group table is very much drawn in private schools. While the experimental table is seen in the majority of student images in both school types, it can be concluded that while the real experiment table is used in private schools due to the details such as the faucet, the sink, the U-shaped table that covers the whole classroom, in the state schools the student desk is used as the experiment.

**Table 11** Findings of fourth-grade students studying at public and private schools regarding the sub-theme of teaching environment elements

| Theme                                | Sub-Theme                  | f  | %   |
|--------------------------------------|----------------------------|----|-----|
| Public school the elements of teaching environment | Tools suitable for the topic | 197 | 92.1 |
|                                      | Technological equipment    | 5  | 2.3 |
|                                      | Classic student desk       | 57 | 26.6|
|                                      | Group table                | 1  | 0.5 |
|                                      | Experiment table           | 149| 69.6|
|                                      | Positive experience        | 157| 73.4|
|                                      | Negative experience        | 0  | 0.0 |
|                                      | Laboratory material        | 37 | 17.3|
| Private school the elements of teaching environment | Tools suitable for the topic | 123 | 86.0 |
|                                      | Technological equipment    | 20 | 14.4|
|                                      | Classic student desk       | 12 | 8.4 |
|                                      | Group table                | 54 | 37.8|
|                                      | Experiment table           | 114| 79.7|
|                                      | Positive experience        | 87 | 60.8|
|                                      | Negative experience        | 1  | 0.7 |
|                                      | Laboratory material        | 92 | 64.3|

**Table 12** Findings of the Chi-Square test of independence related to the theme images of teaching environment elements of private and public school students studying in the fourth grade of primary school

| Theme                                | Sub-Theme                  | Public f | %   | Private f | %   | sd  | Calculated Value | Critical Value |
|--------------------------------------|----------------------------|----------|-----|-----------|-----|-----|------------------|----------------|
| The elements of teaching environment | Tools suitable for the topic | 197      | 92.1| 123       | 86.0| 7   | 147.8            | 14.0           |
|                                      | Technological equipment    | 5        | 2.3 | 20        | 14.4|     |                  |                |
|                                      | Classic student desk       | 57       | 26.6| 12        | 8.4 |     |                  |                |
|                                      | Group table                | 1        | 0.5 | 54        | 37.8|     |                  |                |
|                                      | Experiment table           | 149      | 69.6| 114       | 79.7|     |                  |                |
|                                      | Positive experience        | 157      | 73.4| 87        | 60.8|     |                  |                |
|                                      | Negative experience        | 0        | 0.0 | 1         | 0.7 |     |                  |                |
|                                      | Laboratory material        | 37       | 17.3| 92        | 64.3|     |                  |                |
In both types of schools, it was found that students' images generally contain positive experiences. The student who had a negative experience was absent in the public schools subject to the study. A negative experience encounter in the image of a student in private schools. That may be due to the downbeat mood of the student before drawing or the negative attitude towards the science learning environment.

| Theme | Sub-Theme                      | f   | %   |
|-------|--------------------------------|-----|-----|
| In public school the elements of the learning environment that are important to the students | Cleanness | 22  | 10.3|
|       | Having a laboratory            | 6   | 2.8 |
|       | Materials                      | 35  | 16.4|
|       | Security                       | 3   | 1.4 |
|       | Learning/understanding the topic | 49  | 22.9|
|       | The topic itself               | 32  | 15.0|
|       | Quiet place                    | 29  | 13.6|
|       | Being careful/doing it right   | 10  | 4.7 |
|       | Listening                      | 8   | 3.7 |
|       | Interaction with the teacher    | 15  | 7.0 |
|       | Undertaking a task             | 6   | 2.8 |
|       | Interaction with friends        | 17  | 7.9 |
|       | Having fun                     | 1   | 0.5 |
|       | Explanation of the station     | 7   | 3.3 |
|       | Experimenting                  | 25  | 11.7|
|       | Everything                     | 1   | 0.5 |
|       | My existence                   | 5   | 2.3 |
|       | Seeing the experiment          | 5   | 2.3 |
|       | Health                         | 0   | 0.0 |
|       | Being successful               | 8   | 3.7 |

| In private school the elements of the learning environment that are important to the students | Cleanness | 2   | 1.4 |
|                                                                                       | Having a laboratory | 1   | 0.7 |
|                                                                                       | Materials           | 44  | 30.8|
|                                                                                       | Security            | 12  | 8.4 |
|                                                                                       | Learning/understanding the topic | 27  | 18.9|
|                                                                                       | The topic itself    | 6   | 4.2 |
|                                                                                       | Peace/silence       | 5   | 3.5 |
|                                                                                       | Being careful/doing it right | 13  | 9.1 |
|                                                                                       | Listening           | 6   | 4.2 |
|                                                                                       | Interaction with the teacher | 10  | 7.0 |
|                                                                                       | Undertaking a task  | 0   | 0.0 |
|                                                                                       | Interaction with friends | 9   | 6.3 |
|                                                                                       | Having fun          | 5   | 3.5 |
|                                                                                       | Getting an explanation | 1  | 0.7 |
|                                                                                       | Experimenting       | 22  | 15.4|
|                                                                                       | Everything          | 3   | 2.1 |
|                                                                                       | Itself              | 3   | 2.1 |
|                                                                                       | Seeing the experiment | 3  | 2.1 |
|                                                                                       | Health              | 6   | 4.2 |
|                                                                                       | Being successful    | 4   | 2.8 |

Table 13 Findings of the primary school fourth-grade students studying in public and private schools regarding the sub-theme of the elements that are important to the student in the learning environment.

When the two schools are compared, the sub-theme that makes the difference between them the most is the "laboratory material" sub-theme. Students generally have a beaker, microscope, graduated cylinder, scaffold, test tube, magnifier, etc., in the science learning environment in private schools. While most of the laboratory materials were drawn, the number of students drawing these materials in public schools is deficient. The laboratory
materials are drawn by very few students studying at the state school. The subject covered when the natural science learning environment drawing test is applied to the students is a subject that does not require laboratory materials. Public school students generally teach science lessons in traditional classrooms. The reason why laboratory materials are included in the images of private school students may be because science learning environments in private schools take place in laboratories based on drawings. Table 13 presents the findings of the fourth-grade public and private school students about the elements of the learning environment that are important to the students.

According to Table 13, 10.3% of the fourth-grade public school students answered as cleaning, 2.8% as laboratory, 16.4% as materials, 1.4% as security, 22.9% as learning/understanding the topic, 15% as the topic itself, 13.6 as peace and silence, 4.7% as being careful/doing right, 3.7% as listening to the teacher, 7.0% as interacting with the teacher, 0.0% as undertaking a task, 6.3% as communicating with friends, 35.0% as having fun, 0.7% as getting an explanation, 15.4% as doing experiments, 2.1% as everything, 2.1% as the topic itself, 2.1% as seeing the experiment, 4.2% as health and 2.8% as to be successful. Table 14 presents the findings of the Chi-Square test of independence related to 4th grade private and public-school students’ image of the elements of the learning environment that are important to the students.

Regarding Table 14, Calculated Value (75.9) > critical value (30.1); therefore, there is a significant difference between public and private school students’ images of the elements of the learning environment that are important to the students.

A significant difference was found between the theme images of the essential elements in the science learning environment for the students between the two types of school. In the theme of the elements that students care most about in the science learning environment, learning / understanding the subject has been the most preferred element in public school students. Also, the subject itself, 

| Theme | Sub-Theme | Public | Private | sd | Calculated Value | Critical Value |
|-------|-----------|--------|---------|----|------------------|----------------|
| The elements of the learning environment that are important to the students | Cleanness | 22 | 10.3 | 2 | 1.4 | 19 | 75.9 | 30.1 |
| | Having a laboratory | 6 | 2.8 | 1 | 0.7 |
| | Materials | 35 | 16.4 | 44 | 30.8 |
| | Security | 3 | 1.4 | 12 | 8.4 |
| | Learning/understanding the topic | 49 | 22.9 | 27 | 18.9 |
| | The topic itself | 32 | 15.0 | 6 | 4.2 |
| | Peace/silence | 29 | 13.6 | 5 | 3.5 |
| | Being careful/doing it right | 10 | 4.7 | 13 | 9.1 |
| | Listening | 8 | 3.7 | 6 | 4.2 |
| | Interaction with the teacher | 15 | 7.0 | 10 | 7.0 |
| | Undertaking a task | 6 | 2.8 | 0 | 0.0 |
| | Interaction with friends | 17 | 7.9 | 9 | 6.3 |
| | Having fun | 1 | 0.5 | 5 | 3.5 |
| | Getting an explanation | 7 | 3.3 | 1 | 0.7 |
| | Experimenting | 25 | 11.7 | 22 | 15.4 |
| | Everything | 1 | 0.5 | 3 | 2.1 |
| | Itsel | 5 | 2.3 | 3 | 2.1 |
| | Seeing the experiment | 5 | 2.3 | 3 | 2.1 |
| | Health | 0 | 0.0 | 6 | 4.2 |
| | Being successful | 8 | 3.7 | 4 | 2.8 |
peace/quiet, experimenting / being able to experiment, materials, and cleanliness stand out compared to other sub-themes. It is seen that public school students find the cleanliness element important (Table 14). This situation makes us think that the students studying in public schools do not find cleaning sufficient. When the studies in the literature are examined, there are results for students to complain about cleaning problems in schools (Göksoy, 2017; Yüksel, 2019). The laboratory element has been given more in public schools than in private school students. Students in public schools write it more. As understood from student drawings, science learning in public schools is not done in a laboratory environment, and students want a laboratory. When the studies in the literature on this subject are examined, it is observed that, similarly, public school students want to do laboratory activities from their teachers (Kılıç & Aydın, 2018). The laboratory element is less in private schools than in public schools because private schools have budgets allocated to laboratories (Üzümülü, 2019). The abundant material element is written more in public schools than in private schools. Students' missing material in the teaching environment may have arisen in their drawings. Based on this, it can be deduced that the students do not find the instructional environment material sufficient (Okuyucu, 2019).

The security element was written by private school students more than public school students. This situation is closely related to how students interpret the concept of security. Students in private schools may have answered security by referring to the strict safety rules in their schools. Learning/understanding the subject has been written extensively by students of both school types. It can be considered normal that this element is essential in both types of school. The issue itself is written more often in public schools than in private school students. In this study, teachers took place more proportionally as the person presenting the subject in public schools' images. The reason for this situation is thought to be that the teacher wants to explain the subject herself due to reasons such as a large number of classrooms in the public school and the skill of the teacher in classroom management. The rate of writing the peace/silence element in public schools is higher than in private schools. It is thought that the crowded learning environments of the students and other reasons may create a peaceful learning environment in the student. Being attentive / doing right, listening, interacting with the teacher, interacting with friends, having fun, experimenting, everything, the student himself, seeing the experiment, and the successful elements were written by the students studying in both types of school at close rates. This situation can be considered normal. The element of taking part is not written by any students in private schools but by a small group of public schools. The reason for this may be that students want to take more positions in public schools. The element of disclosure is written more frequently to students in public schools. That may be because the classes in public schools are more crowded. It is difficult for teachers to explain separately according to each student's learning style and the possibility of not choosing it. The health factor is written more frequently in private schools. There may be more attention to health issues in private schools or vice versa. That is also an issue that needs to be investigated.

**CONCLUSION**

As a result, this study aims to investigate the learning environment images of public and private school students in fourth grade and determine whether there is a significant difference between these images.

No significant difference was found between the place theme images of public and private school students. This result reveals that teachers working in public and private schools do not prefer informal environments. A significant difference was found between public and private school students' student behavior theme images. The most prominent in this theme of the study are the drawings showing the visual/spatial sub-theme. Within the scope of visual-spatial intelligence, students follow an experiment and a situation according to their drawings. From this point of view, it can be said that the lessons are teacher-centered in public schools. There was no significant difference between public and private school students' teacher behavior images.

However, when the drawings of the 'no teacher' sub-theme of this theme are examined, it was determined that private school students stand out more than state school students. This situation shows that the training carried out in private schools is mostly student-centered. A significant difference was found between the state and private school students' images of the position of the teacher. Teachers are intertwined with students in public schools, while in private schools, teachers are located away from students. This result is consistent with the 'no teacher' sub-theme drawings in the teacher behavior theme of private school students. Found a significant difference between the teaching method images of public and private school students. There is a student-centered education in both school types. However, student-centered education is more common in private school student images. A significant difference was found between the images of teaching environment staff of public and private school students.

According to this result of the study, it stands out that the classroom order in the public school is in the classical order. Another element that stands out in this theme is the frequent use of laboratory materials in the drawings of private school students. Based on this result, it can be said that private school students perceive science lessons more as teaching with experiments. A significant difference was found between public and private school students' images of things that are important to students in the teaching...
environment. Among these images, it has been determined that the state school students draw the most cleaning element in the school. Based on this result, the drawings of the public school students made drawings due to cleaning problems. Another element that emerges in this theme is that public school students attach importance to the element of peace. This situation may be the inability of both students and teachers to ensure the peace of the lesson. Private school students often drew the materials element. According to this result, those students give importance to teaching environment materials. In addition, it is one of the prominent sub-themes that private school students give importance to being careful / doing right. This result may be due to the students' desire for the expected success from science education to be error-free.

REFERENCES

Acar, Ç. (2000). Zihin özürüz okullarla çalışan özel eğitim öğretmenlerinin sınıflarında karsılıklarını problem davranışlarına ilgili görüş ve önerileri. [The Opinions and suggestions of teachers who work with children with mental retardation about the problem behaviors in their classes] (Master Thesis). Anadolu University Institute of Social Sciences, Eskisehir.

Acar, M. B., Karadağ, E., & Kaplan, M. (2012). Kırsal bölgelerde fen ve teknoloji dersi öğrencileri: Yaptılar, davranışları, chicago. [Classroom behaviors and actions]. [A study on the effective use of class board]. (Doctoral Thesis). Kafkas University, Institute of Social Sciences, Kars, Kars.

Bayındır, N., & Arıcı, A. F. (2015). Sınıf tahtalarının etkili kullanımı. [A study on the effective use of class board]. (Master Thesis). Ankara: Pegem Akademi.

Baltırır, M. (2006). Fen bilgisi öğretmenin eğitim adaylarının davranışlarında karışımlarını görüşlerini ve görüşü örnekleri. [Encountered problems and solution suggestions in laboratory studies of science teachers and teacher candidates]. (Master Thesis). Kafkas University, Institute of Social Sciences, Kars, Kars.

Bozdoğan, A. E. (2012). Eğitim amaçlı gezilerin planlanmasına ilişkin fen bilgisi öğretmen adaylarının uygulamaları: Ayn farklı alan gezisinin değerlendirilmesi. Educational Science:Theory and Practice, 12(2), 1049–1072.

Büyükoztürk, S., Çağ鸾Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2018). Bilim ve Teknoloji Öğretimi Yapay Zeka, [Scientific Research Methodology] (26. Edition). Ankara: Pegem Yayınları.

Çakıcı, Y. (2008). Fen ve Teknoloji Öğretiminde Yapay Zeka ve Bilim İnsanları. [Artificial Intelligence and Scientists]. [Artificial Intelligence and Scientists]. 81. (Doctoral Thesis). Ankara: Pegem Akademi.

Çandıra, B., Kırık, Z., & Ünal, S. (2021). Bilim Tanrısı Temelli Hikayelerde Fen Öğretmeni: Tesla ve Volta Örneği. [Yüçüncülük Eğitim Fakültesi Dergisi, 18(1), 405–435. https://doi.org/10.33711/yuefd.867570

Çavdar, O., & Doymuş, K. (2016). İyi bir eğitim ortamı için yedi ikilinin birbirlikte öğrenme yöntemi ile kullanlarının fen ve teknoloji dersinde başarısı etkisi. [The using of seven principles for good practice with cooperative learning method: Effect on achievement in science course]. Átataktı Meram Dergisi, 20(2), 441–466.

Çepni, S. (2014). Araştırma ve Proje Çalışmalarına Giriş. [Introduction to Research and Project Studies] (7. edition). Trabzon: Cepni, S. (2014). Araştırma ve Proje Çalışmalarına Giriş. [Introduction to Research and Project Studies] (7. edition). Trabzon: Cepni, S. (2014). Araştırma ve Proje Çalışmalarına Giriş. [Introduction to Research and Project Studies] (7. edition). Trabzon: Çağ鸾Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Karadağ, E., & Kaplan, M. (2012). Kırslal bölgelerde fen ve teknoloji dersi öğrencileri: Yaptılar, davranışları, chicago. [Classroom behaviors and actions]. [A study on the effective use of class board]. (Doctoral Thesis). Kafkas University, Institute of Social Sciences, Kars, Kars.

Demirel, F. (2018). Bilim insanları imajları üzerine etkisi. [The Effect of Science and Technology Course on Students' Achievement and Motivation in Science]. (Master Thesis). Çanakkale Onsekiz Mart University, Institute of Educational Sciences Canakkale.

Digili Baran, A., & Karaçam, S. (2020). Bilim insanların sahip oldukları risklere yönelik ortaokul öğrencilerinin algıları. [Perceptions of Secondary School Students About Risks of Scientists]. P.A.U Journal of Education, 50, 269–290.

Dikmen, M. (2010). Undergraduate biology students’ representations of science and the scientist. College Student Journal, 44(2), 579–588.

Dönmez, G. (2017). Ortaokul öğrencilerinin fen bilim bilen, bilbilim bilen öğrenme modelinin ve bilimin insanına yönelik metaforik algıların ve imagiler. [Metaphorical perceptions and imaginations of secondary school students for science course, science, science teachers and scientists] (Master Thesis). Adnan Menderes University, Institute of Science, Aydın, Aydın.

Duru, S. (2017). Pre-service elementary education teachers’ beliefs about teaching and learning in Turkey. Turkey'de: Smfn öğrenmeni öğretmen adaylarının öğrenme ve öğrenme ile ilgili inançları. [Bibliographic analysis of doctoral level thesis studies in science education domain in Turkey]. Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 17(1), 72–81.

Eroğlu, S., Armagan, F., & Bektaş, O. (2015). Fen bilimleri dersi öğrencilerinin yapay zeka ve bilim insanları ile ilgili algıları. [Perceptions of elementary school students in terms of constructivist properties]. Kırkoz Eğitim Fakültesi Dergisi, 16(2), 293–312.

Gökşen, M., & Ak, S. (2019). Ortaokul öğrencilerinin geleceği okullarına ilişkin hayalleri. [The dreams of elementary school students in terms of the schools of the future]. Kastamonu University Kastamonu Education Journal, 28(1), 72–81.

Göksoy, M. (2017). Okulların altyapı yeterliliği. International Journal of Leadership Traing, 1(1), 9–15.

Güneş, T., Dilek, N. Ş., Hoplan, M., & Güneş, Ö. (2001, April). Problem solving skills of secondary school students in terms of constructivist properties. [Perceptions of elementary school students in terms of constructivist properties]. Journal of Human Sciences, 11(4), 4002-4014.

Güneş, T., Dilek, N. Ş., Hoplan, M., & Güneş, Ö. (2001, April). Problem solving skills of secondary school students in terms of constructivist properties. [Perceptions of elementary school students in terms of constructivist properties]. Journal of Human Sciences, 11(4), 4002-4014.

Hastürk, G., & Sönmez, D. (2020). Türkiye'de fen eğitimi [Introduction to science and technology course in rural areas: An assessment study]. Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 20(2), 441–466.

Hızlı, A. (2010). Problemler için çözüm özkolajına önem veren ortaokul öğrencilerinin algıları. [Perceptions of high school students concerning the importance of problem solving in their daily life]. (Doctoral Thesis). Kafkas University, Institute of Science, Kars, Kars.

Hızlı, A. (2010). Problemler için çözüm özkolajına önem veren ortaokul öğrencilerinin algıları. [Perceptions of high school students concerning the importance of problem solving in their daily life]. (Doctoral Thesis). Kafkas University, Institute of Science, Kars, Kars.

İstanbul Sıfırlama Sistemi ve Daha İyi Ortaokul Öğrenmeleri, Antalya, Turkey. [An investigation of the effect of the technological pedagogical based learning environment on students' achievement and motivation in science]. (Master Thesis). Çanakkale Onsekiz Mart University, Institute of Educational Sciences Canakkale.
Karadeniz, Y., & Doymuş, K. (2015). Fen ve teknoloji öğretmenlerinin işbirliği ögrenme modeli sunuca uygulamaları ve elede edilen sonuçların değerlendirilmesi. İlgdr İ. öreni. [Informing of science and technology teachers applications of cooperative learning model, in the class and evaluating the obtained results: Example of İlgdr City]. e-Kafkas Journal of Educational Research, 21(1), 1–12.

Kaya, E., & Zengin, E. (2018). 5E modelinin lütfen bilişimlerinin öğretiminde örençeye başarına etkisi. Eko Akademî Dergisi, 73(4), 415–427.

Kılıç, M. S., & Aydın, A. (2018). Ortaokul düzeyinde hacim kavramına giriş: Somut materyaller destekli bir öğretim örneği / Introduction to the concept of volume in middle school mathematics lesson by means of the expanded sourcebook (2. edition). California: SAGE Publications.

Kuram ve Uygulama Eğitiminde Sınıf Öğrencilerinin Enerji Dönüşümlerine Yönelik Bilgi Düzeyleri ve Öğrenme Sosyolojisi. [Determination by drawing of the images of eighth grade students, which are intended for actual and ideal science learning environment (Mûlûğa city example)]. (Master Thesis). Mûlûğa Sîrkoçman University Institute of Education Sciences, Mûlûğa, Mûlûğa.

Salur, I., & Pehlivan, M. (2021). Sorgulamaya dayalı Öğretmenin fen bilgisi adaylarının eğitimi ve sorgulamaya örençeyi becerilerine etkisi. [The effect of inquiry-based teaching on pre-service science teachers' academic achievement and skills of inquiry learning]. Journal of Ege Kafkas University Education Faculty, 3(1), 101–116.

Selanlik Ay, T., & Erbasan, Ö. (2016). Views of classroom teachers about the use of out of school learning environments. Journal of Education and Future, 10, 35–50.

Şimşek, H., Hıçreact, N., & Coşkun, S. (2012). İlköğretim fen ve teknoloji öğretmenlerinin öğretim yöntem ve tekniklerini tereci ve uygulama düzeyleri: Şanlıurfa ili örneği. [Primary science and technology teachers' selection of teaching methods and techniques and the levels of their applications: The sample of Şanlıurfa city]. Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 9(18), 249–268.

Soytay, G., Tutar, M., & Karamustafoğlu, O. (2016). Student views about science teaching with outdoor learning environments: Planetarium tour. Journal of Research in Informal Environments (JRINE), 1(1), 1–24.

Tatar, N., & Ceyhan, Y. (2018). Fen bilgisi öğretmen adaylarının yapılıştırmaları kurum dayalı öğretim uygulamalarının geliştirilmesi. [Development of pre-service science teachers' constructivist-oriented teaching practices]. Elementary Education Online, 17(1), 207–222.

Tüzçü, E., Dilekli, Y., Yıldırım, S. V., Kervan, S., & Mehmeti, F. (2017). Öğrencilerin adaylarının sahip olduğu öğretim anlayışları üzerine bir analiz [An analysis on pre-service teachers' teaching conception]. Education Sciences, 12(4), 163–176.

Türkmen, H. (2010). Informal (sunf-dis) fen bilgisi öğrenime tarihsel bakış ve eğitimimize entegrasyonu. Çukurova University Faculty of Education Journal, 3(39), 46–59.

Türkmen, H., & Unver, E. (2018). Comparison of elementary students' images of science teaching for Turkish, Dutch, Scottish, and German school classrooms. Universal Journal of Educational Research, 6(11), 2624–2633.

Ula, H., & Oacak, İ. (2018). İlköğretim öğretmenlerinin fen öğretimine yönelik zihinsel modellerinin incelenmesi. [Examination of primary school students' mental models for science teaching]. Electronic Turkish Studies, 13(11), 1367–1388.

Ürey, M., & Aydın, M. (2014). Genel biyoloji laboratuvar kapsamında geliştiren biyo-la-b web yönteminin etkiliği ve öğretim adaylarının görüşleri. [Pre-Service Primary Teachers' Views on A Method Called Bio-Lab-Web (BLW) in Introductory Biology Laboratory Course and Its Effectiveness]. Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 22(1), 150–167.

Üzümli, S. (2019). Öğretmen adaylarının laboratuvarda kullanmak istedikleri ve kullanamayacakları meslek fikirlerinin analizi / Analysis of prospective teachers’ opinions to perform laboratory practices in science education]. Kırşehir Eğitim Fakültesi Dergisi, 19(2), 322–328.

Özdemir, S., & Öztürk, S. (2013). İlköğretim adaylarının fen bilgilerine ilişkin zihinsel modellere yakınlığı analizi / Examination of prospective teachers’ views about science teaching with outdoor learning environments. Journal of Science Learning, 13(11), 1367–1388.

Yasin, A. I., Prima, E. C., & Sholihin, H. (2018). Learning electricity using Arduino-Android based game to improve STEM literacy. Journal of Science Learning, 1(3), 77–94.

Yaşar, S. (2012). Fen eğitiminde hayvanat bahçelerinin kullanımının akademik başarısı ve kayguya etkisi ve öğretmen-örens fiyazısı. [The effect of using zoos in science education on students' academic achievement and anxiety towards science and teachers-students' conceptions]. (Master Thesis). Sakarya University, Institute of Educational Sciences, Sakarya, Sakarya.

Yazlık, D. O. (2018). Öğretmenlerin matematik öğretiminde somut öğretim materyalini kullanma yetenekleri. [The Views of...
Teachers About Use of Concrete Teaching Materials in Mathematics Teaching]. OPUS International Journal of Society Researches, 8(15), 777–805.

Yıldırım, A., & Şimşek, H. (2018). Sosyal bilimlerde nitel araştırma yöntemleri. Ankara: Seçkin Yayınevi.

Yılmaz, M., & Akkoyunlu, B. (2006). Farklı öğrenme ortamlarının kalıcılığa etkisi. [The effect of different learning environments on retention]. Eurasian Journal of Educational Research, 7(3), 45–56.

Yılmazlar, M., Çorapçılı, A., & Toplu, B. (2014). Fen bilgisi öğretiminde programlı öğretimin öğrenci başarısı ve tutumu üzerindeki etkisi. [The effect of programmed instruction in science education on students' achievements and attitudes]. Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 8(1), 45–67.

Yüksel, İ. (2019). Okul yönetimi ve öğretmenlik mesleğine yönelik bimer'e konu olan şikayetlerin analizi (Antalya Örneği). [Analysis of complaints that are subject to BİMER for school management and teaching profession (Antalya case)]. International Journal of Karamanoglu Mehtebey Educational Research, 1(1), 19–30.

Zhai, X., Zhang, M., & Li, M. (2018). One-to-one mobile technology in high school physics classrooms: Understanding its use and outcome. British Journal of Educational Technology, 49(3), 516–532.

Zheng, M., & Spires, H. A. (2014). Fifth graders' flow experience in a digital game-based science learning environment. International Journal of Virtual and Personal Learning Environments (IJVPLE), 5(2), 69-86.

Zydnyk, J. M., & Warner, Z. (2016). Mobile apps for science learning: Review of research. Computers & Education, 94(March 2016), 1–17.