CURRENT RESEARCH IN EDUCATION

EDITORS
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MARCH 2022

gece kitaplığı

İmtiyaz Sahibi / Publisher • Yaşar Hız

Genel Yayın Yönetmeni / Editor in Chief • Eda Altunel

Editörler / Editors • Assoc. Prof. Dr. Onur Zahal

Dr. Halil Taş

Kapak & İç Tasarım / Cover & Interior Design • Gece Kitaplığı

Birinci Basım / First Edition • © Mart 2022

ISBN • 978-625-430-035-6

Gece Kitaplığı / Gece Publishing
Türkiye Adres / Turkey Address: Kızılay Mah. Fevzi Çakmak 1.
Sokak Ümit Apt. No: 22/A Çankaya / Ankara / TR
Telefon / Phone: +90 312 384 80 40
web: www.gecekitapligi.com
e-mail: gecekitapligi@gmail.com

Baskı & Cilt / Printing & Volume
Sertifika / Certificate No: 47083

Current Research in Education

March 2022

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Dr. Halil Taş

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CHAPTER 1

DETERMINATION OF SCIENCE TEACHER CANDIDATES' LEVELS OF INTERPRETATION OF GRAPHICAL INSTRUMENTS: AN EXAMPLE OF PROJECTILE MOTION

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INTRODUCTION

Scientific models facilitate conceptual understanding in science learning and therefore have an essential role. Scientific models are valuable tools as they can be used to bring together and make sense of abstract, challenging, and unobservable science concepts (Grosslight et al., 1991). According to Hodson (2014), scientific models are essential for students to acquire conceptual and theoretical knowledge, be interested in scientific applications, and understand science learning. According to Düşkün and Ünal (2015), one method for students to make concepts, facts, and events easier to understand is learning with a model.

Often, educators describe models as a representation, such as graphs, diagrams, or sketches, of the embodiment of words, symbols, and shapes. Bilen and Çiltaş (2015) thinks that a model is a mental picture that requires a high degree of thinking and mathematical ability. According to Lee, Jonassen & Teo (2011), model and modeling are also crucial in associating the data obtained through observation and experiment with theories, using scientific process skills such as forming hypotheses, making synthesis and evaluation, and ensuring the realization of meaningful learning. It is also crucial for what purpose and how models will be used in science teaching. For example, according to Van Driel and Verloop (2002) the student's passive use of models can be perceived as descriptive, while active use can make them perceived as interpretive and predictive tools. Therefore, models can encourage students to analyze and evaluate scientific ideas. On the other hand, scientific models used superficially prevent understanding (Cosgrove & Schaverien, 1997). In addition to the contribution of models to support and improve the learning process, many primary and secondary school students see models as concrete copies of real objects. In contrast, few students see them as representations of ideas or intangible assets (Grosslight et al.,1991). Scientific models include various symbolic representations of scientific phenomena such as equations, diagrams, analogies, metaphors, pictures, ideas, three-dimensional objects, and simulations (Harrison and Treagust, 1996). Models can be classified as concrete models (real object, copy, plastic model), visual models (e.g., symbols, drawings, graphs, charts), and verbal models (text) (Lee, Chang & Wu, 2017; Lee, 2018; Treagust et al., 2002). According to Kapur (1998) a mathematical modal is the expression of the property of any situation with a mathematical form such as a formula, equation, graph, table and figure. According to Harrison and Treagust (2000), mathematical models are represented by mathematical equations or graphs that reveal the relationships and processes between concepts. According to Maden and Altunbay (2016) graphics and tables are visual compositions, so reading and interpreting these tools require the use of metacognitive learning strategies along with the use of prior

knowledge. According to Durgun and Önder (2019) although graphics, one of the mathematical models, are tools that simplify and turn complex information into concrete, they are considered by many students as forms that are difficult to understand. Kwon (2002) has divided the ability to use graphics; into three, three parts in general; interpretation, modeling, and transformation. Defining interpretation as the ability to translate from graphics to verbal expressions, he has stated that students can extract the information they need from graphics to solve problems, make different kinds of comments, or focus on different aspects of a graphic.

Studies in the literature show that students at different levels, science teacher candidates, and science teachers have different knowledge, attitudes, and skills about model and modeling (Ergül, 2021). In addition Lee, Lu and Lien (2019) has stated that according to previous research, students' and teachers' views of scientific models have a significant gap in meeting expectations for science education. Graphs are frequently used tools in science lessons such as physics and chemistry. One of the subjects in which graphics are used the most, especially in physics lessons, is the subject of "force and motion." Motion graphics are tools that show the change of kinematics concepts (position, velocity, acceleration) over time and help to understand motion (Aydın and Tarakçı, 2018).

This study aimed to examine the graphical tool interpretation skills that Kwon (2002) mentioned and thus the level of access to information of science teacher candidates. The main problem of the study is: Can science teacher candidates determine the characteristics of the projectile motion with the help of a graphic tool, which is one of the mathematical models? Within the scope of the research, we sought answers to the following sub-problems:

1. What are the science teacher candidates' levels of interpreting the given graphic tool?

2. What is the level of science teacher candidates to conclude using the given graphic tool?

METHOD

In the study, we used the special case research design, one of the qualitative research methods. Case studies allow one aspect of the researched problem to be studied in-depth and quickly. These studies seek answers to how, why, and what questions (Çepni, 2021 p:104).

Study Group

We carried out the study with 40 science teacher candidates studying at the Faculty of Education, Science Teaching Department of a State University in Bursa in the fall semester of the 2020-2021 academic year.

34 of the candidates were girls, and 6 were boys. We also used the criterion sampling method, one of the purposive sampling methods, to determine teacher candidates. The purpose of the criterion sampling method is to create observation units from people, events, objects, or situations with certain qualities in research (Büyüköztürk et al., 2019). For this purpose, we determined that the students were taking the physics I course as a criterion in the study.

Data Collection Tools

In the study, we created and employed a graphic tool, including a drawing from mathematical models representing the projectile motion, as a data collection tool. Mathematical models are represented by mathematical equations and graphics that reveal physical properties relationships between concepts and processes (Harrison & Treagust, 2000). In the study, we gave the teacher candidates 2 research questions, together with the graphic with the drawing, during the lesson before explaining the related subject and asked them to answer these questions within one lesson hour. We started the research with 43 candidates and continued with 40 volunteer teacher candidates who answered the questions. The graphic tool (Figure-1) given to the teacher candidates for the research and the questions are shown below:

1. Write all the information you understand from the figure for the projectile motion in order?

2. How can you conclude by using the information in the given graphic tool?

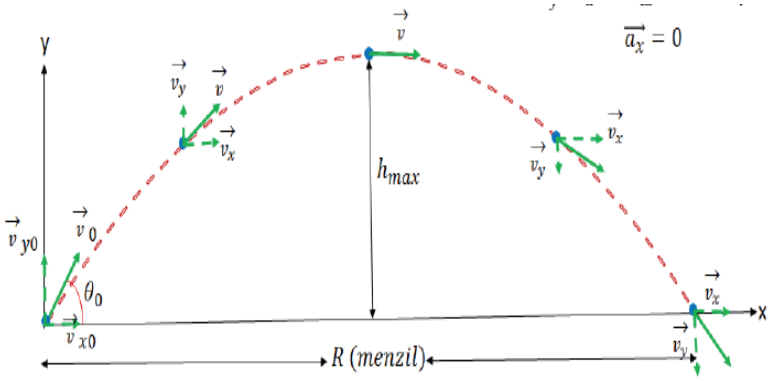

Figure-1 Projectile motion type movement (URL-1)

Data Analysis

We applied content analysis to the data obtained from the forms answered by the teacher candidates individually in the classroom environment. One of us is an expert in Physics education, and the other is an expert in the field of science education. First, we independently determined the codes and themes that emerged from the students' statements participating in the study and then examined the codes and themes. Later, we determined that there was 80% consistency between the two views and discussed the situations found to be different and evaluated again. Finally, we reached a consensus and gave these codes and themes the final shape. As a result, we brought similar data together within the framework of themes and reported them in tables. To ensure impartiality in the study and protect the candidates' confidentiality, we coded the teacher candidates as S1, S2….

FINDINGS

Findings of the first sub-problem: write down all the information you extracted from the given graphic tool in order? The findings, in which the views on the problems were explained, are presented in Table-1.

Table 1

Data from the given figure for the projectile motion.

Codes	f	Themes
Projectile motion.	15	Motion type
Horizontal motion	4	
It makes parabolic motion.	1	
Motion with constant acceleration in two dimensions	1	
Horizontal velocity is the same.	7	Features with velocity
The vertical velocity is the same.	8	
Velocity has two components, horizontal and vertical.	10	
Thrown without initial velocity	2	
The vertical component of velocity first decreases smoothly, becomes zero at the top, and then reaches vo	2	
At the top of the trajectory, velocity = 0	9	
V_o has initial velocity	10	
The object accelerates, slows down and accelerates.	6	
The magnitudes of the velocity vectors on the ascent and descent are equal and opposite.	1	
Vertical velocity at top of the trajectory is Vy = 0.	12	
Vx remains constant while the velocity Vy changes.	4	
The velocity vectors Vy at the beginning and at the end are equal and opposite to each other.	5	
The throw is in the same direction.	1	Throwing features
It is thrown upwards with velocity V_0 and angle α.	2	
The object falls to the ground at the angle from which it was thrown.	1	
It is thrown with the angle α.	2	
Time of descent equals the time of ascent	6	Features related to motion time
The object flew for 2t time.	2	
The gravitational acceleration is constant.	3	Features related to acceleration
It makes accelerated motion	1	
It is not dependent on mass.	3	Properties related to force and mass
It has frictional force.	2	
There is gravitational force.	3	Features related to highest point and horizontal distance
Highest point in a trajectory is ym	4	
Xm is the horizontal distance from the starting point to where the hits the ground.	6	
Explanation with formula	4	Write an expression with a formula
It is a position-time graph.	1	Specify a graph type

As shown in Table 1, we determined 9 themes; as a result of content analysis based on teacher candidates' answers after giving the shape

showing the projectile motion. Among these themes, the expressions of the themes related to the type of motion and speed were more common.

Some of the student opinions stated in the forms regarding the categories belonging to the first sub-problem are as follows.

Motion type comments on the theme:

S2:"It is a Projectile Motion."

S9: "It is a Projectile Motion thrown with v_0 velocity."

S6:"It is the horizontal motion thrown with initial velocity v."

S3: "It is a parabolic motion ."

S23:"It is motion with constant acceleration in two dimensions."

Comments on the velocity-related features theme:

S24:"The magnitude of the velocities slows down while throwing up, when it comes to the y_{mak} point, it becomes zero, and when falling down, it falls by accelerating."

S19: "All velocity vectors given as v are equal in magnitude, but the directions of these velocity vectors are different, and therefore they are not equal vectors, but they are equal in magnitude."

S26:"The object moves in the horizontal direction with v_x in the vertical direction with the v_y component."

S16:"There are horizontal and vertical components of throwing velocity."

S23:"While v_y velocity changes, v_x velocity remains constant throughout the motion."

Comments on the throwing features theme:

S10: "It is the falling motion of an object thrown at a certain angle α horizontally, again with an angle of α, effect of gravitational pull."

S18: "It was thrown upwards with the speed v_0 at the time t with an angle of α."

S6:"An object with initial velocity v is thrown with a horizontal motion."

S26:"A throwing force was applied to an object."

S24:"This object was thrown Projectile."

Comments on the theme of properties related to motion time:

S3:"The time for the object to ascend to the top of the trajectory is equal to the descent time."

S18:" The object has moved with time 2t."

S22:"The time to fall to the ground is the sum of the times from the top to the trajectory and from the trajectory to the ground. These times were equal to each other."

Opinions on the theme of properties related to acceleration:

S1:"g gravitational acceleration is constant."

S18: "While the object is falling down, it gains speed because the acceleration is downwards."

S40:" The object has accelerated."

S30:"There is gravitational acceleration acting on the object."

Opinions on the theme of properties related to force and mass:

S2:"The motion does not depend on the mass."

S7: "There is a gravitational force acting on the object."

S6:" The forces acting on the object are friction and gravitational force."

Maksimum yükseklik ve menzil ile ilgili özellikler temasına yönelik görüşler:

S7:"y_m is the highest point in a trajectory,, X_m is the horizontal distance from the starting point to where the hits the ground.."

S32: "There is vertical and horizontal motion , X_m is the horizontal distance. The highest point in a trajectory is y_m ."

S34: "We know the *highest point in a trajectory*."

S33:" *X_m is the horizontal distance*."

Opinions on the themes of writing expressions with formulas and specifying graphic type:

Ö25:*"$y=v_{0t}-1/2\ gt^2$, $t_u=2t_ç$."*

Ö*28:"$x=vt$, $v_0^2= v_{0x}^2+v_{0y}^2$."*

Ö*29:" $v_0^2= v_{0x}^2+v_{0y}^2$, $y=v_0t+1/2\ gt^2$, $x_m=v_x.t$"*

Findings of the second sub-problem: What conclusion can you reach by using the information in the given graph? Findings related to the sub-problem are shown in Table 2.

Tablo 2

Results obtained using the information given in the chart.

Codes	f	Themes
Vy is allows elevation from the ground	1	Features related to velocity and its components
Vx determines the horizontal distance	1	
Objects thrown with horizontal velocity go up to a certain height and fall down with maximum velocity due to gravity.	1	
Throw velocity and fall velocity are the same	1	
Using Vy, ym, xm and α are found.	1	
As the velocity goes up, it slows down, and when it goes down, it velocity up.	2	
Magnitude of Vx is the same, the direction of vy has changed.	1	
It reaches its maximum height at the top	1	Features related to Heigh h
At Ymax the velocity is zero.	1	
Vy=0 at hmax	1	
Ymax is the maximum height.	1	
Vx=0 at maximum height	2	
Time t passes until the point ymax	1	
If y is known, the time of descent is known.	1	
Projectile motion	5	Features related to the motion type
It is the graphed version of the throwing motion	2	
Free fall after top of the projectile	2	
Horizontal motion	2	
The object makes horizontal motion with constant velocity and vertical motion with constant acceleration	1	
Parabolic motion	1	

When Table 2 is examined, it is seen that 3 themes emerged. Four of the candidates did not indicate any results with verbal expressions from the information given in the graph and tried to indicate the result by writing a formula, while nine candidates could not write any answers.

The opinions of some pre-service teachers regarding the categories belonging to the second sub-problem are as follows.

Opinions on the theme of features related to velocity and its components:

S36: "The object thrown with velocity V hits the ground again with velocity V. V_x is constant."

S5: "The direction of V_y has changed."

S17: "The angle between V_{0x} and V_0 is the same as the angle between V and V_x."

Opinions on the theme of features related to highest point:

S33: "The object has reached a certain height and then completed its movement."

S29:"y_m is the highest point and V_x =0."

S30: "Objects thrown horizontally with a certain velocity rise to a certain height. It will accelerate down again due to gravity."

S16: "The object has flowed $2y_m$ vertically".

Opinions on the theme of features related to motion type:

S27: "This is a projectile motion. Accordingly, the object is thrown up vertically at a certain velocity from the ground and goes up to the y_m point by making horizontal motion with constant velocity, and v_x=0 at the top. Then it accelerates smoothly, but continues in the opposite direction compared to the first situation and hits the ground with velocity v_0 and the motion is completed."

S19: "The object makes parabolic motion.."

S25: "It is thrown up at a certain velocity, and when he reaches the top, his velocity becomes zero and it makes a free fall motion."

S33: "It is the graphed version of the projectile motion."

S20: "The object making horizontal motion along the horizontal axis, vertically, and shoots vertically from bottom to top. Vertically due to gravity, the velocity decreases until the highest point, and becomes zero at the top, it accelerates downwards. The horizontal distance on the way up is equal to the horizontal distance on the way down.

CONCLUSION AND DISCUSSION

This study aimed to examine the students' level of access to information by using a graphical tool that covers all the features of the projectile motion. Regarding the sub-problem "What are the science teacher candidates' levels of interpreting the given graphic tool?", the candidates were expected to indicate all the sizes and features they saw in the graphic provided. When examining the answers given by the candidates, we saw that their answers included features related to speed, projectile characteristics, properties related to motion time, properties related to acceleration, properties related to maximum height and range. All of the candidates expressed their opinions on the first question. We obtained 9 themes by making use of these views. For example, most of the students (38%) determined the shape as a direct projectile motion in the motion type theme. Although the answers given by these candidates were correct, they were not the expected answers. We can assume that the candidates answered in this way because they remembered the subject from their high school years. Some candidates misidentified the motion type as a horizontal projectile. On the other hand, one candidate showed a correct approach by saying parabolic motion and two-dimensional motion. While specifying the features related to speed, most of the students found that speed had two components, horizontal and vertical, there was v0 initial velocity, and the vertical velocity component at maximum height was zero. However, there were also erroneous interpretations that the first slow motion (10%) and the vertical velocity (20%) didn't change. While 18% of the few candidates (20%) who could evaluate the projectile characteristics gave the correct answer, only one candidate gave the wrong opinion saying that the projectile was in the same direction. The 8 candidates who stated the characteristics related to the motion time made the correct inference by saying that the ascent time was equal to the time of descent, and the object flew for 2t. 25% of the candidates could interpret characteristics related to altitude and range correctly from the graphic saying that ymax was the last point reached and Xm was the distance between the projectile and the descent. While three candidates talked about the existence of gravitational force, two candidates mentioned the existence of friction force. However, it was clearly seen in the figure that the friction force was neglected (the ascent and descent velocities and angles were the same). On the other hand, four candidates did not write any explanations and wrote formulas based on their previous knowledge.

In the second research question, we investigated the ability of science teacher candidates to conclude by using the given graph. We expected, in this question, candidates to interpret from the graph that the horizontal velocity remained constant along the horizontal axis, the vertical velocity

component changed along the vertical axis, the velocity decreased in the upward movement, and the velocity was zero when it reached the maximum height. We also anticipated them to conclude that the motion was two-dimensional, a resultant of the smooth linear motion and the upward vertical projectile motions. However, as seen in Table 2, the teacher candidates could not fully understand the second question. Candidates gave similar answers to the first and second questions. The number of candidates who answered the second question was less, and the expected explanations could not be made. From these results, we concluded that the teacher candidates' graphical tool interpretation and evaluation skills were not sufficient. However, in science lessons, graphic tools are essential in concept teaching and make the subject more understandable. If abstract phenomena are explained with graphics or three-dimensional models, the student will have the opportunity to observe and examine the phenomenon, and it will become concrete for the student (Güneş and Çelikler, 2010).

When the studies on motion and projectile on earth in physics are examined, it is seen that it is mainly aimed at misconceptions and the effect of computer-assisted teaching on success (Hidayatullah,Wilujeng & Munawaroh, 2021; Diola, 2021; Jahangir et al., 2020; Aslan and Büyük, 2020; Şimşek, Yurtcan, and Oktay, 2019; Coşkun and Özdemir, 2013). In the literature, there are also studies on the importance of teaching with a model (Lingefjard, 2020; Vallo and Valovicova, 2019; Düşkün and Ünal, 2015). Nonetheless, there are few studies on graphical tool interpretation in the literature (Prada Núñez et al., 2022). As Harrison Treagust and (2000) stated, science teachers can achieve more productive results due to drawing graphics using pencil and paper so that students can realize the role of models in science learning.

As a result, it can be said that models should be used more in lessons, considering that they are necessary tools for the simplified schematic representation of reality and the understanding of abstract concepts (Çökelez, 2015). For this reason, the effective use of graphic tools should be given importance in the lessons; students should be encouraged to use and interpret these tools and should be reinforced with practices.

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CHAPTER 2

CONTEXT-BASED PROBLEM-CONSTRUCTING SKILLS OF SCIENCE TEACHER CANDIDATES

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INTRODUCTION

When the contents of the science course are examined, it is seen that it is related to daily life. Science lessons allow students to transfer the knowledge they have learned to their lives to solve the problems they face in daily life. At the same time, the permanence of learning depends on the transfer of knowledge to life. Associating science lessons with daily life, as Elmas and Eryılmaz (2015) stated, allows students to draw attention to the subject by answering the question "Why am I learning these subjects?". Thus, a connection between the subject and the student's life is established. This established connection should also be preserved in the questions directed to the students. The student should see the connection between the question and his/her life. In this respect, in addition to using strategies suitable for the context-based approach, it is essential to use context(life)-based questions in the evaluation phase (Elmas and Eryılmaz, 2015).

Context-based questions present the subject to the student with the help of an appropriate context and enable students to respond with the help of their texts based on this context.(Kabuklu, Yüzbaşıoğlu and Kurnaz, 2019).

Evaluation with context-based questions also prevents students from answering them based on memorization and formula (Ahmed and Pollitt, 2007; Elmas and Eryılmaz, 2015; Sak, 2018). For this reason, teachers should also have the ability to prepare context-based questions in a way that keeps students away from memorization and emphasizes their reasoning skills. When we examine the literature, we see that although different studies are investigating the effectiveness of context-based physics problems, these studies do not mention the problem constructing process (Tekbıyık, Akdeniz, 2010).

Çepni et al. (2020) gave 25 science teachers the context-based question writing theoretical and practical training based on science literacy. Then they concluded that although teachers had some deficiencies in writing context-based questions, their question writing skills improved in parallel with the training provided.

According to (Gülyurdu and Eryılmaz, 2012), three basic conditions are required for a problem to be context-based. The first of these conditions is that a problem should be related to the individual or society. The second condition is that science's concepts, formulas, and laws should be in a pattern with the context while the problem is being constructed. The last one is that the answer should emerge from a thinking process, not only by memorization.

METHODOLOGY

The research is a descriptive study in which the case study method, one of the qualitative research methods, is applied. A case study is especially suitable for individual studies in educational studies. This is because a problem investigated is studied in-depth and in a short time. According to Hancock and Algozzine (2006), case studies aim to define themes or categories of behavior and events rather than proving relationships or testing hypotheses.

Study Group

We conducted the study within the scope of the physics I course with 10 volunteer science teacher candidates studying in the Science Teaching Department of the Faculty of Education in the fall semester of the 2021-2022 academic year. Eight of the candidates were female, and two were are male.

Data Collection Tools

In the study, we used a problem prepared in a traditional structure in fluid mechanics taken from the Physics of University I book by Young and Freedman (2009) as a data collection tool. We gave this problem to the candidates in writing and asked the students to turn this problem into a life-based problem. We explained the subject of fluid mechanics for 4 hours before the research. After the explanation, we gave the candidates the following research question and expected them to turn it into a life-based question within 30 minutes. At the end of this period, we evaluated the candidates' answers with the help of another field expert and conducted interviews with the same candidates.

The problem given to the candidates was "Calculate the area of a heating pipe with air moving at 2m/s to refill a hall with a volume of 500 m^3 with hot air every 20 minutes."

We evaluated the students' data, which were transformed into a life-based problem form by considering the following criteria given by Kabuklu et al. (2019).

(i) Determination of context

(ii) Constructing a problem with a context-related scenario

(iii) Writing a qualitative question sentence

Thus, we formed the research question and sub-problems of the study as follows:

The main problem of the study is "What are the candidates' skills to transform the problem given for the physics course into one connected with daily life?"

Sub-problems are

1. "Were the teacher candidates able to transform the given problem into a life-based form?"

2. "Did teacher candidates write a context-related scenario while transforming the given problem?"

3. "Were the problems constructed by the teacher candidates qualitative questions?"

To ensure impartiality and protect confidentiality in the analysis process, we coded teacher candidates as S1, S2...

FINDINGS

After conducting the study with ten teacher candidates, we got the following life-based questions from some candidates as follows:

S1 "Yeliz goes to the cafe with the expers to decorate the cafe she rented. When he realizes that the cafe is very cold and cannot warm up, he talks to the expers. Exper find a solution like this. It writes the volume of the heating pipe with air moving at 2m/s inside to be 500m^3 and the space required to fill hot air in 20 minutes. But when Yeliz goes to get the pipe, she sees that the written part of the pipe area is torn. The seller calculates and gives the pipe. What is the area of the pipe the seller gave you?"

S2 "The air of a part of a passenger aircraft is cleaned with the help of a pump every 20 minutes. The volume of this aircraft is 500 m^3, and the pump sends the air into the aircraft at a speed of 2m/s. In this case, what should be the area of the part of this pump connected to the aircraft? "

S3 "While Mr. Serkan, a physics teacher, is waiting for his dental appointment, he catches his eye with the papers on the table. In these papers, which is about the heating of the waiting room, it is seen that the hall, which is 500 ^{m3} in volume, will be aired with the air pipe at a rate of 2 m/s for heating and this is planned to be repeated every 20 minutes. He notices that the pipe area is wrongly specified and tells the truth of this area to the people in charge of this in the clinic. What could teacher Serkan have said to these people? "

S4"*Inside our body, blood moves at a speed of 10m/s. The volume of our veins is 100m3. Then, what should be the area of our veins to pump blood into our body every second? "*

S5"A plumber wants to install a natural gas system in a 500m^3 house.

It researches the homeowners in the most appropriate way and determines that the heating system must pass hot air through the pipes every 20 minutes. Since the air passing through the pipe must travel at a speed of 2m/s, how many pipes does the plumber use to install the natural gas system throughout the house, and what is the volume of the pipe?"

S6"*Since a family with a newborn is not satisfied with the heating system in their house; they are investigating a new house. The first thing they look at in the house is how it heats up. They go to an expert to get an opinion on the heating system of a children's room in a house they like very much. When they say they want to refill with hot air in 20 minutes for the room with a volume of 500m^3, how much does the expert calculate the pipe area they should buy for this family? "*

S7 "*Ali and Ayşe are brothers and sisters, and they decide to go to the cinema. Ali tells his sister that a heating pipe with a volume of 500m^3 is filled with air, moving at a speed of 2m/s to heat this theatre hall. He asks Ayşe to calculate what the area of the heating pipe should be so that it is filled with hot air every 20 minutes. What could Ayşe's answer be?"*

S9"*It is dangerous to breathe the same air continuously in closed areas within the scope of Covid-19 measures. For this, dirty air is discharged every 20 minutes, and fresh air is filled. The area where the air will come out is 500cm^3, and the velocity of the particles in the air is 2m/s. Then, what should be the area where the air comes out? "*

Table-1 gives the question contexts constructed by the candidates and the relationship between the contexts and the questions

Table-1 Contexts and subjects relationship

Candidate No	**Context**	**Subject Context Relation**
Ö1	Heating the cafe	Area of Heating pipe to be used
Ö2	Cleaning the air of a part of the passenger aircraft	The area of the pipe of the fresh air pump
Ö3	Heating of the waiting room of the doctor's practice	Area of the heating pipe to be used
Ö4	Pumping blood in our body	area of veins
Ö6	Heating the children's room in the house	The area of the pipe to be used
Ö7	Heating the movie theater	Area of Heating pipe to be used
Ö8	The water needs of the villagers engaged in agriculture	The area of the water conveying pipe
Ö9	Covid-19 problem	The area of the air discharge pipe
Ö10	Heating of the workplace	Area of Heating pipe to be used

CONCLUSION AND SUGGESTIONS

In this study, we investigated the skills of science teacher candidates to transform the traditional problem of fluid mechanics into a problem related to daily life. We took the criterion of determining the context stated by Kabuklu et al. (2019) into account related to the sub-problem "Within the scope of the research, did science teacher candidates turn the given problem into a life-based problem form?".

When we examined the problems written by the candidates, we saw that although there were some deficiencies in the suitability of the given problem and the context they created, they usually could transform the given problem into a life-based problem form. For example, S7 created a context related to the cinema hall heating problem but could not fully reflect the content of the given problem. In the given problem, s/he stated the hall volume as the volume of the heating pipe. It is understood that the candidate was in a hurry while reading the given problem. Elmas and Eryılmaz (2011) stated that when constructing a question, science concepts, formulas, and laws should be related to the context. On the other hand, S4 created a different context by considering the blood flow in the veins. The candidate tried to adapt the context by changing the numerical values of the problem given here. Besides, S2 created a context for cleaning an aircraft's air under the content of the problem. S3 provided a context related to a problem seen in the heating of a dentist's waiting room and provided compliance with the content of the problem. S9 created a question by associating the concept with a context that emphasized the need for fresh air concerning the Covid-19 problem, which is a serious situation today. S8, on the other hand, made an association with the concept by drawing attention to the water needs of the villagers engaged in agriculture. Moreover, S6 associated the concept with heating the nursery at home. According to Elmas and Eryılmaz (2011), a context-based question should include a problem that concerns the individual or the society. Accordingly, in the study, we saw that the candidates used contexts that attracted attention interested the society and related to daily life. Apart from this, the level, prior knowledge, and timeliness of the questions and their harmony with life are essential points to consider, and the concepts of science and contexts should be integrated within the question (Kabuklu et al., (2019)).

In the second research question, we examined the writing of a problem with a context-related scenario. In this regard, we saw that the candidates created scenarios in their daily lives by choosing topics such as cleaning the air of the passenger plane, emphasis on air-cleaning due to Covid-19, heating the house, cinema, or workplace and the need for water in agriculture. When we examined the scenarios, we found that the candidates avoided giving unnecessary details that did not increase the reading load. Still, they

made mistakes such as sentence distortions that reduced comprehensibility. According to (Ahmed & Pollitt, 2007), it is crucial to determine and use the context correctly in preparing context-based questions, and failure to create the appropriate context makes it difficult to focus on the question by creating a reading burden. In this respect, unnecessary details should be avoided to show the relationship between science and context when preparing context-based questions (Elmas, Eryılmaz, 2015).

The interviews drew attention to this issue, and the reasons were examined. Also, the students stated that this situation was due to the reasons such as not using the language well, lack of attention, rushing, etc.

In the third research question, we investigated the completion of the problems organized by the teacher candidates with the expression of qualitative questions.

They used some question forms such as "What should be the level of knowledge and comprehension in the questions of eight candidates in the study?", "What is it?", "How much?", . Only two candidates used the expected question forms like "What can be the answer?" and "What could he have said?". These question statements draw the student into a thinking and evaluation process. Therefore, as stated by (Elmas, Eryılmaz, 2015), the answer to the question should arise not only as a result of memorization but also as a thinking process. The literature states that a context-based question should be completed with a qualitative question sentence (Kurnaz, 2013; İlhan and Hoşgören, 2017). In traditional question types, we generally come across question sentences with "'Why?", "What is it?", "Define it," "Explain," "Compare," "Calculate." (Kabuklu et al., (2019). However, using question statements appropriate to the analysis, synthesis, and evaluation steps of the Bloom taxonomy in life-based questions is also vital in directing students to use their mental skills.

The implementation and evaluation of context-based education programs are also crucial for the sustainability of science teaching. Therefore, teachers and teacher candidates should be competent in evaluation processes and practice. As in this study, it would be helpful to conduct activities and studies to transform traditional question examples into context-based forms or construct context-based questions by giving the subject scope.

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CHAPTER 3

ATTITUDES OF PRESCHOOL TEACHERS TOWARDS ART EDUCATION AND ART ACTIVITIES

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1. Introduction

Education is a lifelong endeavor that starts from the moment we are born. Preschool period is the foundation of life. During this period, children are in the process of rapid development and learning. Children need education that tracks their development and care needs at their own pace to solve creative problems, develop social skills, cooperate with others, be courageous and adapt to the environment. One of the basic principles of the preschool education program is the development of children's imagination, creative and critical thinking skills, communication and expressing their feelings (MoNE, 2013). Visual arts education in the preschool period also aims to develop and nurture the child's potential in a holistic and integrated way as a child who is self-confident, creative, imaginative and able to face future challenges. Visual Arts provides opportunities for children to increase their interest in learning, artistic growth, and development, and encourages the use of fun, meaningful, inquiry-based learning strategies (Tee & Mariani, 2018). Children express themselves by using their problem-solving skills and motor skills while bringing their ideas to life on a piece of paper (Lai, 2000). For pre-literate children, the visual arts are the primary tool through which they can explore and share their perceptions of their world. Visual arts can help children communicate ideas that cannot be expressed verbally (Wright, 2007).

Visual art is where children learn how to experience, develop, represent, and understand ideas, emotions, values, and cultural beliefs while working on their art projects (Gibson, 2003). Visual art activities enable the children to understand the space they live in. It develops and supports the social and cultural space surrounding the children, the development of visual thinking, and the ability to communicate with the language of visual arts (Arnheim, 2009). Visual arts activities enable the child to realize the elements of art and design elements such as color, form, texture, composition, rhythm, contrast, and proportion (Butina, 1997; Didek, 1982; Eisner, 2002). Through visual art, the emotional point of view and intelligence of the child is enriched, contributing to different thinking skills, social, ethical and moral development (Herne, Cox, & Watts, 2009; Hickman, 2010). In addition, in the visual arts learning environment, children learn to handle and embrace differences, to present emotions freely without giving right or wrong answers, and to observe social realities (Punzalan, 2018; Theodotou, 2017). Visual arts also encourage teachers to work on common projects and provide opportunities for children to explore common interests together, to communicate with each other, to exchange ideas, to think about solutions, and to develop common meanings through cooperation (Christensen & Kirkland, 2009).

Visual art is an excellent space for preschool teachers, who include appropriate practices for the child in their visual arts activities, to nurture children's curiosity and encourage them to use their senses to observe, solve problems, think differently, express their thoughts, and ask questions (Pendergast, Lieberman-Betz, & Vail, 2015).

Children need to be encouraged and directed by teachers so that they can learn artistically, support their development, participate in art activities, enjoy, and appreciate (Eman & Aseel, 2016). Attitudes and beliefs are important concepts. Preschool teachers' attitudes and beliefs about teaching are very important as they affect their classroom practices, behaviors, and children's desire to learn (Maier, Greenfield, & Bulotsky-Shearer, 2012). Attitudes and beliefs can be defined as teachers' general positive or negative feelings towards their thought processes, teaching practices, and the way they conduct activities (Koballa & Crawley, 1985; Richardson, 1996).

Having positive attitudes and beliefs while interacting with children during art activities also contributes to the development of children's social and language skills (Lai, 2000). In addition, through art activities, preschool teachers learn to understand what children are saying, to observe their behavior, and to document and analyze the results of observation (Green, 2012). Preschool teachers, who have positive attitudes and beliefs that want to support children in decision making, problem solving and creating value, encourage children to think with appropriate art performance (Punzalan, 2018).

Preschool teachers' beliefs and attitudes towards teaching different art forms (dance, drama, media, music, and visual arts) also affect their efforts to include and conduct art activities. If the teachers' experiences with art are positive, they include more art activities in their schools, but if their experiences are negative, they probably limit children's acquaintance with art or completely neglect art activities (Garvis & Pendergast, 2010).

Preschool teachers play a crucial role in how children experience the visual arts because it is the teachers who create the classroom environment, decide which visual art materials will be used when and where, and determine how and what kind of art activity will be included.

Some preschool teachers believe in a hands-on approach (Richards, 2007). Teachers who advocate this approach argue that the child is innately creative, and the role of the teacher should prepare materials and a supportive environment. The intervention of the teacher negatively affects the creativity of the child (Richards, 2007). On the contrary, in the approach that adopts that the teacher should be a guide, teachers prefer to have children do the same work based on social media, internet environment,

or their experiences (Lindsay, 2017). Teachers who include art activities, where it may be difficult to distinguish one child's work from another, feel more secure, do not encounter surprises, and can predict possible results. Teachers, who adopt this approach and are constantly guiding, affect children's self-efficacy in art negatively with the activities they include, and make children dependent on the teacher for guidance and teaching (Probine, 2015).

Visual arts have an important place in contemporary education. Visual literacy is a skill based on visual communication methods, as well as encouraging and supporting creativity, empathy, spatial intelligence, and visual development from an early age (Bleed, 2005). The creativity and other abilities of visual arts in children can only be developed when preschool teachers give them the freedom to explore works of art on their own and the freedom to create and express visual arts (Einarsdottir, Dockett, & Perry, 2009). Visual-creative activities allow children to explore how they can express their thoughts, ideas and experiences about the outside world using different materials and techniques. The role of preschool teachers is to encourage and motivate children to express themselves using visual arts by preparing an environment designed and organized to facilitate creative processes and direct them to creative activities (Balić Šimrak, Šverko, & Županić Benić, 2010). For this reason, beliefs, self-efficacy, and attitudes are of great importance for preschool teachers to develop their proficiency in art and reflect it on educational practices. In this context, the aim of the study is to determine the attitudes of preschool teachers towards art education and art activities.

2. Method

Research Model

This is a descriptive research in screening model. The screening model aims to reflect the existing situation as it is (Karasar, 2000). With this research, it is aimed to determine the attitudes of pre-school teachers working in Balıkesir towards art education and art activities.

Study Group

The study group of the research consists of 315 preschool teachers working in Balıkesir in the 2020-2021 academic year. Since the entire study population was reached, no sampling was made. Descriptive information for the study group is given in Table 1.

Table 1. Descriptive Information for the Study Group

		Frequency (*f*)	Percentage (%)
Gender	Female	282	89.50
	Male	33	10.50
Age	25	61	19.37
	26-30	103	32.70
	31-35	65	20.63
	36-40	43	13.65
	41-45	28	8.89
	46 and older	15	4.76
Education Level	High School	7	2.20
	College	31	9.80
	Undergraduate	269	85.40
	Graduate	7	2.20
Marital Status	Married	192	61.00
	Single	121	38.40
	Other	2	0.60
Seniority Status	5 years	149	47.30
	6-10 years	72	22.86
	11-15 years	52	16.51
	16-20 years	19	6.03
	21-25 years	12	3.81
	25 year and above	11	3.49
Institution	Preschool	176	55.90
	Kindergarten	107	34.00
	Nursery	31	9.80

As seen in Table 1, 89.5% of the teachers in the study group are women and 52.07% are under the age of 30. 269 of the teachers have an undergraduate degree and 192 of them are married. Approximately 50% of them have 0-5 years of service and only 9.8% work in nurseries.

Data Collection Tools

The Personal Information Form, the Inclusion of Art Education Questionnaire developed by the researchers, and the Attitude Towards Art Education Scale developed by Aykanat and Güneysu (2018) were used to collect data in the research. The personal information form contains demographic data and was used to define the study group.

Inclusion of Art Education Questionnaire prepared by taking the opinions of field experts consists of 20 questions. It includes questions about teachers' art education, the way they include art activities in the classroom, and their practice of art activities.

The Attitude Towards Art Education Scale was developed by Aykanat and Güneysu (2018). The scale consists of 23 items and 4 sub-dimensions. Cronbach α Coefficients for the scale are given in Table 2.

Table 2. Cronbach α Coefficients of the Factors of the Attitudes towards Art Education Scale

	Number of Items	Cronbach's Alpha
Enjoyment of Art and Contribution of Art	10	0.94
Negative Attitudes Towards Art	7	0.95
Role of Communication Enhancer	3	0.89
Role of Significance	3	0.81

The Cronbach α coefficients of the Attitude Towards Art Education scale, including the Enjoyment of Art and the Contribution of Art (0.94), Negative Attitudes towards Art (0.95), the Role of Communication Enhancer (0.89) and the Role of Significance (0.81), were calculated. Scores were calculated for each sub-dimension of the Attitude towards Art Education Scale. In each sub-dimension, the relevant items were added and divided by the number of items. The sub-dimension scores of Enjoyment of Art and the Contribution of Art and the Role of Communication Enhancer indicate positivity as they approach 5, Negative Attitudes towards Art and the Role of Significance sub-dimension indicate negativity as they approach 5.

Data Analysis

The mean, mode, median, skewness and kurtosis values of the variables that are the basis of the study were calculated. When the mean, mode, and median values of a series are equal in the frequency distribution, we can say that the data are distributed symmetrically around the central tendency measures. In cases where these values are not equal to each other, it can be decided whether the series is normally distributed by looking at the Z scores of the skewness and kurtosis values. The fact that the Z scores of the skewness and kurtosis coefficients remain in the range of (+- 1.96) indicates that the data exhibit a normal distribution (Field, 2000; Field, 2009). In this case, it was observed that the distribution of the sub-dimensions of the scale was not in accordance with the normal distribution. The normality test results of the attitude scale towards art education are given in Table 3.

Table 3. Normality Tests of Research Data

	Mean	*sd*	Mode	Median	$Z_{Skewness}$	$Z_{Kurtosis}$
Enjoyment of Art and Contribution of Art	4.58	.020	5.00	4,70	-20.93	52.66

Negative Attitudes Towards Art	1.17	.027	1.00	1.00	38.18	125.10
Role of Communication Enhancer	4.50	.035	5.00	4.66	-12.04	12.83
Role of Significance	1.48	.038	1.00	1.33	13.83	15.55
Whole Scale	3.13	1.77	5.00	4.00	-.18	-1.77

The statistical package program SPSS 17.0 (Statistical Package for the Social Sciences) was used to analyze the data collected within the scope of the research. The analysis of the data collected in the research was made by taking into account the frequency, percentage, mean and standard deviation values.

3. **Findings**

Table 4. Attitudes of Preschool Teachers towards Art Education

	The Attitude Towards Art Education Scale	*N*	$\bar{X}$	*sd*	Min.	Max.
Enjoyment of Art and Contribution of Art	1. Art education supports the creative side of people.	315	4.77	0.608	1000	5000
	2. Art education develops multidimensional thinking skills.	315	4.72	0.585	1000	5000
	3. Taking art education is very useful in terms of improving one's productivity.	315	4.69	0.617	1000	5000
	4. Art education gives people an aesthetic view.	315	4.68	0.616	1000	5000
	5. Art education is interesting.	315	4.57	0.680	1000	5000
	6. Art education is fun.	315	4.60	0.731	1000	5000
	7. Art education gives people the ability to think critically.	315	4.35	0.778	1000	5000
	8. Art education gives people peace.	315	4.44	0.695	1000	5000
	9. Art education should be at all levels of education.	315	4.51	0.711	1000	5000
	10. Art education is important for individuals of all ages.	315	4.52	0.811	1000	5000
Negative Attitudes Towards Art	11. Art education is worthless.	315	1.17	0.688	1000	5000
	12. Art education has harmful consequences.	315	1.15	0.585	1000	5000
	13. Art education is boring.	315	1.23	0.573	1000	5000
	14. Art education is a waste of time.	315	1.16	0.539	1000	5000
	15. Art education has no contribution to the individual.	315	1.15	0.553	1000	5000
	16. Art education makes people uneasy.	315	1.14	0.529	1000	5000
	17. Art education does not support critical thinking.	315	1.26	0.678	1000	5000

Role of Communication Enhancer	18. Art education is beneficial in improving interpersonal communication skills.	315	4.38	0.875	1000	5000
	19. Art education improves communication skills.	315	4.47	0.706	1000	5000
	20. Art education has the power to positively support the cognitive, physical, emotional, and social skills of the person.	315	4.66	0.639	1000	5000
Role of Significance	21. Rather than allocating a budget for art education, more important needs should be met.	315	1.57	0.887	1000	5000
	22. Instead of art education, other fields should be given more space.	315	1.60	0.895	1000	5000
	23. Arts education can also be omitted.	315	1.30	0.736	1000	5000

The Attitude Towards Art Education Scale, which consists of 4 different sub-dimensions, was filled by 315 participants. There are 10 questions in the sub-dimension of Enjoyment of Art and Contribution of Art, and the mean of the sample on this scale was 4.59. The mean for the sub-dimension of the Negative Attitudes Towards Art was 1.18, and the mean for the Role of Communication Enhancer was 4.50. The mean for sub-dimension of the Role of Significance was calculated as 1.49. While the sub-dimension that has the highest mean score was Enjoyment of Art and Contribution of Art, the Negative Attitudes Towards Art sub-dimension has the lowest mean score. The item "Art education supports the creative side of people" in the scale has the highest mean score of both the Enjoyment of Art and Contribution of Art sub-dimension and the whole scale. The item with the lowest mean score of the scale was "Art education makes people uneasy" in the Negative Attitude Towards Art sub-dimension.

Table 5. Inclusion of Art Education Questionnaire

Inclusion of Art Education		Frequency (*f*)	Percentage (%)
1. Do you consider the art education you have received in your education life sufficient?	Yes	110	34.9
	No	94	29.8
	Partially	109	34.6
2. Do you find yourself sufficient in the art activities you practice?	Yes	209	66.3
	No	13	4.1
	Partially	92	29.2
3. Are there any art activities you attend outside of school? If yes, what is the frequency?	Once a week	15	4.8
	Every two weeks	11	3.5
	Once a month	43	13.7
	Once a year	46	14.6
	Disagree	200	63.5

4. Do you consider art education necessary in pre-school education?	Yes	308	97.8
	No	2	0.6
	I do not know	5	1.6
5. Do you include an art activity every day?	Yes	144	45.7
	No	171	54.3
6. How many times a week do you hold art activities?	1	5	1.6
	2	33	10.5
	3	110	34.9
	4	80	25.4
	5 and more	87	27.6
7. How much time do you devote to an art activity you do?	Less than 30 min	88	27.9
	Less than an hour	160	50.8
	1-2 hours	61	19.4
	3-4 hours	4	1.3
	All day	2	0.6
8. Which methods and techniques do you use in art activities?	Demonstration	95	30.3
	Question-Answer	52	16.5
	Discussion	9	2.8
	Lecture	35	11.1
	Hands-on	110	34.9
	Other	14	4.4
9. What kind of painting techniques do you include in your art activities?	Watercolor	96	30.6
	Crayons	110	34.9
	Finger Paint	30	9.6
	Gouache	4	1.3
	Dry Paint	74	23.3
	Other (felt-tip pen, marbling paint)	1	0.3
10. Which of the art activity types do you use the most?	Painting	152	48.5
	Tearing-Gluing	29	9.3
	Cutting-Gluing	105	33.0
	Folding	3	0.9
	Three Dimensional	22	6.9
	Kneading	4	1.3
11. Which materials do you use more often in art activities?	Scissor	167	53.4
	Paint	117	36.9
	Glue	12	3.8
	Dough	9	2.8
	Types of Paper	10	3.2

12. Do you use molds in art activities?	Yes	114	36.2
	No	30	9.6
	Sometimes	171	54.2
13. Where or how do you get the molds you use?	Internet	217	69.1
	Books etc.	20	6.3
	I make myself	78	24.6
14. What is the status of your students' participation in art activities?	All of them	279	88.6
	Half of them	35	11.1
	Few of them	1	0.3
15. How would you rate your students' attitudes towards art activities?	Very good	128	40.6
	Good	149	47.3
	Average	38	12.1
16. To what extent can you achieve the objectives you want to achieve in the art activities you implement?	All of them	64	20.3
	Most of them	244	77.5
	Some of them	7	2.2
17. Do you rate your students' products at art activities?	Yes	36	11.4
	No	210	66.7
	Sometimes	69	21.9
18. Is the process or the product important to you in your art activities?	Process	120	38.2
	Product	15	4.7
	Both Process and Product	180	57.1
19. Do you receive support from the school administration for your art activities?	Yes	77	24.4
	No	113	35.9
	Sometimes	125	39.7
20. Which area of development do you think art activities support the most?	Motor	240	75.6
	Cognitive	41	13.7
	Self-care Skills	4	1.3
	Language	1	0.3
	Social-Emotional	29	9.1

When Table 5 is examined, only 35% of the pre-school teachers in the research group find the art education they have received during their learning process sufficient, while 66% consider themselves sufficient in the art activities they practice. 64% of teachers do not participate in any art activities outside of school.

While 98% of the teachers consider art education necessary within the scope of pre-school education, only 45% include art activities every day. In terms of the time that teachers allocate to art activities, 50% of them allocate less than an hour. During the activity, 65% of the teachers use the

demonstration and hands-on method, and 58% use crayons and dry paint. 48% of the teachers use painting as an art activity, 54% prefer scissors as a material, only 10% do not use ready-made molds, and 70% of teachers who use ready-made molds obtain these molds from the internet. 88% of the teachers stated that children participate in art activities, 40% stated that children's attitudes towards art activities are very good. 20% of the teachers stated that they could achieve all the objectives they want to achieve in art activities, 66% of them did not rate the art products of the students, 57% of them stated that the product and process are important together in the evaluation of art activities. Only 25% of the teachers stated that they received support from the school administration to implement the art activities. Regarding the contribution of art activities to the developmental areas of the child, 75% of the teachers stated that they supported motor skills, while only 1 teacher stated that they also contributed to language development.

4. Discussion, Conclusion and Suggestions

The study, which aimed to determine the attitudes of preschool teachers towards art education, was carried out with 315 preschool teachers. 90% of the teachers were women and 85% had a bachelor's degree. 70% of the teachers had 0-10 years of service. It can be said that the knowledge and experience of these teachers regarding the art education courses they took in their undergraduate education was more recent. The art education courses they took during their undergraduate education may have a positive/negative reflection on their classroom practices. In the study of Büyükyıldırım (2018), when the teachers were asked about the proficiency of the visual arts course they took during their undergraduate education, the participants stated that they mostly spent the visual arts course they took throughout their education life by working at their own level. In this case, the participants may not have knowledge about what kind of work they should have pre-school students do when they graduate and start their professional life. In the same study, the researcher stated that teachers mostly made their knowledge and experience on this subject by imitating what they saw from their colleagues in the same branch in their professional life, and they made students do activities by trial and error.

Based on the findings related to the scale used to determine teachers' attitudes towards art education, the sub-dimension scores of Enjoyment of Art and the Contribution of Art and the Role of Communication Enhancer indicate positivity as they approach 5, Negative Attitudes towards Art and the Role of Significance sub-dimension indicate negativity as they approach 5. The mean score of enjoying art and believing in the contribution of art was 4.59, and the mean score of the role of communication enhancer was found to be 4.50. These findings can be interpreted as the teachers like art,

believe in the contribution of art, and show an attitude that it increases communication.

Bae (2004), in his study aiming to determine the role of the teacher in visual arts education in early childhood, indicated that teachers lead children to discover new ways and to creative discussions to develop children's perceptions of art. In the research conducted by Bae (2004), the inclusion of creative discussions aimed at developing children's art perceptions can be interpreted as being compatible with the communication-enhancing role of art education. Teachers' views on art are very important for the successful implementation of art education among children of different education levels (Hui, He, & Sam Ye, 2015). It is stated that in order for art education to achieve its purpose and benefit children, teachers must first have an artistic perspective and teachers themselves must be creative, and it is argued that the most effective teachers facilitate meaningful art experiences. According to the research findings, the mean score of the negative attitudes of preschool teachers towards art was calculated as 1.18, and the role of significance was calculated as 1.49. This situation can be interpreted as teachers do not have a negative attitude towards art and they believe in the importance of art education.

Teachers think that art education contributes to the child, gives peace, and supports critical thinking. Studies have shown that art education is effective in improving reading and comprehension skills (Gravalin & Maki, 2013), increasing student creativity (Nderu-Boddington, 2008), contributing to the development of thinking skills and aesthetic sensitivity, and raising environmental awareness. The results of the study support such findings.

When we look at the findings of the survey to include art education, 30% of the teachers did not find the art education they have received in their education life sufficient, while 67% found themselves sufficient in the art activities they practice. Approximately 64% of teachers did not participate in any art activities outside of school. This situation can be interpreted as the teachers feel competent in art education activities, but they are reluctant to update themselves and develop new perspectives. Contrary to the results of the research, Özkan and Girgin (2014) stated in their study that the majority of teachers (88.2%) found the art education they received during their undergraduate education insufficient. When the related literature is examined, it is emphasized that art depends on teachers' personal interests, and classroom art practices depend on each teacher's art education philosophy and the amount of art education they receive in the teacher training process (Eckhoff, 2011; Garvis, 2012). In order for teachers to develop positive attitudes towards art education, they should improve themselves in organizing different materials, different techniques,

and in-class and out-of-class education environments (Aslantaş, 2013).

Considering the frequency of pre-school teachers' including art activities, 45% of them included art activities every day, 53% of them did art activities 3 times a week and 50% of them allocated less than 1 hour to these activities. Findings regarding the state and frequency of teachers' inclusion of art works in the education program can be interpreted as including art activities in the education program more than once a week. In the study conducted by Özkan and Girgin (2014), it was determined that the majority of teachers (76.5%) included art works in their education program "every day". In a study supporting the research findings, Ünal (2018) found that teachers include art more than once a week regarding the status and frequency of including art work in the education program of teachers. Art education is of great importance in the intellectual, sensory, and psychomotor development of children. The activities practiced in art education, the method and techniques used, and the frequency of the teacher's involvement in these activities are important in terms of contributing to the development of the child and achieving the purpose of the practices. 30% of the teachers participating in the research used the demonstration method, 35% used the hands-on method, and 11% used the lecture method. Supporting the research finding, Özkan and Girgin (2014) determined in their study that the methods and techniques used by the teachers in art activities were 47.1% the lecture and 29.4% hands-on. In their activities, 35% of the teachers prefer crayons and 24% dry paint. In order to provide and support creativity, problem-solving skills, and aesthetic sensitivity of children, children should be included with different methods and different applications, not just one type of activity and method. In the research, the reason why the teachers mostly used the demonstration method, crayons and dry paint as paint, can be interpreted as they feel inadequate and do not have awareness of what different techniques and paints will contribute to the child. According to Feeney and Moravick (1987), if children's creativity and aesthetic feelings are not supported at an early age, they may be prevented from being creative and productive individuals who perceive the beauty around them in the future. Teachers mostly use paint (37%) and scissors as material (54%), only 10% did not use ready-made molds in art activities, 70% of teachers who use ready-made molds acquire these molds from the Internet. In his study, Ünal (2018) found that the art works that teachers include most in the education program are "painting", "collage", "ceramic" and "paper" works. In Özkan and Girgin's (2014) study, it was stated that the most frequently used art works by teachers were painting (52.9%) and tearing-gluing (33.3%). Yılmaz and Özler (2011), in their study, stated that the visual art activities made by kindergarten teachers for children, such

as imitation, stencil, copying, making for students, commonly contain negative examples in terms of creativity when students are most creative; activities that are not suitable in terms of learning outcomes that constitute the visual arts course curriculum in kindergartens were widely included; technical richness and material diversity, which have an important place in the development of creativity, are not given the necessary importance; and students are generally condemned to several types of paint materials.

When we look at the students' participation in art activities, 88% of the teachers stated that all the children participated, that the students' attitudes towards art activities were very good (40%), and that only 20% of the teachers stated that all the objectives they wanted to achieve were achieved. Teachers cared about both the product and the process in art activities (57%), 25% of them got support from the school administration for art activities, and only 1 teacher stated that art activities improved the children's motor skills (76%) and contributed to language skills. Art is a powerful tool for children to cope with their emotions, to express themselves, and for teachers to communicate with children (Zaidel, 2013). In the process of art activities, teachers' communication with children, asking questions that develop creative and thinking skills, and allowing the children to express themself reveal the contribution of art to communication, language development, and vocabulary. Although the teachers within the scope of the research thought that art education increased communication, they did not have awareness of its contribution to language development.

Avcı and Sağsöz (2018), on the other hand, revealed in their research that the average participation levels observed in visual art activities of all children in the classroom differ significantly according to the artistic orientation of the teacher. The average level of participation in visual arts activities of the children in the classes where the unstructured approach is used is higher than the average level of participation of the children in the classes where the product-oriented approach is used. This finding indicates that children are more interested in open-ended activities that allow them to make independent discoveries, rather than closed-ended activities that focus on product producing based on a model. The teacher is the person who organizes the art education by organizing the environment, teaching children the use of materials, talking about what they are doing with materials, and exhibiting and storing their products; and keeps track of the practice; and guides students where necessary. For this reason, in art education, care should be taken to ensure that the education process is student-centered, not teacher-centered. Children should show their creativity by working with whatever they want and in the way they want from a variety of materials in an environment specially prepared for them. In terms of art education, it can be said that although teachers like art, believe

in the contribution of art, believe that it increases the communication, do not hold negative attitudes towards art and believe that art is important; they cannot reflect these attitudes in classroom activities. Teachers who believe in the place, effect, and support of art in the child's life should establish a cause and effect relationship about colors, shapes, textures and concepts, and reflect children's artistic expressions to their practices that develop their physical, mental, emotional, and fine motor skills, and visual-motor coordination.

Based on the results of the research, although preschool teachers exhibit positive attitudes towards art, they should be supported in order to reflect these attitudes in their practices. It can be suggested that teachers participate in in-service training and workshop activities, increase their awareness and experience in different teaching methods, paint techniques, use of materials, artistic criticism, and enriching the process in activities.

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CHAPTER 4

MULTI-USER VIRTUAL ENVIRONMENTS IN FORMAL AND INFORMAL LEARNING SETTINGS: STUDENT AND TEACHER PERCEPTIONS[1]

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1 This study is produced from the dissertation titled "The perceptions and experiences of students and teachers in formal and informal learning settings that uses MUVEs: Quest Atlantis case" completed by the first author at the Graduate School of Natural and Applied Sciences at Middle East Technical University.

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1. Introduction

With the wide use of technology, the way societies live has been changing. It is a necessity of the era we are in that educational institutions, as one of the indispensable priorities of the society, should keep up with technology. Increasing exposure to technology is changing the habits of learners and differentiating their interests. Today's students, called digital natives, have different thinking, reading, research, socialization and learning skills because they are intertwined with technology from the moment they are born; preferring visuals to texts while learning, being able to carry out many tasks simultaneously, being active in learning and preferring digital games to homework can be counted among the prominent features of this generation (Prensky, 2001a, 2001b). For this reason, it is important to restructure educational environments with technology supported by concrete and interesting learning content, in which students actively participate.

The educational use of technology provides students with effective learning environments (Agrawal & Mittal, 2018) where they can construct new knowledge through exploring, experimenting, and interacting (Jonassen, Peck & Wilson, 1999). Students can either work individually or collaboratively while being engaged in an educational problem (Nelson, 2007). They regard technology as a means to be used in education for information search, collaboration, communication, writing and visualization (Lindberg, Olofsson & Fransson, 2017). The use of technology removes the borders of learning (Livingstone, 2012), promotes creative, integrative and active learning (Raja & Nagasubramani, 2018) and fosters adaptive learning (Hernandez, 2017). Having its origins from Multi-User Dungeons (MUDs), Object-Oriented Multi-User Dungeons (MOOs) and Internet Relay Chats (IRCs) (Damer, 1997), Multi-User Virtual Environments (MUVEs) can be regarded as a good example of recent technologies to be used in educational settings.

1.1. MUVEs

As technology evolves, the educational media and methods used in classrooms have also changed. MUVEs are one of the promising technologies to conduct or to support educational activities. MUVEs are 3D online virtual environments where large number of users can interact with each other and with non-player characters (NPCs) (Nelson, Ketelhut, Clarke, Bowman & Dede, 2005). MUVEs "enable multiple simultaneous participants to access virtual contexts, to interact with digital artifacts, to represent themselves through "avatars" to communicate with other participants and with computer-based agents, and to enact collaborative learning activities of various types" (Ketelhut, Clarke, Dede, Nelson & Bowman, 2005, p. 2). According to

Chen, Yang and Loftin (2003) the characteristics of MUVEs are 1) centering the curriculum on real-life problems, 2) allowing communities of practices emerge, 3) letting students involve in inquiry-based learning activities, and 4) ensuring knowledge construction where the students are active and can collaborate with each other. MUVEs can be used with a wide range of age groups when the technological infrastructure in schools suffice the requirements and they meet the curricular aims. As Dede, Clarke, Ketelhut, Nelson and Bowman (2005a) claim, MUVEs are more like computer games in terms of their similarity to creating real-life-like learning experiences that are immersive and problem-based.

As a popular media among youth, MUVEs make it possible to meet people across the world. This interaction among people can possibly go beyond having chat and can turn into a learning community where students collaborate (Hong, 2013). Once you log in to these portals, you step up to a 3D environment where you can also do shopping, participate in business meetings, meet new people, or just have fun. In addition to these real-life-like occasions, these environments provide with experiences to people for enrolling in learning opportunities that is either pure online or designed as a supportive part for a face-to-face class. Nevertheless, these open to public MUVEs (e.g. SecondLife) have been criticized since it enables students move out of the educational context, to communicate other people misbehaving, and to interact with malicious content, because it is free and there are also other people around using the same places for different purposes (Pence, 2007; Antonacci & Modaress, 2008; Harris & Rea, 2009). Therefore, for formal education, especially with young age group of students, these 3D places can turn into a threatening place, which is a sufficient reason for people for disuse of MUVEs in education. There are other examples of MUVEs (such as Quest Atlantis, River City) designed specifically for educational purposes and they are safer virtual settings for young students by only allowing groups of teachers' and students' access.

1.2. MUVEs in Education

MUVEs are relatively new technology-based environments and they let teachers provide their students with tools that situate theoretical content (Barab et al., 2007; Fokides & Chachlaki, 2020). Dede, Clarke, Ketelhut, Nelson and Bowman (2005b) assert that MUVEs can be effective environments for students to participate in learning. Barab, Gresalfi and Arici (2009, p. 77) name the type of the learning experience in MUVEs as "transformational play" in which "a player must become a protagonist who uses the knowledge, skills, and concepts embedded in curricular content to make sense of a fictional situation and make choices that transform that situation". According to the authors, playing in or visiting virtual worlds does not always result in learning; rather, transformational play is necessary

in order to ensure learning. Having involved in transformational play, the students are immersed in the learning environment and experience the subject matter.

MUVEs with educational purposes let students involve in inquiry-based learning practices that are highly immersive (Erlandson, Nelson & Savenye, 2010). Within these immersive environments, the students act on their own learning by studying the ill-structured problem (Parson & Bignell, 2017). They "gather data, comment on and annotate it, synthesize and analyze, and distribute content essentially in real time" (Steinkuehler & Squire, 2009, p. 10). Moreover, students take on a role and internalize it (Barab, Gresalfi & Arici, 2009), through which they get the feeling of social presence, too (Omale, Hung, Luetkehans & Cooke-Plagwitz, 2009).

MUVEs, as being interactive learning environments, have many advantages. Students can be involved in a motivating, fun and effective learning process (Fokides & Chachlaki, 2020). Ensuring learner engagement, MUVEs allow knowledge construction in which the learner actively participates and therefore empowers cognitive skills (Kalyuga, 2007). The visual features of MUVEs give a chance to the users to have a feeling of being in that virtual area (Warburton, 2009), which increases the sense of social presence (Esteve-González, Cervera & Martínez, 2016). The multi-user feature of the MUVEs gives opportunity for the students to interact with other students with a variety of skills all around the world.

2. Purpose of the Study

The curriculum of Turkey was changed recently in accordance with constructivist approach. The aim was to shift education into a more student-centered approach. It was restructured in a manner that students would be equipped with skills such as communication, inquiry skills, problem solving, creative thinking, critical thinking and computer and Internet use proficiency (Board of Education, 2005). Regarding this change, teachers have been encouraged to use technology based materials in their classes as well. With this new curriculum and the change in the learning approach, it is important to provide students with variety of learning opportunities so that they gain expected skills and qualifications. As the literature review above shows, MUVEs seem promising in this respect. When an innovative technology is integrated into educational environments, it is important to analyze the perceptions of teachers and students. With this aim, the current study investigates the following research questions.

1. What are the students' perceptions of using MUVE?

a. How do they perceive their experiences that they have while using MUVE?

b. What are students' likes and dislikes regarding MUVE?

c. How do they compare learning experiences in MUVE with learning in traditional classrooms?

2. What are the teachers' perceptions of using MUVE?

a. How do they perceive the use of MUVE as a technology based educational material?

b. How do they evaluate students' learning in MUVE?

c. How do they perceive their role during the implementation of MUVE?

3. Methodology

For this study, qualitative research methodology was chosen since the purpose was to investigate the research problem in a detailed way and to understand the situation from the participants point of view. As the type of the qualitative research method, multiple case study was selected. According to Gillham (2000, p. 1) case means "a unit of human activity embedded in the real world; which can only be studied or understood in context; which exists in the here and now; that merges in with its context so that precise boundaries are difficult to draw". Case study is defined as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context" (Yin, 2009, p. 18). A case study may investigate an individual, a group, or a community. Multiple case study method allows the researchers to deeply analyze more than one case (Stake, 2006). In the scope of this research, the selected cases are student groups and their teachers from two private schools, and student groups from a non-governmental organization (NGO). All the implementations were conducted in computer labs.

Case 1 – Formal Learning Setting: First case was selected from a private school in which the classrooms were equipped with a computer and a projector. Science classes took place in classroom and science labs. The teacher was female and had twenty-five years of teaching experience. The research implementation took five weeks in this case (orientation time not included).

Case-2 – Formal Learning Setting: This case was selected from another private school. The school was equipped with technology and open to technological innovations. As in the first case, science classes took place in classroom environment and science labs. The teacher was female and she had ten years of teaching experience. The implementation took four weeks (orientation time not included).

Case-3 and Case-4 – Informal Learning Setting: Both cases took

place in the same NGO. The organization aims to contribute to educational practices executed in school. The target group is students aged from seven to sixteen. There are no teachers but volunteers facilitating the educational activities. This research implementation was presented during summer period as an extra-curricular and voluntary activity. Implementations took three weeks long in each case; nevertheless, it took longer than the first two cases on an hourly bases.

Facilitating the implementations and collecting data in all cases, the first author was participant-observer (Merriam, 1998; Fraenkel & Wallen, 2003; Johnson & Christensen, 2004). In cases 1 and 2, implementations were facilitated by the first author; the teachers were present, guiding and observing as well. Teachers did not want to carry out the activities as they both said they did not feel competent enough with the MUVEs and did not have time to be prepared. In the cases 3 and 4, the first author took the volunteer role in the organization and facilitated the implementations, too.

3.1. Characteristics of the Cases

Student Demographics: The distribution of participants in each case is provided in Table 1. The students in the formal learning settings had families with high socio-economic status (SES) and had home computer with Internet access. More than half of the students had a game console, and playing computer and console games were their favorite pass time activity. The games they played had high-graphics resolution. The majority of the students had been using computers and Internet for more than five years.

For the students in the informal learning setting, the SES of families were low and most of the parents were primary or secondary school graduates. Mothers were housewives and fathers were self-employed. The students had been enrolled in government schools, some of which did not have a science lab. Half of the students had home computer; but, few had Internet access and game console at home. They had been using computers for 2-3 years in case 3 and 1 year or less in case 4. The games they played were casual; only few played games with high-graphics resolution.

Table 1 *The comparison of cases*

	Case 1	Case 2	Case 3	Case 4
Setting	Formal	Formal	Formal	Formal
Number of students	20 (7 female, 13 male)	24 (12 female, 12 male)	9 (3 female, 6 male)	16 (10 female, 6 male)
Home computer	20	24	4	8

Internet access at home	18	24	3	7
Game console	14	16	1	4

Teacher Demographics: In school cases, science teachers were both female, teaching in private school and had special interest towards technology usage in education. Types of the technology use in their classes were mainly making PowerPoint presentations (mainly scanned pages of science book), and showing videos and pictures related with the lesson. Type of the activity their students sometimes enrolled was simulations of experiments. Teachers rarely used the computer lab due to availability issues.

3.2. The MUVE: Quest Atlantis

Also conceptualized as a meta-game, Quest Atlantis (QA) is a multi-user virtual environment. It was designed as an innovative technology-rich learning environment including curricular tasks "to provide a meaningful context for significant learning and pedagogy" (Barab, Arici & Jackson, 2005, p. 15). According to Barab, Thomas, Dodge, Carteaux and Tuzun (2005, p. 2), QA "leverages a 3D multi-user environment, educational quests, unit plans, comic books, a novel, a board game, trading cards, a series of social commitments, various characters, ways of behaving, and other participant resources". Target group is elementary school students aged nine to fifteen. The virtual environment is immersive in that students take active role in their learning. It allows students to experience and learn in a content- and context-rich game-like environment (Codier, 2016). The aim is not only to support students with learning activities but also to let them have fun while studying and to improve social responsibility skills through QA Social Commitments. Quests cover a variety of subject areas. Students can either work individually or collaboratively. Each student has an online portfolio. With Teacher Toolkit, teachers can manage their classroom activities, follow their students' progress, review logs and statistics.

In addition to providing with a game-like 3D virtual environment, QA supports students with 2D web interface and chat options (Fig. 1). Students have the opportunity to browse on the online web-pages while communicating with their friends online as they walk in 3D space with their avatars.

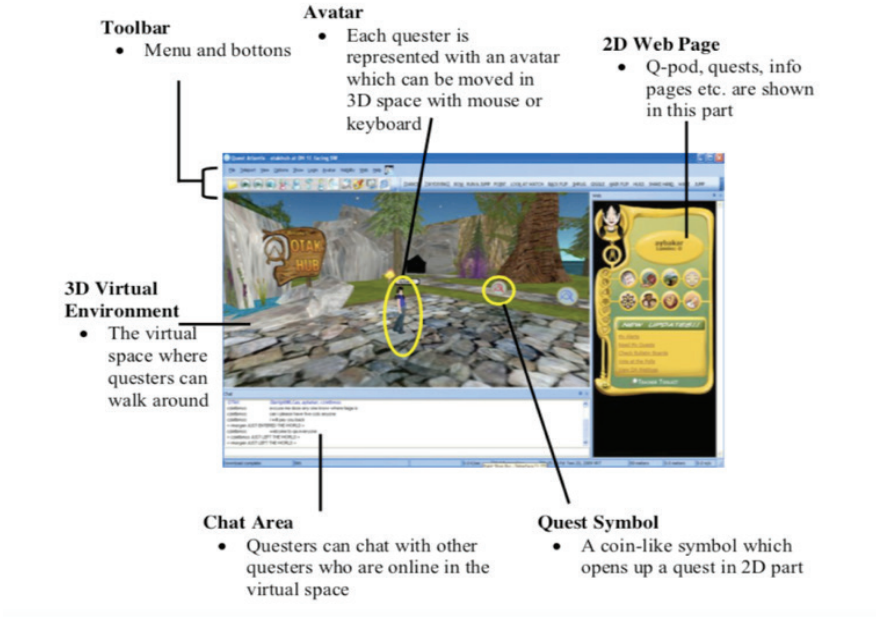

Fig. 1 *The interface of QA*

3.3. The Implementation

In QA, there are some virtual worlds, with their own narrative, presenting a multidimensional immersive problem. The Taiga world is one of them. Taiga covers the multifaceted problem of water quality in the Taiga Natural Park that causes the decrease in the fish population. Barab et al. (2007, p. 753) defines this underlying narrative of Taiga as not a simple story, but as "transactive trajectories that unfold in relation to evolving student understanding and application of disciplinary formalisms". The activity starts with a letter from Ranger Bartle, the park administrator, explaining the current problem they have been through and asks for students help to solve this environmental issue. After that, the students, as field investigators, start conducting research and collecting data about the possible reasons of the problem. Meanwhile, they take notes on their worksheets. Students are required to approach the issue from a multidimentional perspective (Barab, Sadler, Heiselt, Hickey & Zuiker, 2007). There are groups of people living around Taiga river, park administrators trying to sustain the park and several other NPCs. Students can interact with each character; each of which tells the story from their perspectives, gives information about the problem and mainly blaming other groups. Students can also take photos of the area from different locations, read notes, graphs or tables, and analyze water samples of the river. After this multifaceted research, students come up with a solution.

When they submit their work, they are teleported to the future version of Taiga where they can see the results of their suggestion.

Since the original world was in English, for this study Taiga world is cloned with all the quests attached to it; and translated to Turkish. Moreover, to make the topic more relevant, the story was associated to the longest river in Turkey, Kızılırmak. By preserving the original story, a number of minor changes have been made to make the activity in line with the curricular objectives and to shorten the activity due to time constraints.

3.4. Data Collection Methods

Qualitative research method requires in depth data collection (Patton, 2002), therefore, a variety of data collection methods were utilized in order to better understand each case in detail (Table 2). Each tool was developed by the researchers, reviewed by field experts and pilot tested. The interviews were tape-recorded and the observations were video-recorded. In case 2 due to permission issues, the student data was relied on the observation records, field notes and instant questions asked during the implementations. For the teacher perceptions of cases 3 and 4, the results was deduced from observations and field notes by the first author.

Table 2 *Data collection tools*

	Case 1	Case 2	Case 3	Case 4
Students demographics questionnaire	✓	✓	✓	✓
Teacher interviews	✓	✓		
Student interviews			✓ (3 students)	✓ (10 students)
Student perception questionnaire	✓			
Teacher perception questionnaire	✓	✓		
Observations	✓	✓	✓	✓
Field notes	✓	✓	✓	✓

3.5. Data Analysis

Qualitative studies end up with a large amount of data collected through different methods. The analysis starts with reading through the data to get a sense of it. What comes next is “line-by-line analysis” (Strauss and Corbin, 1998, p. 57). Codes emerge from the data and make sense in the scope of the study. The analysis of the data in this study went through three main steps: 1- transcription of all data, 2- reading through each data set to make a sense of it, 3- conducting content analysis to create themes and codes and explain each by giving examples coming from the data set. Data analysis was conducted with QSR NVivo.

Trustworthiness refers to validity and reliability issues in case study research (Bassey, 1999). To provide with trustworthiness, issues considered by the researchers included triangulation (Johnson and Christensen, 2004), peer review (Miles and Huberman, 1994), rich descriptions, and long term interaction.

4. Results

The results from the cross-case data analysis is provided in this part regarding research questions.

4.1. Research Question 1 – Student Perceptions of Using QA

Table 3 shows the results of cross-case analysis of students' experiences. Students explained their experiences of the implementation by stating that they enrolled in a scientific activity taking place in 3D environment in which they acted as a researcher/scientist, investigated the problem case, collected data, and took field notes. Moreover, they stated that they had learned throughout the project. According to most of the students in informal cases, the project and the MUVE contributed to their learning (such as science concepts, environmental awareness, making research, inquiry skills, computer literacy skills, and self-confidence). Most of the students in each case thought that the project was easy to finish since it was easy to collect data and to finish planned tasks. There were just a few students who found the project difficult to finish due to work load. The students in all cases found the project a fun way of learning. As the project required collecting several versions of data, the printed notebook helped students combine and sort the data and their field notes.

Table 3 *Student perceptions about their experiences*

	Case1	Case2	Case3	Case4
Easy project	✓	✓	✓	✓
Difficult project	✓			
Contributing to learning			✓	✓
Taking notes helped solving the problem			✓	
Fun way of learning	✓	✓	✓	✓

The cross-case analysis results of students' likes are summarized in Table 4. In all of the cases the students liked gaming elements situated in 3D environment such as driving cars, having an avatar, walking around with it in 3D environment, discovering new places, and even swimming. They also liked being able to see and interact with friends online in 3D worlds. Being presented in the form of a human-like-avatar made them feel they are really experiencing the environment in person and they see

and feel the presence of their friends online. Students liked acting like a researcher trying to solve an environmental problem. The students in cases 3 and 4 also liked the opportunity of interacting with NPCs in Turkish since they had lack of English knowledge. This issue did not come out in cases 1 and 2 because the students were well-educated in English. Regardless of the cases the students liked being involved in the project and liked learning science concepts in a game-like environment.

Table 4 *Students' likes*

	Case1	Case2	Case3	Case4
Gaming elements (e.g. avatars, driving cars)	✓	✓	✓	✓
Interaction with friends	✓	✓	✓	✓
Interaction with NPCs			✓	✓
Being involved in the project and learning in QA	✓	✓	✓	✓
Acting like a scientist/researcher	✓		✓	

Students' dislikes across cases were provided in Table 5. In all of the cases, students stated that they disliked technical problems (slow Internet access, deficient capacities of computers) and bugs. It was not very common but when happened, it prevented students complete their work and caused QA software stop running. Then the students had to restart either the software or the computer, which distracted their studies. In school cases time limitation emerged as a dislike. In the cases that take place in informal learning setting, the students experienced the problem of being lost in 3D worlds. QA's English interface also made it harder for them to get rid of this situation. This could also be due to their prior gaming habits. Using QA was more exciting experience for the students in informal cases, because they did not have a similar experience before. On the other hand, some of the students of cases 1 and 2 found the software deficient in terms of gaming elements and graphical features due to their previous gaming habits. Some students in case1 even stated that they did not like QA at first but their opinions changed as the implementation progressed. For some of the students, the project was complex, reading through all the data was kind of boring, and they also disliked taking notes on their printed notebooks. In all of the cases, this was the first time the students involved in a MUVE project and it seemed they expected more gaming than reading or writing.

Table 5 *Students' dislikes*

	Case1	Case2	Case3	Case4
Technical problems and bugs	✓	✓	✓	✓
Limited time for implementation	✓	✓		
Complex, reading through all the data and taking notes	✓	✓	✓	✓
Getting lost in 3D world			✓	✓
Deficiency of QA in terms of gaming elements	✓	✓		

Students were asked to compare their regular science class activities with the inquiry-based science project in QA (Table 6). In all of the cases, students found the project fun and useful for their learning as bringing fun and learning together. They asserted that the project led them to science and to become a scientist, and it increased their interest towards either to science or environmental issues. On the other hand, few students in case 1 could not relate the project with science curriculum. This might be due to the project was a more different type of an educational activity than what they got used to. In fact, the project was chosen with the opinions and approval of the science teachers as being compatible with learning outcomes. Comparing with their school homework, the students found QA as more fun way of doing homework, with the opportunity to communicate with their friends, being online and being able to use the computer.

Many students asserted QA and the project was more motivating than their in-class science activities. QA project was mainly student-centered. The main teaching method in traditional class setting was lecturing, sometimes enrichened with lab experiments, and the main material was textbook. Especially in case 3 and case 4, the students complained about the science lessons as being teacher-centered and not having opportunity to express themselves or to practice what they have learned. The problem was related with crowded classrooms and teacher centeredness in their schools.

Table 6 *Students' comparison of QA implementation with traditional class setting*

	Case1	Case2	Case3	Case4
QA - More motivating / increased interest	✓	✓	✓	✓
QA - Could not relate with curricular science content	✓			
QA - Learning and fun together	✓	✓	✓	✓

Class - The use of text-books as the main source	✓	✓	✓	✓
Class - Lecturing in class as the main teaching method	✓	✓	✓	✓
Student-centered vs. teacher-centered			✓	✓
QA - Can express their opinions			✓	
Crowded classrooms in school			✓	✓
QA - Feeling more successful			✓	✓
Class - Teacher authority			✓	✓

4.2. Research Question 2 – Teachers' Perceptions of Using QA

Teachers' opinions about the use of QA as a technology-based supportive educational materials are summarized in Table 7. According to the results, using QA was beneficial for students to learn and to practice, and it was also more motivating when compared to regular in-class activities. The teachers found QA as an effective material with that the students could better remember what they had learned.

About the reading/writing parts of the project, the amount was found excessive in all cases. Students did not want to read or write much, which caused some students lose their motivation. However, none of them gave up because they were thrilled by the project. The time limitation in school cases was more of limiting. The teachers asserted that if there were more time, it could have been better.

Table 7 *Teachers' opinions about using QA*

	Case1	Case2	Case3	Case4
Beneficial	✓	✓	✓	✓
Motivating		✓	✓	✓
Learning by doing / practicing knowledge	✓	✓	✓	✓
Excessive reading/writing	✓	✓	✓	✓
More time needed	✓	✓		

Teachers' opinions about students' learning in the QA setting are summarized in Table 8. Teachers' opinions were positive in general. According to case 1 teacher, this project showed students could learn through games, however students needed some time to gain the discipline of this new learning method and to get used to it. Students were accustomed to learn through lecturing as the main teaching method and books as the main material. Using MUVEs for learning could be a handicap for them. Both teachers claimed that students mostly were interested in the project;

nevertheless, there were few uninterested students who were not very much into either the project or QA. There were just a few students with lower level of interest in cases 3 and 4 as well. This might be the related with different student learning styles.

In all cases, the potential of MUVE in providing students learn visually and by doing was pointed out. Moreover, the teachers believed that it enhanced students' skills (e.g. creative thinking, scientific thinking, analytical thinking, reading skills, critical thinking, problem solving). The teachers and the first author claimed the students could easily transfer what they learned to real life. They became aware of how important it was to protect their environment, the trees, and the animals as ecology was a complex system.

The teachers agreed that the students liked technology and they used it in their daily lives. Even case 1 teacher claimed that her students were more competent in technology use than herself. Case 2 teacher claimed the project did not only increase students' knowledge and awareness about environmental issues, but also enhanced their technology use skills. She also added that with the features QA provided, students could track their own learning progress as well.

In cases 3 and 4, scaffolding of students, especially of the younger ones, was emerged as an important theme. The field notebook was very helpful in scaffolding students in organizing their work and the data they collected. Field notebook gave clues to the students about what to do next to successfully complete the activity. Scaffolding was also conducted through classroom discussions that were held in order to make students share information with each other, decide on how to use the data they collected and think about the problem considering about others' perceptions of it. In informal cases, collaboration and competition among students emerged as a theme as well. The students who were more competent using QA helped peers during the project. They also competed with each other in order to complete the project first.

Table 8 *Teachers' opinions about students' learning*

	Case1	Case2	Case3	Case4
Enhances students' thinking strategies	✓	✓	✓	✓
Visual learning	✓	✓	✓	✓
Learning by doing	✓	✓	✓	✓
Students like technology	✓	✓	✓	✓
Students can track their progress		✓		

Transfer of learning	✓	✓	✓	✓
The importance of scaffolding			✓	✓
Collaboration and competition			✓	✓

The teachers mentioned about teacher's role in an educational environment where MUVEs are used (Table 9). Case 1 teacher believed in the effectiveness of technology-related implementations. She asserted that the current curriculum was open to technology-based implementations, but it was at the same time turned into a struggle due to curricular load. The other teacher also indicated that she liked being a teacher in a technology rich environment and mentioned about time problem and curricular load.

Comparing teaching in an educational environment using MUVE to teaching in a traditional classroom environment, case 1 teacher stated the former was more difficult. Feeling confident about technology usage case 2 teacher found it easier in terms of classroom management, assessing students learning and doing the implementation. In fact, as a participant-observer, the first author thought that using MUVEs in classroom environment was not easy at all. Time limitation, technical problems and the need to follow each student continuously and facilitating the activity in a crowded classroom environment was challenging especially in formal cases. In cases 3 and 4, classroom management was still an issue as the project took place in informal setting as a summer-time activity.

Table 9 *Teachers' opinions about teacher role*

	Case1	Case2	Case3	Case4
Teaching was easy		✓		
Teaching was difficult	✓		✓	✓
Like teaching with QA	✓	✓		
Want further use	✓	✓		
Teacher should be proficient	✓		✓	✓
The importance of teacher/facilitator in class		✓	✓	✓

Both teachers claimed that they would use the MUVE in the future. In cases 3 and 4, the importance of facilitator was an emerging theme. It was a complex learning activity and students could easily get lost in the virtual environment or in the activity. The facilitator (or the teacher) should be proficient enough in controlling students' progress, asking inspiring questions, making class discussions, supporting active participation, and scaffolding students.

5. Discussion

MUVEs are known as virtual environments where users can walk around and do tasks while interacting with other users, NPCs, content, or virtual objects (Ketelhut, Nelson, Clarke & Dede, 2010). In this study, the students defined their experiences in QA in a similar way. According to students, QA was a 3D environment where they could wander and interact their online friends and NPCs. They also pointed out that QA let them learn and have fun at the same time because it included both educational activities and game-like features. There are other studies showing students' likes about learning through MUVEs (Bayırtepe & Tüzün, 2007; Bakar, Tüzün & Çağıltay, 2008; Lee & Liu, 2017; Tüzün, Arkun, Bayırtepe-Yağız, Kurt & Yermenday-Uğur, 2008). In fact, in general, learning is imposed to the students as a "work" (e.g. homework or schoolwork) that should be completed before they can play computer games, this is like "eating one's vegetables before getting dessert" (Barab, Arici & Jackson, 2005, p. 15). This idea may transform "learning" to a must-done-work rather than an activity they would like being involved, and therefore cause "over-theorizing and over-valuing product and under-valuing the rich processes of learning, the joy, fun, challenge, and meaning have, in part been stripped out of educational activity" (Barab, Arici & Jackson, 2005, p. 19-20). As the results of the current study showed books were the mainly used materials and the way the teachers used the technology was still teacher-centered. In order to change this and providing constructivist student-centered learning environments, MUVEs can be used as a more fun and engaging way of learning.

Although not been measured through standardized tests in the current study, the students asserted that they learned things like facts about science, environmental issues, how to do research, collecting and analyzing data, and how to be a scientist. The teachers also agreed on this issue by stating QA allowed students learn by doing. In fact, the project was presented as part of the science class in formal cases, but it was an environmental project in informal cases. Despite this, the students in informal cases related their involvement as learning about science, too. The issues students learned were not only about content-related but also about some other skills and knowledge. Studies also claim that students who involved in educational activities in MUVE learn (Borona, Tambouris & Tarabanis, 2018; Dede, Ketelhut & Ruess, 2002; Dempsey, Lucassen, Haynes & Casey, 1996; Lan, 2015; Lim, Nonis and Hedberg, 2006; Loh, Harper & Howard, 2019; Tokel & Cevizci Karataş, 2014; Tüzün, Bilgiç & Elçi, 2019) sometimes even more than their peers who learn through traditional methods (Dede, Clarke, Ketelhut, Nelson & Bowman, 2005a; Ketelhut, Dede, Clarke & Nelson, 2006). They also have fun while learning with a MUVE (Chen, 2016;

Tüzün, Barab & Thomas, 2019), have more satisfaction (Vrellis, Avouris & Mikropoulos, 2016), and become more active (Kuznetcova, Glassman & Lin, 2019). In a similar study using Taiga world in QA, the researchers found "strong evidence that QA intervention supports transfer to externally developed, high-stakes achievement tests" (Barab et al., 2007, p. 768). At this point it is important to point out that MUVEs may not always ensure learning. The way the MUVE structured is very important; situating activities, scaffolding or facilitating learners, supporting interaction, providing with learning opportunities and the quality of the content are all important factors (Squire, 2002). It should be more than just walking around 3D space, which may not result in engagement (Lim, Nonis & Hedberg, 2006) or learning. It depends on the way how the technology and the pedagogy was combined (Squire, 2002). Parson and Bignell (2017) also claim problem-based learning scenarios increase the effectiveness of a MUVE in helping students learn.

Being game-like environments, MUVEs are motivating for the students (Chen & Kent, 2020; Fokides & Chachlaki, 2020; Pares-Toral, 2013; Tuzun, 2004; Tüzün, Yılmaz-Soylu, Karakuş, İnal & Kızılkaya, 2009). In the current study, students and teachers found QA as a motivating instructional material. In addition to game-like features, the mysterious story of virtual worlds and the complex problematic situations to be solved increase students' curiosity and interest towards the applications and learning (Dede, Clarke, Ketelhut, Nelson & Bowman, 2005b). Students' existing interest towards these environments can be used in either formal or informal learning settings with structured learning activities. Prensky (2001c) claim that there is a relationship between learning and having fun: the more students have fun, the more they become motivated towards learning. MUVEs, as game-like environments, offer a different type of learning experience than traditional ones because "it is about finding joy and fascination in the world, asking questions and engaging in inquiry, developing expertise and participating in social practice, and developing an identity as a member within a community" (Squire & Jenkins, 2003, p. 29). In the current study, regardless of the cases, the students thought that QA let learning and fun together. Comparing with science-classes, they added that QA was more motivating and it increased their interests. There are similar findings available in the literature. Tüzün, Yılmaz-Soylu, Karakuş, İnal and Kızılkaya (2009) claim that students have high level of intrinsic motivation and low level of extrinsic motivation while learning in a MUVE. According to Parson and Bignell (2017) MUVEs increase student motivation and makes fun and learning possible together. According to teachers' and students' perceptions, the reasons behind high student motivation could be that MUVEs allowed learning by doing,

visually enhanced learning, sense of involvement, fun way of learning, students' control over their learning process, transfer of learning, and rich interaction.

From the teachers' point of view, QA enhanced students' thinking strategies, made transfer of learning easier and allowed collaboration and cooperation. Gamage, Tretiakov and Crump (2011) claim that teachers thought that MUVEs had positive effects on students' learning by providing students with authentic learning activities. The results were compatible with other studies in the literature. According to studies, MUVEs enhance students' skills, such as creative thinking (Songkram, 2015; Bourgeois-Bougrine, Richart, Lubart, Burkhardt & Frantz, 2019), critical thinking (Warren, Dondlinger & Barab, 2008), collaboration (McFarlane, Sparrowhawk & Heald, 2002; Tüzün, Bilgiç & Elçi, 2019), scientific thinking (Nelson et al., 2005), analytical thinking (Sardone & Devlin-Scherer, 2008), problem solving (McFarlane, Sparrowhawk & Heald, 2002), self-directed learning (Brown, Gordon & Hobbs, 2008) and spatial skills (Yıldırım & Zengel, 2014; Tüzün & Özdinç, 2016). The theme collaboration emerged by itself even though the implementation was planned as an individual activity. Collaboration can be regarded as the social activity that is required for knowledge construction according to socio-constructivists (Dickey, 2005). In the current study, students asked each other for their opinions about the problem-case and worked together at some points throughout the activity. Additionally, the students who were more computer-competent took the leadership role in class and helped other students. Having avatars were found as an enabler of collaboration among the students (Hong, Jeong, Kalay, Jung & Lee, 2016). Collaboration is not only good to share information with others, but also a motivating factor in MUVEs (Dede, Clarke, Ketelhut, Nelson & Bowman, 2005b). Collaborative learning has the potential of supporting students' communication and critical thinking skills (Roberts, 2005). It also gives students a chance to see others' perspectives (Veerman & Veldhuis-Diermanse, 2001). As MUVEs allow multiple users, students are able to see others in 3D environment and follow their friends' progress via clicking on their avatar and displaying their online portfolios.

Depending on student interviews, teacher interviews and observations, the results of this study asserted that scaffolding in this type of learning environments is very important. That is because getting lost in 3D environment or in the project may cause students lose their motivation and their self-efficacy. Lim, Nonis and Hedberd (2006, p. 226) also point out the importance of scaffolding in complex learning environments and say that when students are not provided with scaffolding "they might suffer cognitive overload that, in turn, might then result in disengagement".

Therefore, teachers, who want to implement similar projects in their classrooms, should ensure providing scaffolding for their students and facilitating them throughout the project. According to other research, teacher involvement in MUVE makes the learning context positive and might enhance students' learning (Zulkanain & Rahim, 2018), which is in fact very much related with the technology competency of the teachers (Sipilä, 2014). Collaboration among students can be a way of scaffolding, too. As Reiser (2004) asserts peers, who are more experienced, can scaffold to the students especially if they are learning in a complex learning environment. This concept is also very much related with the term "zone of proximal development" described by Vygotsky (1978). Another way of providing scaffolding can be provided with informative guiding tools, just like field notebooks used in the scope of this project.

6. Conclusion

Implementing the MUVE activity either in formal or informal learning environment requires extensive time which turn into a more challenging issue in formal learning environments because schools are more structured, there is a curriculum to complete, and teachers have an extensive work load. The use of MUVE results in different experiences with the students who are not privileged of technology use neither in school or at home or in the settings that are more flexible. The good thing is that, as this study shows, the students enjoy learning in a MUVE regardless of being in a formal or informal learning setting. The experience of learning in an immersive and fun virtual environment, using technology for learning or actively involving in learning process may be the factors influencing students' feelings about their learning in the current study. Learning in game-like MUVEs is not only a fun activity students love (Lan, 2015) but also easier than learning in school for the students (Dede, Ketelhut & Ruess, 2002). From the teachers' perspective MUVEs have the potential to enhance students' skills of using technology, thinking and collaboration. They are also motivating and effective learning environments that allow active student participation, retention and visualization of learning content. The use of MUVEs support high level of student engagement (Claman, 2015). Therefore, it is possible to say that providing students with learning environments using MUVEs does not only give them the opportunity for having fun but also for actively participate in learning.

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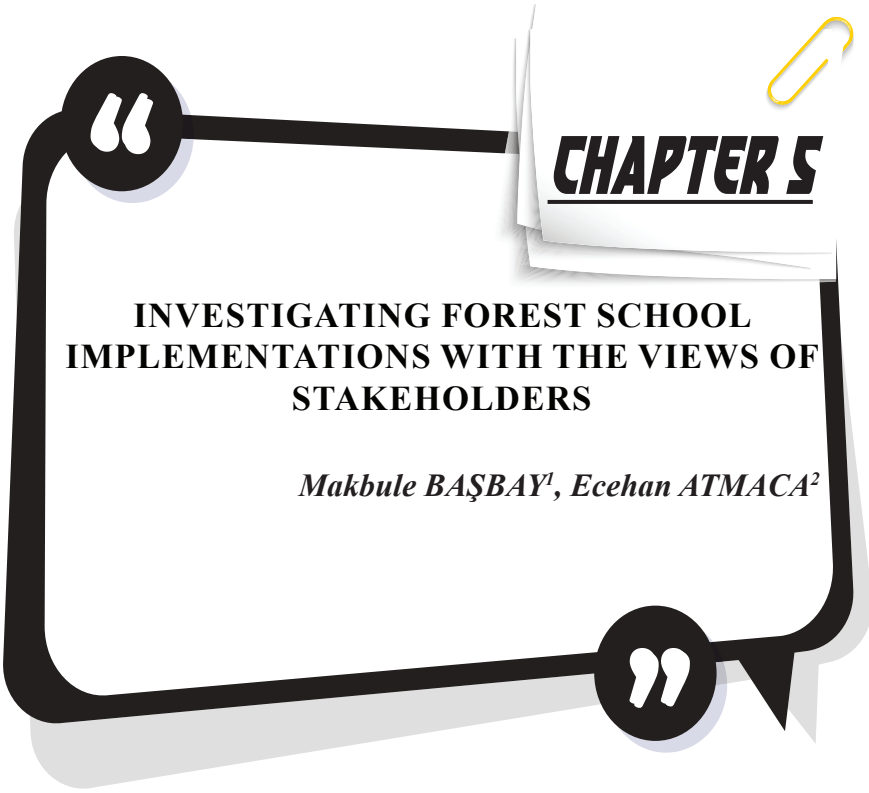

CHAPTER 5

INVESTIGATING FOREST SCHOOL IMPLEMENTATIONS WITH THE VIEWS OF STAKEHOLDERS

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Introduction

Needs for education, types of it and the conditions have been changing all over the world continuosly and apparently traditional approaches are not sufficient anymore to meet those needs. The pursuits to meet these needs and to establish school systems that will serve the best interests of the child are increasing their voice and impact day by day. The new educational approach balances the knowledge and skills with activity-centered methods and takes the experiences and individual differences of learners into account and it offers opportunities to learners to interact with the environment and nature. As this new approach is approved, the implementations emerging accordingly take the school out from the four-walled restrictions to the city, countryside and forests. Such a change brings forward a lifestyle for humans to be in harmony with all living species and nature through providing humans with the belief that unity with the nature is necessary (Şenel & Gençoğlu, 2003). This change requires the children to discover the natural world for themselves.

Before 19th-century urbanization, children used to spend more time in open areas and it was not necessary to make official connections between education and the outer world. Gradually increasing industrialization and urbanization altered the communication of children with the natural world and outer surroundings. Industrialization resulted in agglomeration of labourers and their families in cities which then turned into shantytown. Urban settelements prevented the access of children to natural surroundings while increasing the building style settlements and accessing to countryside, fresh air and healthy exercises became a privilege for middle and high-class people (Knight, 2009). The significant issue in that aspect is that the children cannot interact with the nature as the ones in previous generations (Thompson, Aspinall, & Montarzino, 2008).

One of the common points of alternative learning approaches becoming more known recently is that they give the children chance to develop and learn. Accessibility of convenient playground here is remarkable. Accessing such places is particularly restricted for children who do not have the autonomy to go there (Knight, 2009). Outdoor education culture which was propounded as a solution to that issue and which has a long history first emerged in the United Kingdom (Davis, Rea, &Waite, 2006). Rickinson et al (2004) defined the keywords affecting the outdoor education culture in the United Kingdom as nature study movement, field studies, rural studies and outdoor adventure activities.

In many countries all over the world, interest in outdoor learning and forest schools is rising. Forest school is defined as an outdoor school where active learning methods requiring active involvement are implemented for

children, teenagers and adults; where children, teenagers and adults join activities in a forest or a forestland and where inspirational experiences improving confidence and self-respect are gained besides individual, social and technical skills (Forest School Association, 2002). Forest school implementations could give opportunities for children to experience rich outdoor activities so that they could learn in various ways and this could have a significant role in their development (Close, 2012).

When the historical period of forest school is scrutinized, its changing values and permanent traditions are overtly seen. How long a forest has been used for educational purposes is open to discussion. Particularly, materials used to provide food for families and benefit to the economy have been inspirational for social and free time activities (Borge, Nordhagen, & Lie, 2003). Philosophers like Comenius, Locke, Rousseau, Pestalozzi, Froebel and Dewey are perceived as the initiators of education out of the classroom (Okur-Berberoğlu & Uygun, 2013). The first forest school was founded in the United States of America, Wisconsin and then in 1927, at Wisconsin-Madison University Faculty of Agriculture; afterwards in 1950s in Sweden, Denmark and other European countries, other forest schools were started. As one way of supporting children's gaining access to forestlands in 1980s in Denmark at pre-school programs, children were led to go to the forest on a regular basis and attain practical skills (Bradley & Male, 2017).

Although the forest school concept is considered as a new one, it is actually based on the rich heritage of outdoor education going back to the 19th century. In the 1970s and 1980s the education system made attempts to improve artithmetics and literacy and moved towards a teacher-centered approach. Nowadays, some educators and health care professionals have noticed the drawbacks of getting away from the nature on children. As an illustration, Mac Millan sisters established outdoor kindergartens which provided the fresh air for children to have healthy bodies and minds. Educationalists such as, Susan Isaacs, BadonPowell, Kurt Hahan and Rudolph Steiner utilized this trend in many different ways. Their main goal was both finding solutions to the crises caused by industrialization and helping children's learning by seeking new ways (Pugh & Dufy, 2013). As a result of these, in 1990s, an increase in the interest in alternative schools is seen and, in this aspect, forest school has gained popularity (Cree & McCree, 2012).

Forest schools which enable children interact with nature are referred to schools where children are encouraged to play, explore and learn in the forestland or a natural surrounding nearly all year, whole day or half day except from dangerous situations (Amus, 2013; Knight, 2009). Forest schools not only targets to teach lighting a fire, building shelters or climbing

trees but also to teach various types of information and skills by doing and living through those activities (O'Brien, 2009). In this surrounding, children can use some traditional tools to undertake specified self-oriented activities. However, the risky sides of the tools are gradually introduced before using them and security measures are taken. Teaching children how to use a tool like a saw, a knife, a shovel and a digger step by step and applying the security procedure enable children improve their motor skills by developing their self-confidence (Blackwell, 2005). Forest schools aim to improve team working and risk-taking skills as well as confidence and independence of children (Blackwell, 2015). Children will both learn to take a risk while climbing a tree and the precautions for taking risks as well. They are encouraged to work in collaboration while building a shelter and carrying a log. They learn to respect the other living creatures in nature while lighting a fire and prevent the contact of the fire with the soil and also experience to set a cause-effect relationship and take responsibilities. Fast lifestyles of today require humans to be flexible, creative, innovative and enterprising. In order to go on living, they need to be strong and learn how to struggle with difficulties. Forest schools are convenient for growing compatible, strong, knowledged and skillful individuals as they offer open-ended opportunities (Knight, 2012).

In 2011, England Forest School Association determined principles for implementations (FSA, 2011). These principles emphasize the following points:

- Implementations should be conducted in long and frequent sessions in different seasons,
- planning and observing are essential,
- children should be supported to use the natural resources so that they can produce creative ideas and get motivated,
- the implementations should improve individual, social, cognitive, linguistic, emotional and spiritual skills,
- they should also support children's risk taking and evaluating abilities,
- those principles should be conducted by literate and competent educators in forest implementations,
- sufficient children-adult rates should be provided,
- the games should be used to teach and,
- the implementations should be learner centered.

Whereas there is a good deal of samples of forest school

implementations worldwide, they are quite novice in Turkey and has been gaining importance recently. Most of those implementations which are followed with interest and are in the process of actualization are composed of independent activities rather than pedagogical approaches adopted by a school. Only a few kindergartens and very few primary schools have forest school activities. One of them is Renkli Orman Primary School which applies the principles of Another School is Possible Association. Renkli Orman Early Education Center which was founded in 2015 by education association partners in Yakaköy, İzmir was followed by Renkli Orman Primary School in 2017. Both are cooperative schools implementing the alternative education, democratic school, ecological position and authentic finance (non-profit) principles of Another School is Possible Association. In this study, forest school implementations being conducted at primary school level at Renkli Orman Primary School have been searched within the views of parents, teachers and administraton.

The study conducted to investigate the forest school implementations at primary school level is considered to be significant to put forward the problems in implementations of forest schools, to be able to find solutions to those problems, to determine the necessities and to contribute to the improvement of the process. Particularly accountability and transparency in investigating the school program in a school culture having a participatory structure and democratic mechanisms are essential. Such implementations and scientific studies on them are not sufficient in Turkey. Therefore, this study might have significance and be necessary both in institutional perspective and also for its contribution to the literature.

Since no evaluation has been made before with the class teacher, art educator, language teacher, school psychologist and school coordinator working at Renkli Orman Primary School in terms of parents, their views in this study are expected to have contribution. As a result, contribution to the improvements in the process and to the forest school practices in Turkey are expected.

The research question has been constructed as “How are the experiences of the teachers, administrators and parents about the forest school implementations?”. Within the scope of the main research question, the following questions are suposed tobe responded:

1. What are the expectations of the stakeholders on the forest school implementations and at what extent are those expectations met?

2. What are the gains of forest school implementations?

3. How do the forest school implementations take part in the curriculum?

4. What are the metaphors the stakeholders use about the forest school implementations?

5. What are the challeneges faced in forest school implementations?

6. What are the requirements for forest school implementations?

Method

In order to examine the views of stakeholders on forest school implementations at Renkli Orman Primary School, integrative case pattern as one of the qualitative methods has been used (Yıldırım & Şimşek, 2016). Views of the stakeholders have been gathered through interviews (Patton, 2014). Three data sources including parents, educators and the school coordinator have been determined based on the fact that the participants of the study have shared experience as different views from the participants influencing each other might come forward (Çokluk, Yılmaz, & Oğuz, 2011).

Case

Renkli Orman Schools were founded by İzmir Education Association in 2015 to implement the principles of Another School is Possible Association (ASPA). When this study was conducted, there were five pre-school teachers, a school psychologist, a language teacher, an art teacher, a class teacher, 56 pre-school students and eight primary school students at this non-profit school. It is a school highlighting creativity, freedom of children and interaction with nature and it has a program which is determined in accordance with interests and fonds of children including flexibility and spontaneity in a big deal. It is believed that learning through living outdooors instead of in a closed and isolated places will provide a lifelong experience for children. It offers the freedom of movement and right to children they deserve and plenty of free playing time as chilldhood requires; hence, those create the appropriate environment for affective, cognitive, physical and emotional improvement for children. While doing those, what alternative educational approach adopts is influenced by progressive, holistic and libertarian educators and philosphers like Malaguzzi, Montessori, Vygotsky, Tolstoy, Piaget, Steiner, Neill, Holt, Gardner and Dewey. Here, the teacher's role is acting like a researcher. Topics the teacher talks about appear to be initiators or references for children and have the value of a call to them for research. No matter how the weather conditions are, at least two forest days a week; project times spent with all age groups in the morning; daily outdoor activities and free time, visits to exhibitions, museums, theaters and libraries in accordance with the interests and fonds of children are very important parts of school life.

Participants

Working group is composed of first year educators (n= 4), parents (n=6) and the school coordinator (n=1) at Renkli Orman Primary School of Another School is Possible Association in İzmir. Four educators are the class teacher, the art teacher, the language teacher and the school psychologist studying with primary school first year students. Although there were eight parents in total, as two of them were out of the city, they could not attend the interviews and six parents were included in the study. In addition, only one school coordinator participated in the study. The class teacher has three-year experience and the others have two-year experience at this school. All of the educators have master's degrees in their own fields. The common point of them is that none of them has the experience at a forest school beforehand. School education coordinator has an experience of 17 years at state schools who has worked as the administrative and academic coordinator at kindergarten and primary school for five years. The coordinator has a two-day certificate of practical training on forest schools. The parents participated in the study consist of a dentist, a financier, a veterinary, a secretary and a house worker. Children of those parents have attended school from one year to three years.

Data Collection Tools

Data in this study have been gathered through focus group interviews with educators and parents separately and and individual interview with the school coordinator. Interviews were conducted with semi-structured interview forms. The questions in the forms were prepared by the researcher through examining the research questions and the related studies. They were revised and finalized after three lecturers two of whom are at the Department of Curriculum and Instruction and one is at Department of Elementary Education gave feedback as expert views. Ten questions were asked to the participants in additon to the fact that their demographic information is taken.

Data Collection Process

After determination of the school to conduct the research, the school staff was informed about the study in detail and the official permission was taken. The participants were informed about the purpose of the study and they were explained that the focus group interviews would be recorded but no one would be allowed to listen to them or read the transcripts. Focus group and individual interviews were conducted in nearly an-hour sessions in the first classroom of the school on the days determined by the participants. One focus group interview was carried out with the class, art and language teachers and the school psychologist and another one with 6 parents. An individual interview was done with the school education coordinator. The process is shown below (Figure 1).

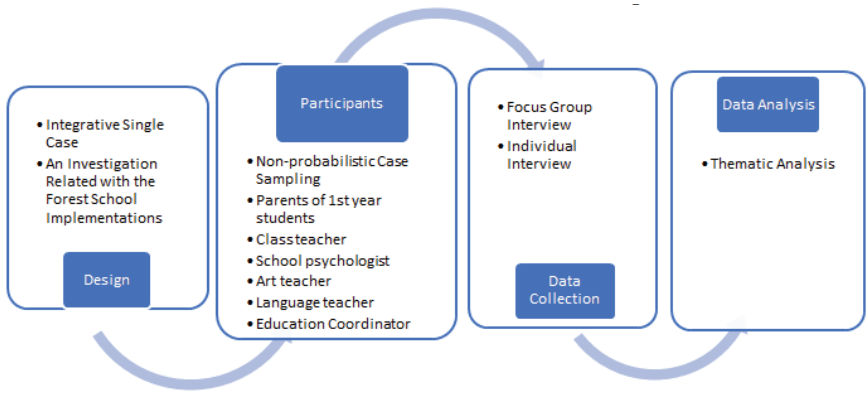

Figure 1. Research Design

Validity-Reliability

In this study, through variation, expert review and participant confirmation, credibility and internal reliability have been inreased. Involving participants with various characteristics in the study is remarkable in obtaining different perceptions and experiences as well as reaching multi realities. Views of teachers from different subject matters, a psychologist, an education coordinator and parents having similar experiences but different careers were included. Data and findings obtained from the study are cooperated through participant confirmation and double analyses of the qualitative data by two researchers. In addition, credibility has been supported by frequently citing from different studies.

Furthermore, in order to keep the identities of participants confidential, Teacher (T), Parent (PA), Psychologist (PS) and School Coordinator (CO) has been coded as the letters in parantheses.

Data Analysis

In the process of data analysis, that is exporting the meaning of the data (Merriam, 2009), the stages followed included preparation of data for analysis, coding them, constructing the upper structure by gathering the codes, presenting the data in schemes, tables or in the form of discussion (Creswell, 2017). The analysis went on in the stages like setting the codes, gathering them and categorizing according to their common points, explaining the categories with the upper theme according to their relationships and presenting the conclusions (Saldana, 2009) to go towards exploring, eliciting and inductive reasoning (Patton, 2014).

Data collected in the study was converted to text initially. The texts were read several times and preventing any data loss was aimed. Data was analysed with descriptive method. At the first stage, a framework for the analysis was set with the data obtained from the dimensions of interview

forms. In this study, data was framed by directly and necessarily citing from participant views on expectations from forest school implementations and teacher-parent perceptions, status of implementations in curriculum, challenges, solutions and the level of expectation fulfillment. At the second stage, data were ranked together in a meaningful and reasonable way. The third stage is the one to identify the data, so at this stage data collected from participant views were defined. During those stages, two researchers analyzed the data separately, compared the results and tried to commonize them. The fourth stage included clarifying the findings and evaluating them. Direct citations were made at this stage. At the final stage, data were interpreted and evaluated and the evaluated data were associated with forest pedagogy principles and then the experiences were explained.

Findings

Findings are presented under the titles of expectations and fulfillment of them, gains, forest school implementations and the program, forest school perceptions, challenges and requirements.

Expectations and Fulfillment

Three categories related with the expectations are found as a result of the content analysis about forest school implementations. *Other Schools*, *Child Happiness* and *Fulfillment of Expectations* are the titles of those categories.

Other Schools

Findings from the interviews indicate that implementations of *other schools* have effects on the fact that parents choose forest schools. This reveals that the expectation is avoiding the other schools. PA6 proves the situation by saying "*We started the education period at a normal school, actually a private one. There are forest school implementations in Turkey, too. While examining such practices I came across with many places having unrealistic applications and they made me feel disappointed.*" PA2 makes a comparison and states that they had better results than they expected by wording "*At first, we had many questions, too. Introductory meetings, yes, you attend lots of meetings. Everything is perfect in theory but in fact nothing is so. This time, when we saw that the things are just the opposite here, we believed more*." As it could be inferred from the statements of parents, one of the factors determining the expectations from forest school implementations were the implementations of other schools and also their restricted facilities.

Happiness of Children

One of the expectations of stakeholders in forest school implementations

is *happiness of children*. Findings indicate that there are participants underlining that happiness of children is apparent. For example, PA6 says: "*I like this school because children are happy here. That the forest processes are close to nature in reality not so-called makes me really happy. It makes the children happy, too*." And PA5 says: "*We are very happy. The child is happy, too. We cannot think of another school right now and I'm for this view, too. This is the most important issue*." Those statements display that at this school having forest school implementations which put the children in the center makes the children happy. Thus, the reason to choose that school focuses on that point.

Fulfillment of Expectations

While the views of stakeholders indicate that the expectations from forest school implementations are strongly met, it is striking that the teachers, the coordinator and parents have similar views. As an illustration, T4, one of the teachers says: "*…I think now the forest meets the needs of the children greatly.. It meets our expectations, too*." PA4, one of the parents points out: *"..I mean, compared to where we started, we are satisfied with what we live now and it meets our expectations*." And PA1 concretizes similar opinions with those words: "*If you are living in a big city like İzmir, it is almost impossible to provide such a chance for your child. That's why, I'm feeling very lucky"*. In addition to this, PA3 clarifies the fulfillment of expectations at a much higher level: "*It will presumably be a big claim but we had lived in America for 9 years and we have American citizenship. If we had not met ASPA, we would consider going back. This is not because I believe that American education system is very good but we could have better alternatives there. We could have gone back unwillingly*." The school coordinator, on the other hand, expresses that the school meets the expectations in the words "*yes, I can say that it fulfills the expectations. I believe that it does so in a great deal*."

<u>Gains</u>

The categories related with the gains after the analysis are: *Academic Development, Survival Skills, Ecological Awareness, Creativity, Affective Features, Artistic Encouragement, Social Skills, Physical Development, and Children with Special Needs.*

Academic Development

Participants state that the forest offers a positive learning environment to develop academically and to reach the gains in lessons. For instance, T4 emphasizes that the natural needs in the forest lead children to academic gains and states the words "*For example, we built fence. The wanted this to mark off our land. In this process, we studied length as well because*

we planned 10-cm length. We drew it on a paper and tried to scale it. Then, we tried to set out the fence by leaving 10-cm distance." and CO underlines that the forest is an open-air classroom environment through the expression: "*Forest is a learning environment. It has contributions to academic gains. Lots of achievements can be gained in nature in a stronger way. Particularly social studies lesson at primary shool. We make circles in the forest. Certain Turkish gains are included in it. If we use it as an outdoor classroom, everything can be included*."

Survival Skills

Participants remark that forest life enables children to develop survival skills. For example, T4 stresses the importance of gaining skills with the words "*Survival skills is the main issue for me in education; thus, the team here goes to the bazaar and it gives survival skills and they learn to survive in the forest, too. Survival skill is something general including everything. I believe that the knowledge has always changed in history. It has renewed itself. However, skill is not something changing that much.*" PA3 clarifies the skills achieved through stating those words: "*they light fires and cook sausages*" and PA5 says *"...we normally did not permit such things and we were anxious as she is not very good at fine motor skills. Watch, you could cut your hand or something like that..but she can do those now, goes to the kitchen, takes peppers, cucumbers and stuff..She chops them up*.." The statement of T4 as "*We use pocketknife, gear-type cutter and axe. But we had a deal with children on how to use them. First, I learn how to use those tools. Then, we check them together. We check how each is used. I try and they watch. Afterwards, I teach them to the children in the control of adults*." explains the process teachers pursue that shows the children's achievement of the skills.

Ecological Awareness

Participants share the view that forest school experiences raise the children's ecological awareness. To illustrate, T2, one of the teachers, says "*We actually want children to understand that they are parts of the nature. They are in a different environment but we want them to feel to be the parts of that environment.*" and PA2, one of the parents says "*I can understand that children have been like parts of the nature from their normal life acts. I do not need to warn them like "do not leave it there." The child can intuitively do that and does not leave garbage anywhere*." PA6 adds "*She knows the plants. We are pleased with this.*" PA2 tells about an event *"a kid got burned accidentally with some hot water. I asked my kid what they did then. He said that they applied aloe vera pulp…I mean they practice such things…they learn it..you know when we ask about the plants, aloe vera to an adult, you know they may know it but a 7-year-old child, you know..*

They can apply the correct plant pulp appropriately." These all clarify the situation.

Creativity

Participants emphasize that the creativity of children improves as they are in an unstructured environment in nature. Particularly, PS, by saying "*their creativity is improved so much that I can observe that they can set far more games than they do in a structured environment*." and CO by stating "*a creativity scale was implemented and the highest result belonged to our school in İzmir. Here the children at the age of 5-6 years old got the highest creativity scores among 22 schools and in my view the forest has a big effect on that*" explain this creativity issue. Participants also express that children's working with natural materials in the forest is compatible with the pedagogical approach of school and it improves creativity as well. T3 concretizes this by adding "*I believe that without having any materials with them and just going to the forest and spending time with whatever they find there supports the creativity of children strongly*."

Affective Features

Pleasure, self-confidence and curiosity can be taken as affective gains of forest school implementations.

-Pleasure

All participants agree that children are pleased with forest school practices. While parents state that children feel more joyful in that school compared to the ones not having such implementations, teachers say that they also feel really pleased with those implementations besides children. For example, PA2 makes some concrete points on that issue by saying "*At this school, children do not get fed up with education all day. They do not lose their childhood*." In addition to this, the explanation of T3 like "*That children are in nature which makes them feel fine as it does so for all living creatures. It is great for us, too*." underlines a similar point of view.

-Self-confidence

All participants point out that children gain self-confidence by experiencing the natural conditions, coping with difficulties and playing free and risky games. T2 says "*They gain self-confidence, I mean, it gives us chance to reveal the strengths of all children*." And T4 says "*Definitely it opens areas for teachers, too. One of the children had lack of self-confidence as he learned reading and writing late. But, here, he realized that he was better than the others in jumping, finding directions and some other survival skills. Very soon, he gained natural leadership. I mean, if we are choosing a leader in finding directions in gloomy weather, he becomes*

the one as we trust him." Both participants emphasize the fact that forest school implementations support children in discovering their strengths and improving their self-confidence. PA5 highlights the change in their children by stating "*In past, he used to say that "mom, can you cut this? Can you do that?" and so on. Here, he gained confidence. I realized that we had never given him a chance*". PA3 adds "*We went camping a while ago. My child was willing to light a fire and was curious about setting the barbecue, I felt that he gained confidence and also improved some skills. How many children can do that*?" PA6 exemplifies their situation with these words "*My kid was extremely scared of bees. She defeated that fear. The school transformed some of her fears*."

-Curiosity

Participants frequently claim that being in nature and having a chance to observe it triggers the curiosity of children. For instance, the statement of PS as "*They wonder about things, they see them, look at them and search for them. I believe that the forest has a big effect on that*." and the expression of PA6 as "*We are curious about different plants and we search for them. His interest in nature got more and the same with geography. Nature provided that*" could be displayed as evidence for curiosity.

Artistic Encouragement

Teachers state that spending time in forest encourages children in terms of art and contributes to their artistic studies. T3 explains this by these words: "*It is quite different doing still-life painting in the forest by seeing the real scene than doing it in a workplace. It motivates them a lot. They draw in the forest with fondness. It is a really prosperious environment, it improves the artistry of children. There are many different types and textures. The more variety the children interact with, the more they capture in their minds. The tree, the soil, they all are different; they notice those differences*."

Social Skills

While participants explain that the children gain social skills, they particulary emphasize leadership, teamwork and conflict resolution skills.

-Leadership (Guidance)

Particularly the teachers among the participants state that children gain leadership skills, watch the team and lead the others when they go for exploratory walks in the forest. T4 supports the idea that children leading the group watch them, make decisions and coordinates with team members and adds these words: "*You are the leader and you need to ask the group members. Where should we go from? And after a while, that child becomes*

the one who leads the process, what is that called? Coordinating person or coordinator or director or whatever it is."

-Teamwork

Participants state that children experience being in harmony with each other and increasing interaction among themselves while they are doing works, fulfilling their responsibilities and trying to create the appropriate conditions during the period they spend in nature. The statements of T1 as "*Nature gives a perfect chance to children both to work in teams and to work individually.*" and the words of PA5 as "*Two days they spend in forest are valuable in my view. They learn teamwork.*" underline the case. Furthermore, T2 points out that the teamwork decreases conflicts with these words "*What I noticed at school in general, not only at primary school, is that they have less problems and conflicts in the forest. I mean, they collaborate more there and struggle together as well as helping each other*."

Physical Development

Findings show that the gains of physical development focus on *motor development* and *strength* of children.

-Motor development

Participants express their views that the gross and fine motor skills of children develop through experiences in nature. PS explains his/her observations about the developments of children by saying "*I can say that gross motor skills development is invaluable for me. I mean the kids balance themselves while walking. They walk in various environments, put their arms, I mean city life is very far away from nature unfortunately, pedestrians, pavements, elevatros and so on, but here, there is a completely different life and same with the fine skills*." and PA5 agrees with the same statements with the words "*I want to mention fine and gross motor skills. The child progressed at those. For instance, the usage of a knife without cutting himself. He cut his hand a few times but then improved himself. Now he can use knife, pocketknife and lighter easily.*"

-Strength

Participants also give some examples that the physical strength of children improve at school. PA3 approves this by saying "*She has an incision and she says I fell in the forest. But she does not care about it that much*." And the explanation PA6 makes is another piece of evidence for that: "*For example, the kid walked with a good condition with us in trekking*."

Forest School Implementations and the Program

Three categories have been found after the analysis on the forest school implementations. These are *educational opportunities*, *improvement/ transformation* and *flexible program*.

Educational Opportunities

Participants informed that natural environment and materials present effective teaching opportunities to children. They also pointed out that the forest makes a natural learning environment with no special arrangement and this environment can be used effectively for various lessons. T4 qualifies the forest as an effective learning environment by saying "*Teaching is actually a forest design; you give an environment to the child. We naturally have this environment, the forest itself, we get use of it to the full extent…I can study something in the forest in 15-20 minutes which would take 40 minutes in the classroom*." PS stresses that the forest keeps learning and exploring motive of children alive and says, "*They take something, examine it, throw it, it is natural, we do not do anything and the children encourage themselves.*" CO gives details by adding "*Lots of things are happening in nature and the ones which they do not come across in their normal lives draw their attention. Fall of leaves, changing their colours, an insect they have never seen before, plants they do not know, a pond or flowing water, I mean they draw their attention and this leads children to discover*." On the other hand, T2 infroms that the forest offers a rich environment to learn a foreign language and says "*In language education, it is necessary to set a meaningful situation for children. It is a very big ease for children to learn when they need to learn instantly when they see it there, in the environment. Trees, branhces, all other things they see there, it is much easier for them to learn those rather than learning with cards*."

Improvement /Transformation

Mobility and liveliness due to the forest school implementations have influenced improvement and transformation in the process of implemented program. It has been observed that the implementations get shaped with educators and children. Statements of T4 and PS could be taken as evidence for change and transformation lived in the program. T4 says "*Actually the forest school implementations became concrete when we came here. As the experience increases knowledge increases, too*." PS adds "*At first, it was like a journey, I mean we were going, children were playing in a natural environment but we go for a walk there now. We sit, settle, children have breakfast, have meals, they started to live in a lifestyle like they were doing in normal life.*"

It has been observed that the improvement and transformation affected children positively, too. PA2 explains their experience with these words: "*But I observe that the forest activities change at school every year. This can be due to two factors. One is that our teachers really improve themselves continuously. Yes, they might have made the forest more attarctive or perhaps children did not at first know how to communicate with them. Now, gradually, they started to become parts of it. My daughter was saying that she did not want to go to the forest and she was getting bored in the first year but when we started the second year…I have never heard of something like that from my daughter this year.*"

The school coordinator emphasizes the development with those words: "*Our first implementations were not that successful. I mean, we were not able to spend our time in the forest effectively and children did not want to go to the forest. It was like they got bored and did not want to be there. Then, we thought on how to convert the forest into a more joyful place and we made it. We founded different centers, like for children to ski, to do discovery with a certain project, to build houses, to light fires and so on*." As it can be seen, participants stated that they improved during the implemented program process and took shape together.

Flexible Program

Findings exhibit that the forest school implementations were shaped with its flexible program. This was provided by spontaneous implementations and free time activities.

-Spontaneity

Teachers stated that they apply a flexible program with a flow framework. Data collected from the interviews indicate that during the forest school implementations, instead of the structured activities by teachers about implementations, spontaneously emerging activities in accordance with the interests or instant reactions of children took place. "*Sometimes, if there is something planned to study with children, I can take a game or a book appropriate for it. But moslty, if they are doing something spontaneously, I am involved in it.*" says T2. T4 explains the situation as "*No matter how you structure, it rains and all the process changes, I mean, you give way to it*." T2 stresses how the interests and fonds of children shape the program and T4 underlines that the natural conditions affect the program. Additionally, parents draw attention to the fact that the process progresses spontaneously and the teachers change accordingly. PA5 underlines that teachers take forms flexibly in accordance with the progress by saying "*Sometimes teachers might need to do something out of the schedule, I mean they adjust themselves in accordance with the children*."

-Free Time

Findings show that teachers allocate leisure time periods for children in forest school implementations. Teachers quote that they allocate leisure time as they think children need to be alone with the nature and themselves. T4 points out that children have demand for free time by telling "*A few children are in the process of struggle but individually they want to be with the nature and alone. They want to take the pocketknife, sit and hew twigs, get relaxed or maybe observe birds*."

Parent interviews also display the findings revealing leisure time needs. PA3 says "*We used to learn mostly in streets. So, the forest now gives the free game time which we cannot offer today. Because I ask where was the power of the street which was not managed by anyone coming from? It was coming from the fact that they could play games freely there. I expect this to be provided by the forest and it does so*." Participants look at the free time in flexible program implementation from the aspect of children's needs and forest school implementations meet these needs.

Forest School Perception

Metaphors chosen by participants about forest school implementations, such as mud, rainbow, holiday, water, explorer, mother lap, construction, gymnasium, camp, street, black beetle, fragile display the perspectives of them on forest and the implementations. It has been determined that concepts like flexibility, freedom, changeability and differences were described with the metaphors like mud, holiday, water and rainbow. Perceptions of the participants are displayed in the table below (Table 1).

Table 1

Perceptions of participants on forest school implementations

Metaphors	Because…
Mud	*It is like how you shape it. It gets shaped I mean like you do. The more pressure you put on it, the more it takes the shape of it. You do it with the nature and the children and adults you take there and shape it. I mean every group lives it in a different way. It all depends on the things which come and as you shape it. (T3)*
Holiday	*Because you go wherever you want, you sit wherever you prefer and if you want to go walking, you go. You sit and take a breath. You draw, you read. (T2)*
Water	*It is like water, I mean when it flows you cannot stop it, very nice. (PS)*

Rainbow	*It has different colours in it. It is open to lots of places in my view, that's why, you can go with different groups, talk to them, I mean they will tell you about some different challenges and characteristics. (T4)*
Explorer	*Exciting the children all time and nourishing them. Engine of learning is curiosity, I mean excitement. As long as curiosity and excitement go on, children are more open to discovery. They are open to learning. That's why explorer. I imagine an exploring structure. (CO)*
Construction	*In construction only one stone can make nothing. But when you put the stones together, something appears gradually. When children go there, they start without knowing anything and then as they go, new things are learned. One more thing, one more thing and one day they will become such a person that they will be able to do lots of things there on their own. (PA1)*
Gymnasium	*There are all types of obstacles, going up, hopping, jumping, gliding and falling, especially balance.* (PA2)
Camp	*Because you can hear the voices of birds, the sound of a river. I mean it connects you to the nature. (PA3)*
Street	*Because children can play on streets as they like. (PA3)*
Black beetle	*It is an animal that can adapt to any weather conditions and any environment. Yes, in a way, it is an animal surviving after the atom bomb* (PA4)
Fragile	*A year ago, after I witnessed a forest fire closely, I feel that a forest is something fragile. It can disappear at once. Protecting it and paying attention. (PA5)*
Earth mother lap	*I see it as alive and like a mother lap because it is productive, reflective, positive, energizer and instructive. (PA6)*

When the views are examined in general, it has been revealed that teachers consider forest school implementations provide flexibility and freedom, open space for individual differences, bring in awareness and improve curiosity and excitement. Parents, different from teachers, added that the implementations contribute to motor skill development. Also, the contribution of forest to physical characteristics and affective skills of children as well as their learning abilities was emphasized.

Challenges

The results of the analysis display that participants highlighted *academic concerns*, *weather conditions* and *preparation at home*.

Academic Concerns

Participants specify that they faced with the reality that children could be behind academic learning as some of the school time is allocated to forest school implementations but their concerns about this ended very soon. For example, PA2 says "*In the beginning, I had some concerns whether they*

would fall behind academically" and PA3 says "*After the first meeting, I asked myself the typical questions like everyone else. Like whether my kid would be incapapble of some academic issues since she would live in such a lanthorn and so on, questions like all others had.. But as PA4 specified, we are a community school and that's why, we improve ourselves. I mean you question the things you know or you were taught till now. You question your values and priorities. In that sense, the school teaches us, parents such things, too.*" These words explain how they overcame their worries. On the other hand, PA4 adds "*But when you get into it more, you see that they achieve more than they could do in MEB (Ministry of Education). We get this feedback. Still, we may not get rid of some concerns. But I do not have such worries anymore.*" and clarifies how she removed her concerns. T4 discusses a similar concern by stating "*Children are very happy in the forest. That's the reality. But when the child does not learn how ro read and write, parents start questioning. Certainly, the child needs to achieve those goals at the end of the year.*" CO says "*I guess as the age grows, they will need to balance the time they spend on playing in the forest and on academic gains. We, for instance, started to talk one these. Like, why not structuring the time we spend in the forest. They will have to allocate more time for academic gains as they grow up. This might cause a problem for the groups who go to the forest regularly.*" It is discussed here that preparation for academic gains will increase in accordance with the level of the grade.

Weather Conditions

Some parents stated that they have concerns about the weather and natural conditions in the forest and they have difficulties in providing sufficient equipment. PS underlines this by stating "*Some weather conditions, I mean we talked about environmental planning and some equipment and so on, I mean they can light a fire, it is good for us, but sometimes, for example, it rains and yıu know everywhere gets wet and well, afterwards it gets cold and sometimes some kids are crying because of feeling so cold. And this worries the teachers.*"

Preparation at Home

Parents particularly touch on the difficulties of preparing children for forest days. PA5 mentions about this saying "*I really had difficulty in winter. Because you wash, hang and you have to dry up but you don't have to do these in summer*." PA1 discusses the difficulties at preparation at home and cleaning the equipment with the words: "*We have two kids and it is really tough to prepare them for forest. I mean everything is washed. They need to be dried every day*." Participants point to the weather conditions from time to time and preparation at home for sufficient equipment as challenges.

Necessities

Necessities for forest school implementations specified by participants have been examined and they have been categorized as *equipment*, *adult guidance*, *environment-forest reflecting the region children come from*, *enthusiastic educators-learners*, *security*, *parent elucidation* and *logistics*.

Equipment

Among necessities, participants pointed out appropriate equipment mostly. CO underlines this issue by saying "*It is necessary for parents to provide appropriate clothes. When they do not have those clothes, the process gets hindered. It is important to find suitable clothes for different weather conditions*." T2 states "*Seasonal clothes are necessary. Water resistant clothes for winter and sun cream, hat, and so on for summer. Besides these, ropes, pulleys*.." PS discusses that appropriate and sufficient equipment increases the joy and productivity of time spent in the forest; otherwise, any deficiency will hinder the process by the words "*I mean overalls, mats and water bottles are exactly important. Do not just underestimate water bottles..When the child forgets it, he really has trouble. If the child does not have a suitable coat or shoes, he can feel very cold or sweat. For example, tools like a compass or binoculars motivate children and help them gain different perspectives*."

Adult Guidance

Participants expressed that adult guidance is necessary in the forest. They stressed the rate of the number of children and adults about this issue. CO utters the importance of adult guidance in the forest and that they pay attention to this by the words as: "*Generally, number of adults or educators is less than the number of children in the forest. I mean, in the classroom the rate is nearly ten to fifteen children per teacher, but the number of children should be less in the forest so that the children can get supreme benefit. I mean, six to one or four to one rate should be provided so that children can go after their curiosity, discovery and games. That's why, it is important to go to the forest with more adults*." In addition to this, T4 stresses the significance of this rate to pursue the children by stating "*As a teacher, I need to pursue whether the child is wet or not. I did not have difficulty doing this with eight children this year. But if I had to cope with 16 and to manage the situation with them, would I meet a wet child?*"

Environment-Forest Reflecting the Region Children Come From

A qualified environment or forestland which will reflect the climate belonging to that region by definition of forest school implementations were emphasized as one of the necessities by the participants. T4 states about this issue as "*In my view, water is a basic need and it is essential to*

be close to it and the climate reflecting the region." CO says "*A qualified forestland and campsite are important. In the geography we live in İzmir, I think it is very difficult to find such places. Because it is one of the difficulties similar schools having similar demands experience. Having a mobile forest school is another disadvantage. It is against the spirit and philosophy of the concept*." Therefore, it can be inferred that one of the basic and most important features of the forest school implementations is that the school area should reflect the climate of the region that is close to the school.

Enthusiastic Educators- learners

It has been evident that enthusiastic educators and learners are one of the necessities in forest school implementations. It has been approved by the statements of CO: "*In my opinion, learners, teachers, educators who are enthusiastic to spend time in nature and with children are very important. I think the most remarkable thing is eagerness and excitement of educators about this issue. If the educator is unwilling, this reflects on every area and that's a problem. It is also essential for children and educators to spend good time in the forest because if the educator resists, it will unavoidably affect the quality of time spent there*."

Security

Findings display that security is one of the requisites in order to conduct the forest school implementations effectively. Security category explains what can be done to take sufficient and necessary precautons for security. Expressions of CO as "*Security measures must be taken. All question marks must be removed about it. Especially the number of adults to provide security needs to be sufficient. Volunteers or parents skilled at this issue could be collaborated. Volunteers could be trained regularly. Especially they need to be trained on the language used to talk to children and the way to interfere with the children. We use a language without interference and actually we avoid interfering with them.*" reveal that language and effective interference are important in training adults.

Parent Elucidation

It has been mentioned about the necessity of parent elucidation in the implementations. CO points out that infroming parents decreases their worries and explains the necessity of it as well as their experience in forest school implementations by stating the words "*One more thing is that parents need to be pre-worked, elucidation. I mean, actually, informing the parents clearly and overtly because as they experience with their children, they understand that their worries are superfluous. I mean, children do not live trouble when it is cold or rainy or while playing risky games in*

the forest does not give damage to their health. Being insistive and patient look important at this point. Most things settled in time. Another thing we do is sharing the places we go with parents. Walking around together and showing the places to them made them feel better because it is very enjoyable and good to be in nature. Our invitation of anxious parents or all of them to nature and spending all or half day with them, sharing what we do and where we go with them reduce their anxiety."

Logistics

Participants have worded the issues related with logistics, such as arranging the area in the forest, supplying and preserving the materials, producing solutions for the needs of meals and using restroom and meeting transformation needs. It has been stated that forest implementations do not bring too much cost depending on the closeness of the school to the forest and it has been stressed that particularly the planning stage is important. CO concretizes this with the statements as: "*The basic thing is constructing a convenient restroom in the forestland and arranging the campsite for rainy weather. So, we need to go there and build a restroom and a sheltered area without damaging the natural life in the forest*." Furthermore, teachers point out that they need an area to store their materials and T3 states "*Actually if we have aventer in the area, we will feel more comfortable, and it will be easier for the things like first aid. Instead of carrying things here and there, having them here ready will be more convenient*."

Results, Discussion and Suggestions

In this study based on teacher, parent and administrator views, experiences on forest school implementations from different perspectives have been tried to be revealed. The reasons why parents prefer such a school are due to the features they find lacking in schools that do not have such practices, the happiness of their children and the fact that their expectations are met. It is known that schools without such practices are under pressure in terms of subjects, success and standards (Maynard, 2007b). In the literature, there are studies indicating that the time spent in nature makes children happy and this is expressed by parents (Assadourian & Mastny, 2017; Koyuncu, 2019). It has been revealed in this study that the expectations of the parents were met especially based on their observations on the happiness and development of their children. Korkmaz (2019) also emphasizes that the program implemented and the physical environment provided create satisfaction among the parents' views on forest schools. On the other hand, O'Brien (2009) and Ridgers et al. (2012) state in their studies on forest schools that children carry their experiences home with the ripple effect and share them with their families and friends. In many studies in the literature (Borradaile, 2006; Ernst, 2018; Knight, 2013;

Koyuncu, 2019; Murray & O'Brien, 2004; Murrayand O'Brien, 2005; Savery et al., 2017) it was revealed that forest school practices provide parent satisfaction and meet expectations. In a study conducted by Savery et al. (2017), it is revealed that parents' views on opportunities for children to take risks and thus improve their self-confidence are positive, as in this study. That the parents' who choose the schools conducting forest school implementations being conscious about this issue and knowing what they want and expect to seek different learning experiences are considered important to correctly define and monitor their expectations (Koyuncu, 2019). It has been observed that both educators and parents stated children gained many academic, social and emotional, ecological and survival skills and characteristics thanks to their forest experiences. Participants state that enthusiasm and curiosity underlie academic learning and that the experiences in the forest provide academic development by feeding the child in this way.

Findings showing that effective and permanent learning in forest school practices depends on the opportunities offered by the natural environment and learning incentives and the opportunity to learn by doing, experiencing nature, and ecological awareness are important factors also coincide with studies in literature (Clements, 2004; Close, 2012; Davis & Waite, 2005; Dillion et al., 2006; Eastwood & Mitchell, 2003; Maynard, 2003; O'Brien, 2009; O'Brien & Murray, 2007a; Sobel, 2016). In his research, Snyder (1985) also attributes the non-permanence of learning to the inability to connect it with real life, the fact that the information remains at an abstract level in the classroom and that few sense organs participate in learning.

Research findings also show signs that coincide with the literature that children's competencies increase in areas such as leadership, teamwork and conflict resolution, especially in social development (Blackwell, 2015; Harris, 2017; Knight, 2003; Maynard, 2007; Murray & O'Brien, 2004; Nawaz & Blackwell, 2014; O'Brien, 2009; O'Brien & Murray, 2007a).

Other research studies, as displayed in this study, emphasizes that children experience less conflict during the time they spend in nature, they carry out conflict resolution more easily, and their ability to work together increases. On the other hand, it is emphasized in the literature in parallel with the study that survival skills develop effectively with the experiences spent in the forest (Close, 2012; Dawis & Waite, 2005). It is seen that survival skills are developed especially in the process of making fire in the forest, preparing food and drink, using tools such as pocketknife, hammer and knives to make living conditions suitable, and these are a routine part of forest practices. It is also among the findings that movements such as running, walking, climbing and balancing, which are part of forest life, contribute to the motor development of children. It is frequently mentioned

in the literature that both the motor development and physical endurance of children increase with forest applications (Davis & Waite, 2005; Kobayashi et al., 2018; Lamb, 2011; Maynard, 2007a; O'Brien, 2009; O'Brien & Murray, 2007a; O'Brien & Murray, 2006). In addition, the findings provide consistent results with the literature displaying the development of children's ecological awareness and their state of healthy and close relationship with nature (Assadourian & Mastny, 2017; Close, 2012; Gill, 2014; Murray & O'Brien, 2004; Swarbrick, Eastwood & Tutton, 2004).

Being outdoors in a natural environment enables children to connect with nature, while enabling them to gain environmental awareness in the long term, to develop their ability to make sense of the environment, and to develop positive attitudes and behaviors towards the environment (Forest Education Initiative, 2019).

When the findings are examined, it is seen that the most intense theme among the gains is the affective ones. Affective gains became visible with feelings of pleasure, self-confidence and curiosity. It is frequently stated in other studies that (Assadourian & Mastny, 2017; Aydos, 2020; Cahill et al., 2014; Close, 2012; Eastwood & Mitchell, 2003; Lester & Maudsley, 2007; Maynard, 2003; O'Brien, 2009; Thomas & Thompson, 2004) children feel happy and enjoy the time they spend in the forest, both during structured studies and during free game time.

It has also been a finding emphasized in the literature that (Blackwell, 2015; Brownstein & Ravensbergen, 2012; Close, 2012; Davis & Waite, 2005; Kanat, 2020; Koyuncu, 2019; Lawsan, 2009; Maynard, 2007; Maynard, 2007a; Munoz, 2009; O'Brien, 2009; O'Brien & Murray, 2007a; Ömer, 2019; Sheldrake et al., 2019; Waite & Davis, 2007) experiences such as coping with problems in nature, exhibiting survival skills, working together, and establishing relationships have positive effects on children's self-confidence and self-esteem, independence skills and curiosity to learn. Hinkley et al. (2008) also state that children in forest schools always seek physical challenges in their play and need to expand their physical skills and independence. They also emphasize that their statement is linked to children's willingness to learn how to deal with various dangers, their life skills and risk-taking tendencies.

In addition, it is seen in the findings that children with special needs encounter a supportive environment they need during forest school practices. Bradley and Male (2017) also examined forest school experiences for children with autism spectrum disorders, their parents, and educators, emphasizing the opportunity to struggle, take risks, be successful, and make friends. Gill (2014) in his systematic literature study on the benefits of children's relationship with nature explains that spending time in nature

improves mental health and emotional regulation and it leads to holistic improvements in children with special needs.

Findings indicate that the curriculum in practice in a school that conducts forest school implementations also shows some differences. At this point, benefiting from the educational opportunities offered by nature; the continuous development of applications over time and the necessity of a flexible program understanding come to the fore. While O'Brien (2009) states that children who are forest school practitioners gain the ability to see their environment from a different perspective, Harris (2017) states that contact with nature is one of the best ways to give children the opportunity to actualize their own learning. The forest offers a constant opportunity for learning in an environment that is both alive and infinitely diverse. Many studies in the literature (American Research Institution, 2005; Blackwell, 2015; Brownstein & Ravensbergen, 2012; Dillon & Dickie, 2012; Knight, 2013; Nixon, 2015; Sheldrake et al., 2019; Stoneham, 1996) also support the findings that highlight instructional opportunities. While the studies show that changes in nature, cycles, living things, stones, soil and water can offer learning opportunities in all areas, it also shows that art education can be opened through works such as painting with mud and sculpture with snow, as emphasized in this study. Findings indicate that forest school implementations improve and transform in time. It is seen that as the forest experience of the teachers in the school increases, they make the practices more qualified for the passing time and the children start to enjoy their forest life more. It can be said that this situation coincides with the finding that these practices require trained, competent and experienced trainers.

Findings showing that forest school implementations require flexibility in curricula point out that this flexibility is possible by allowing spontaneity and giving time to children's free play. Since forest school practices are student-centered, experiential and based on spontaneous learning (Blackwell, 2015), they have a structure designed by all participants (Adams, 2006; Koyuncu, 2019; Nixon, 2015). In this context, it is possible to say that forest schools allow to produce unique methods and materials in teaching. Furthermore, as emphasized in the literature, the free time offered provides children with improving their physical characteristics such as adapting to change, resilience, agility, psycho-motor coordination and muscle strength (Fjortoft, 2004); creates them other areas like games, free choice, autonomy (Broadhead, Howard, & Wood, 2010); gives them chance to gain independence through self-initiated tasks (Lawson, 2009; Murray, 2006; O'Brien, 2009); and leads following one's curiosity (Nixon, 2015). Since these applications are adaptable to individuals of different ages and levels and with different needs (Brownstein & Ravensbergen, 2012; Knight, 2013; Parks, 2013), it can be said that they may not be strictly

tied to the official program, require flexibility (Cooper et al., 2021; Harris, 2017), and thus the program is an emergent curriculum (Atmaca & Başbay, 2020; İnan, 2007; Keny & Rogers, 2015). Certainly, at this point, it is inevitable that educators should be educated, experienced, enthusiastic and effective leaders (Harris, 2017; Lawson, 2009). The educator qualifications required for forest school implementations, which emerged in this study, can be seen as a natural result of this situation.

Findings point out some challenges of forest school implementations, too. These include, academic worries especially felt by parents, difficulties due to weather conditions and home preparations of children for forest. In the literature, it is emphasized that there is a concern that the academic achievements presented in the official program may not be achieved in various studies on forest schools (Brownstein & Ravensbergen, 2012; Dowdell et al., 2011; Koyuncu, 2019; MacQuarrie et al., 2015). However, in England in the 1990s, the political pressure established on teaching literacy and developing academic skills in preschool age led to the spread of alternative implementations such as forest school (Knight, 2016). For this reason, forest school implementations can also be considered as an element that supports official programs (Murray & O'Brien, 2005), because today it is frequently emphasized that focusing on the development of 21st century skills (Gilchrist et al., 2016; Griffith & Slade, 2013) and the holistic and long-term development of the child (Association for Supervision and Curriculum,2007) come into prominence.

The finding that weather conditions are sometimes seen as challenging gains meaning with the view of Leather (2018) that the adaptation of these practices to the culture should be considered while being taken from the Scandinavian culture. Essentially, in forest schools, there is an expectation that children will be out in nature in all seasons so that getting wet can be fun, and they have the opportunity to learn to cope with very cold and very hot weather (Close, 2012). The outdoor learning experience is affected by unpredictable weather conditions, though. Yet there is no such thing as bad weather, but only bad clothes (Hansen, 2009). This requirement also draws attention to the importance of parents sending children to school on forest day with appropriate and complete clothing and equipment. As a matter of fact, the most frequently mentioned forest school requirements in this study were appropriate equipment. In forest school implementations, especially suitable personal equipment (water and windproof clothes, sturdy and non-slip boots, etc.), first aid materials, tools that children are trained to use safely (Blacwell, 2015; Eroğlu, 2020; Murray & O'Brien, 2005) are seen as essential needs.

The findings show that adult guidance should be provided to children by providing the appropriate child/adult ratio in order to carry out forest

practices effectively. Although the ideal rates vary depending on the grade level and conditions, providing the appropriate rate is considered important both for maintaining effective guidance and for ensuring safety, which is another requirement (Donaldson & Goering, 1970; Eroğlu, 2020; Maynard, 2007; Murray & O'Brien,2005). Kenny and Rogers (2015) also state that the low number of adults/children provides the opportunity for leaders to follow the interests and needs of children, and this situation also positively supports the creativity of leaders as it reduces their stress levels. A sufficient number of competent and experienced educators can make forest school implementations qualified on the one hand, and make children feel safe on the other (Cambium Sustainable, 2015). This educational leadership requires recognizing the connections and cycles in nature, being a good model in risk assessment, encouraging learning with the right questions at the right time, putting the child in the center and hearing him/her (Burçak, 2020; Eroğlu, 2020; Waite, Bolling & Bentsen, 2016).

Findings set forth that in order to carry out forest school implementations, a natural environment belonging to children, reflecting the climate and biodiversity of the region, and easy to access, is needed. It has been emphasized that revisiting such an area, which reflects the climate of the region, helps to develop a deep relationship with that place and to increase awareness about noticing the changes in the environment, especially seasonal changes; contributes to make quality applications in areas such as local bushland or wooded natural parks and provides the development of a sense of belonging to that area and the formation of a sense of protection or surveillance by getting to know a certain forest area/ environment closely with frequent visits (Keny & Rogers, 2015; Knight, 2011; MacQuarrie et al., 2015; Singleton, 2015; Sobel, 2014b). What is more, Uysal (2020) states that although the forest applications in various countries are carried out in a completely natural or open area belonging to wildlife, that the number of spontaneously formed forests in our country especially in big cities is low, or because these areas are far from the city center, it is difficult to carry out the forest school implementations in a natural/wild environment. Koyuncu (2019) adds that both the distances to the forest for a full forest school implementations and financial inadequacies prevent such attempts. At this point, the logistic dimension, which takes its place among the findings, comes into play. Although it is understood that meeting the needs such as transportation and nutrition in a school close to the forest area does not require huge costs, it can be said that many schools, especially in big cities, are unlucky in this sense.

Another requirement for forest school implementations has emerged as enthusiastic teachers and students. All the variables seen under the theme of difficulties and requirements can actually create conditions that

make it difficult for teachers to manage the process from time to time. Therefore, teachers must spend time in nature in all weather conditions, hear the needs of children, constantly review the program and restructure it according to conditions, needs and curiosities, and provide opportunities for free activities. It is mentioned in the literature that teachers who practice forest schools should have experience and knowledge on this subject, be in touch with nature, interfere with children less, and see the open air as a learning process (Blatt & Patrick, 2014; Burçak, 2020; Davies, 1997; Santi & Purboningrum, 2004; Schirp & Vollmar, 2013). With the teachers having such features, it is possible for children to have a pleasant time in nature and to participate in these practices willingly.

It is of great importance that forest school practices are seen and embraced as an integral part of learning by all stakeholders of the process. Then, parents need to internalize it and this is possible only through informing them efficiently. Nowadays, there is not enough time for free game playing in learning environments due to parental fear and anxiety caused by physical dangers (Wooley, Patticini & Somerset-Ward, 2009). As stated by the participants, with sufficient and regular information, parents can also offer support in possible difficulties in realizing the efficiency of the time spent in nature. Louv (2008) declares that the numerous contributions of free plays, which take place in nature in many cultures, on the development and learning of children are not known by the parents sufficiently. It is important for families to know the forest school philosophy, educational approach, forest school pedagogy, dressing rules and effective school-family cooperation in terms of preferring these schools and displaying supportive attitudes (Bradley & Male, 2017; Dilek, 2020; Koyuncu, 2019).

Forest school applications are turning into a need that schools must meet, especially in big city life, where the natural environment, free time and risky play opportunities that children deserve are taken away from them. On the other hand, the tendency of children towards passive indoor activities such as computer games, video and television leads to negative developmental consequences in children. Especially in developed countries, this leads to poor social emotional competence and increasing child obesity as there is a close link between students' health and exposure to the natural environment (Maynard, 2007a; Munoz, 2009).

When taking the contribution of the time children spend in nature to their academic, social-emotional and physical development into consideration, despite all requirements and difficulties, those implementations should be included in the curriculum and evaluated as an opportunity by scchool management and educators. Michek, Novakova, and Menclova (2015) also emphasize the importance of moving education to a natural opendoor

area, underlining that it is one of the approaches that effectively support children's development and learning by combining children's return to nature with nature's teaching. As it can be clearly seen in this study, forest school implementations encourage children to take personal and collective responsibility by adopting a holistic approach in their learning and development, and enable them to make sense of themselves, their relationships, difficulties, new conditions and the natural environment (Williams-Siegfredsen, 2012). Thus, children who see themselves as an integral part of the natural world will be able to embrace nature in all its aspects (Kenny, 2013; Kenny & Rogers, 2015; Louv, 2008). Independence, awareness of one's own and others' personal space, motor control, self-confidence, creativity, endurance, and survival skills are considered among the main achievements of forest schools in this study and in the literature. Precisely, the desire of schools to bring these characteristics to children is indisputable, but in today's conditions, serious obstacles such as school structures, programs and physical conditions deprive our children of these opportunities. For this reason, it is vital to produce policies that take into account the positive effects of time spent in nature in the field of education, to strengthen practices, and not to ignore the subject in teacher education. Otherwise, the nature that we deprive our children of will bring about not only with a deficiency in their development, but also with big problems in the world of the future.

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CHAPTER 6

ADVERSE IMPACT OF POVERTY UPON CHILDREN'S COGNITIVE DEVELOPMENT AND ABILITIES

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Introduction

Theorists and researchers have been discussing whether socioeconomic status (SES) impacts upon cognitive abilities of children, or whether cognitive abilities of children enhances, narrows or stays stable in time. The present study examines the dimensions of upward or downward cognitive mobility of children born into poor families and continually living in poverty compared to their peers. The Millennium Cohort Study that used data from five sweeps conducted research and collected data on children aged 9 months, 3 years, 5 years, 7 years and 11 years. The present study explored the cognitive trajectories of children in the lowest decile in the cognitive ability distribution at a given age and the factors that direct or impede their development or advance compared to their peers. The author analyses children's risks of mobilizing in and out of the lowest decile section in the cognitive ability distribution. The study indicates that children who come from poor families are more liable to stick into the lowest section in the age-appropriate cognitive ability distribution and reveals that upward or downward cognitive mobility is relatively high between children aged 3 and 11 years, especially between children aged 3 and 5 years. Parents with more education play a dual buffer or shield role by protecting children from lagging behind their peers and enhancing their plausibilities of mobilizing up the ability distribution. Parents involved in their socialization and education such as reading them and arranging bedtimes for children aged 3 years preserve children from dropping into the lowest section of cognitive ability distribution. However, it is asserted that such parental involvement does not necessarily help lower scoring children to mobilize upward the distribution.

Studies suggest that educational performance is a tool for upward social mobility within and along generations due to the fact that it is measured by educational attainment as well as present or future attainments. Many disadvantages and persistent socioeconomic trends cause low levels of cognitive attainment in children and can limit children's chances of educational success and prospects of vertical social mobility (McKnight, 2015). Nevertheless, the educational system can enable students to achieve educational success notwithstanding socioeconomic difficulties, race or ethnicity (Coleman, 1966). Cognitive trajectory can be defined as the degree to which children can move upwards or downwards in the direction of the age-specific developmental ladder compared to their peers. Studies assert that factors such as SES and family status can elucidate upward or downward changes in children's cognitive mobility and pose risks or opportunities for children's academic success. This study draws data from the five most recently available areas of the Millennium Cohort Study and concentrates on children who have obtained the lowest scores on cognitive

tests and socioeconomic variables such as education level of parents, parental occupation and family income, which are related to the probability of upward or downward cognitive mobility across the distribution of cognitive development by age 11.

Researchers see intergenerational cognitive abilities as just one of the indicators that aid account of the cognitive development trajectories of children (Becker & Tomes, 1986). Family's socioeconomic origin, SES, parental investments and the quality of the education they provide for their children can obstruct or motivate their academic progress. The effects of family's origin or socioeconomic status on children's socialization and education have been extensively addressed in literature. Bearing in mind the social class of parents (Erikson, Goldthorpe, Jackson, Yaish & Cox, 2005), as an indicator of SES, family income (Machin & Vignoles, 2004), or a combination of SES and all indicators of social class (Caro, McDonald, & Willms, 2009), higher SES has been related to better educational outcomes. Parental education, occupation and income prominently impact upon children's academic success (Bukodi & Goldthorpe 2012; Sullivan, Ketende & Joshi, 2013). Educational attainment and cognitive development trajectories in children are associated with the socioeconomic status of the family, including in particular poverty or low income (Dickerson & Popli 2016; Feinstein 2003). A cohort study in England, which followed the same group of children throughout their development and growth process, has revealed that children from richer families incline to perform better on cognitive tests as early as age 2 or 3 (Feinstein 2003; Blanden & Machin, 2010; Hansen, Jones, Joshi & Budge, 2010; Waldfogel, 2013; Platt, Smith, Parsons, Connelly, Joshi, Rosenberg et al., 2014). In researches conducted in the United States, similar findings were reached by Brooks-Gunn and Duncan (1997) and Lee and Burkam (2002) and Dornan and Woodhead (2015) in lower-income settings.

Researchers have studied the degree of upward or downward mobility of children born into poor families and continually living in poverty across the cognitive distribution. In reference to data from the millennium cohort study, Blanden and Machin (2010) discovered that children between 3 and 5 year-old from high-income families with lower vocabulary moved upward compared to their peers from lower-income families. Feinstein (2003), who drew data from a cohort study on British children born in 1970, showed that children in lower socioeconomic status who scored higher on cognitive ability tests than their peers aged 22 months in higher socioeconomic status continued to perform less well at 42 months. Even before begining school, less able children of parents in higher socioeconomic status caught up and did not lag behind children from families in lower socioeconomic status in terms of cognitive development.

In a UK cohort study on children born in 1991-1992, while children from the most disadvantaged backgrounds and poorest families received higher scores on cognitive tests at age 7, they performed worse compared to their less successful peers from wealthier and the least disadvantaged families between ages 14 and 16 (McKnight, 2015). Over time, a convergence has been observed between the test performances of more talented children from families in low- socioeconomic status and their less gifted peers from families in high- socioeconomic status.

Studies compare the results of average test scores among socioeconomic status groups and analyze the impact of poverty on the degree of upward or downward cognitive mobility of children across the age-appropriate distribution in children aged 3 years, 5 years, 7 years and 11 years. The analysis focuses on children who have had a poor educational start in cognitive ability distribution and received low scores. The researchers measured the cognitive abilities of the same group of children aged 3 and 5 along the pre-school years and the beginning of secondary school education and tried to determine the degree of cognitive mobility for entering and existing from the lowest decile for children with low scores in the cognitive ability distribution. Parental income, education and profession as well as other socioeconomic status characteristics and early parental inputs were determined as independent variables. Depending on these independent variables, it was investigated whether there were any differential risks of getting points in the lowest decile section of the cognitive ability distribution for the children from poor and non-poor families (Bruckauf & Chzhen, 2016).

The role of poverty in obstructing the cognitive development of children as well as efforts to understand the degree of upward or downward mobility in the cognitive development of children who scored lower than their peers in the distribution of cognitive ability, incited debates about the significance and effectiveness of preparing children for preschool and primary school. Studies have focused on children's education during their early years and their position in cognitive ability distribution and cognitive mobility (Field, 2010). The Millennium Cohort Study followed the lives of a group of children born in 2000-2001 until age 11 and investigated the impacts of poverty on children's 'entery' into and 'exit' from the lower scoring group as they grew up. The study examined the trajectories of children associated with their cognitive outcomes at early ages, differential risks of entering into and exit from the lowest performing decile section and their chances and probabilities of exiting from this group (Blanden & Machin, 2010). The study reveals the necessity and importance of the programs and interventions aimed at success especially when children living in poverty enter and remain in the low scoring group in the age-specific

cognitive ability distribution. This study also introduces the theoretical and conceptual framework used to examine the impact of poverty upon cognitive development of children, measures and methods to be applied, as well as data, findings and evidence emerging from the research.

Theoretical and Conceptual Framework and Evidence

The family stress model (FSM) as well as family investment theory has been trying to explain the relationship between the socioeconomic status (SES) of the family and the cognitive development and academic achievement of children. Families offer their children advantages and opportunities or disadvantages and limitations arising from SES through child-rearing, socialization and education processes (Bradley & Corwyn, 2002). The family stress model posits that economic hardship and poverty result in parental conflict and in parental demoralization and stress. As regards the family stress model, the influence of socioeconomic status on the cognitive development of children occurs through household income rather than educational levels or occupations of parents. The family stress model discusses how economic pressures created by economic difficulties or negative financial facts such as low income and job loss lead to stres and tension in parents and how this stress harms the child rearing, socialization and education processes in the family as well as cognitive development in children (Conger, Ge, Elder, Lorenz & Simons, 1994). According to the family investment theory, which tries to explain the association between poverty and cognitive development, as the household SES resources increase, parents use and spend more financial capital resources as well as human and social capital resources for the education of their children in order to foster, improve and enhance their intellectual, cognitive development and academic or school achievement. Mayer (1997) proposes that parents decide to choose how much of their available resources to allocate to and spend for the various family goals, and that these choices, albeit dependent upon individual and cultural preferences, are determined and limited by the availability of household resources. According to the parental investment theory, family income as an indicator of economic and financial resources is combined with parental knowledge and skills or parent education, defined as human capital, and the parental occupation, which reflects the social environment, social network and communication skills in the form of social capital. Educational levels and occupations of parents, which indicate human and social capital, could determine family preferences and impact the level and direction of investments in children and household education expenditures. Higher-educated parents are likely to attach more value to providing children with opportunities to engage in activities that contribute to cognitive development and encourage, enhance and increase intellectual and cognitive learning, compared to

lower-educated parents. Nevertheless, family income can facilitate or limit the ability and power of parents to provide opportunities or activities that require financial investments and expenditures, such as taking private tuition, learning outside the classroom, or attending prep courses for college exams (Altschul, 2012).

It is emphasized that the family stress model and family investment theory, which try to explain the impact of socioeconomic status upon cognitive development and academic achievement of children, are not mutually exclusive, and that family-stress processes and parental investment and spending processes interact with one another as far as children's education is concerned. Many studies using several different nationally representative datasets on young children from infancy to primary school age, evaluate children's cognitive and behavioural consequences for relationships of both the family stress model and family investment theory, and reveal findings verifying the arguments suggested by the family stress theory and family investment theory. Studies have revealed that parental stress is often associated with behavioural outcomes of children, while parental investment is often more strongly correlated with cognitive development of children (Gershoff, Raver, Aber & Lennon, 2007; Guo & Harris, 2000; Linver, Brooks-Gunn & Kohen, 2002; Yueng, Linver & Brooks-Gunn, 2002). Yeung et al. (2002) conducted on research of a nationally representative sample containing 753 preschool children who were different in terms of socioeconomic status. They found that children from lower income or poor families received lower letter-word points. Lower income or poverty was mutually associated with lower letter-word points. Mothers mediated the relationship between family income and early literacy skills in children by dint of engaging children in home learning activities and ensuring cognitive, intellectual experiences and materials to them. It was observed that parents feeling depressed, upset, angry and worried owing to poverty were less involved and engaged in activities that contributed to cognitive and intellectual development and academic performance and skills in their children such as engaging them in substantial, prolific speaking and reading activities, and aiding with homework. In keeping with the FSM associated with economic hardship, parents with stress arising from poverty and economic difficulties disrupted and harmed child rearing, socialization and education practices by demonstrating less warmth and love towards their children. In such a family environment, child-rearing, socialization and education processes or practices were found to have a significant association with lower cognitive skills and higher problem behaviours in children. In a nationally representative sample containing 21,255 kindergarten children they conducted using the Early Childhood Longitudinal Study, Gershoff,

Aber, Raver and Lennon (2007) investigated the relationship between dual components of family income and economic hassle and cognitive, intellectual and social-emotional skills in children. The researchers discussed variables such as positive practices and investments in mediators of parental stress, household income and economic hardship as well as child-rearing, socialization and education processes. They also examined how these variables affected and predicted cognitive skills and social-emotional competence of children aged 6-years. Research results indicated that economic hardships contributed to enhancing parental stress and diminishing educational investment, spending and positive child-rearing as well as socialization and educational practices; whereas, when household income increased, parental investments and resources that helped to enhance, improve and promote cognitive, intellectual and academic or school skills in children, also enhanced. The researchers emphasized that higher income alleviated economic hardships and stress, and reduction of economic difficulties and stress in the family both enhanced positive child-rearing, socialization and education practices and reduced problem behaviours in children. A reciprocal association was observed between cognitive development, cognitive abilities, skills and academic achievement of children and parental investments and expenditures for the education of their children. Addressing the the pathways between household and home environment and household income and demoralization in mothers, Nievar, Moske, Johnson and Chen (2014) focussed on and looked into the reciprocal relationship between parent-child attaching as well as self-regulating in the preschool years and cognitive consequences in first grade during the whole processes of child rearing, socialization and education. The researchers found that household income and demoralization in mothers had a considerable impact on child-rearing, socialization and education practices. Child rearing, socialization, education processes and practices, which are directly influenced by family income, most consistently predicted the cognitive development, cognitive abilities and skills of children. When poor parents ensured a safe, encouraging, stimulating and motivating environment for their children although their restricted monetary and economic resources or mental health problems, they were generally able to prepare their children for school.

Studies indicate that low-income parents are both unable to allocate sufficient time and provide sufficient care for their children and that they cannot adequately provide goods, materials, services, activities contributing to cognitive development of their children with their limited financial resources; and thus they are forced to invest less in for educating their children. (Bruckauf & Chzhen, 2016). Family income can offer children opportunities to access educational, social and cultural resources

that increase the acquisition of knowledge and skills as human capital and also encourage, nurture and enhance their cognitive and social-emotional development. On the other hand, poverty can place limits on parents to purchase materials, products, goods, services, activities and experiences that serve and contribute to fostering, nurturing, enhancing and improving children's knowledge and skill acquisition and promoting cognitive and social-emotional development. Low-income households under the pressure of low and restricted monetary resources offer their children fewer occasions to benefit from cognitive, intellectual and educational activities as well as educational toys, learning materials and services that require spending money for education of their children and contribute to their cognitive development, cognitive abilities and skills. They have fewer and more limited options to provide their children with socially enriching, educational experiences and activities such as taking music lessons and visiting museums (Duncan, Magnuson & Votruba-Drzal, 2017). Mayer (1997) emphasized that low-income families had difficulty providing basic, immediate, vital and essential requirements of their children and meeting the expenses spent on sufficient and regular nutrition, decent housing, clothing and health care. The researcher also stated that children in those families lived in worse and poor conditions, depleted less food, had fewer toys developing, advancing cognitive skills and were less involved in cognitive, intellectual and educational development activities. On the other side, Mayer also pointed out that low-income parents possessed less education, knowledge and skills as human capital and less income as economic, material capital; as well as lower levels of social and network vicinity and fewer relation, communication, interaction skills ensured by the profession in terms of social capital when compared to parents in middle or upper socioeconomic status. Emphasizing that low-income parents spent less time with their children and ensured them with less social capital, Mayer asserted that poverty had negative impacts on family structure, psychological feelings and parental behaviours, as well as child-rearing, socialization, education processes and practices in the family. He also stated that variables such as family structure, parental feelings and behaviours as well as child-rearing, socialization and education processes and practices mediated the association between family income and both cognitive skills and academic performance of children. Likewise, Cooper and Stewart (2017) pointed to the fact that poverty had an adverse impact on child-rearing, socialization and education behaviours of parents and played a role in the negative relationship between poverty and cognitive and behavioural consequences in children; thus, these parenting behaviours mediated this negative relationship between poverty and cognitive and behavioural consequences in children, and indirectly influenced and accounted for this relationship. In another research, Holmes and Kiernan

(2013) indicated the consequences of poverty in 5-year-old children and designated four factors, namely (1) associating with children, (2) encouraging, motivating children for reading and learning (3) improper training, (4) family structure. The research revealed that children born into poor families and continually living in poverty could less experience positive and proper socialization practices or processes than their non-poor peers. Holmes and Kiernan asserted that child-rearing, socialization and education styles accounted for 40-50% of the association between poverty and academic and cognitive consequences of children.

Masarik and Conger (2017) referred to the day-to-day challenges, tensions and strains caused by unstable economic conditions in low-income families, such as inability to meet basic, immediate, vital and essential requirements, difficulty paying bills or being unable to buy basic necessities. Consequently, these economic challenges, tensions and strains led to psychological distress, grief, anxiety, and frustration in parents. Likewise, other researchers also emphasized that exposure to poverty enhanced negative life facts, led to greater demoralization in parents relating and interacting with their children and diminished positive socialization and education practices (Duncan & Brooks-Gunn, 1997; Guo & Harris, 2000). McLoyd (1998) and Elder (1999) also reached similar findings in their investigation and established that poverty, low wages, stressful jobs caused stress, tension and anxiety in parents. They also found that variables diminished the capacity of parents to ensure a warm, supportive and consistent family environment for their children during the socialization and education processes. Parents in low socioeconomic status had lower energy levels and less social support and could more negatively and harsly behave towards their children to socialize and educate; Moreover, they experienced more negative emotions such as demoralization, anger, anxiety and frustration, and felt more tension and distress in their professional life. Considering all these conditions, low-income parents exhibited less warm and sensitive behaviour towards their children and displayed less parental monitoring or observation on account of negligence. Low-income and poor parents experienced difficulties to stimulate, motivate and encourage their children in order to deal with and engage in learning opportunities provided by schools and gain new experiences enhancing cognitive abilities (McLoyd, 1998; Elder, 1999). Similarly, Oxford and Lee (2011) also found that parental demoralization stemming from poverty reduces the sensitivity of parents to their children in the processes of child-rearing, socialization and education in the family, thus diminishing parents' ability to ensure a family environment at home advancing cognitive and intellectual development such as parental encouragement, motivation and engagement in teaching activities Another

recent study asserted that parents feeling demoralized, distressed, anxious, angry and frustrated for living in poverty were involved in less verbally communicating and interacting with their children by demonstrating less sensitive, encouraging and loving behaviour towards their children and also exerted less effort to motivate and encourage their children to learn. Children of parents demonstrating such behaviours obtained lower cognitive ability test scores in early childhood and had difficulty to concentrate and focus on their attention on carrying out complex learning tasks in middle childhood (Lovejoy, Graczyk, O'Hare & Neuman, 2000). In another similar study, Berger, Paxson and Waldfogel (2009) asserted that children born into poor families and living in poverty had higher chances of scoring worse, cognitive behavioural, and health consequences than their wealthier peers.

Researchers emphasized that there was a significant relationship between harsh, inconsistent and inattentive behaviours of parents in lower socioeconomic status who have lower education, less prestigious professions and lower income levels during child-rearing, socialization and education processes and lower cognitive abilities and discordant behaviours in their children (Bradley & Corwyn, 2002). Şirin (2005) asserted that poverty and low income levels played a negative role in cognitive development, cognitive skills, or academic achievement of children. The researcher found that a strong relationship existed between low income levels in families and undesirable outcomes such as low intelligence scores, low educational attainment, and low academic achievement in children. Duncan, Magnuson and Votruba-Drzal (2017) pointed out that children born into poor families and living in poverty displayed lower performance in cognitive ability tests, complained more about physical and mental conditions and were at higher risk in terms of academic failure and early school dropout when compared to their peers. In the same manner, another study emphasizing the negative influence of poverty on cognitive development of children, established that children from poor or less advantageous families displayed poorer and lower performance regarding language and reading skills, social and behavioural development and physical health compared to their wealthier peers (Bradbury, Corak, Waldfogel & Washbrook, 2015). In line with findings from other studies, Sampson, Sharkey and Raudenbush (2008) found that school-age children born into poor families and living in poverty who needed assistance and welfare support received lower verbal skill test scores than their peers. In their research, Burchinal, Vernon-Feagans, Cox and the Family Life Project Key Investigators (2008) pointed to the existence of a negative relationship between poverty and reading and math performances of children. Mothers played a signifant role in cognitive development in children by communicating and discussing with

their children, reading for them and engaging them in learning activities at home

In another recent study, it was revealed that lower-SES mothers showed less effort to teach their children reading letters, words, sentences, numbers and shapes compared to middle and upper-SES mothers (Votruba-Drzal, 2003). In his study, Reardon (2013) asserted that cognitive development or academic achievement gaps between the children from families in low socioeconomic status and the children from families in middle or upper socioeconomic status became particularly evident at school entry age. Researchers highlighted that children from low socioeconomic status or poor families stayed at lower levels in terms of understanding or comprehending literacy and reading and these children started school with lower levels of skills related to literacy or reading such as letter or word recognising and understanding (Dyson, Hett, & Blair, 2003). By dint of their lower socioeconomic status, children living in poverty lagged behind their peers in terms of word and letter recognising and main literacy skills (Duncan & Seymour, 2000). Children from families in poor or lower socioeconomic status received significantly lower points in reading and math area at preschool entry (Baker, Cameron, Rimm-Kaufman & Grissmer, 2012). Likewise, children from families in poor or lower socioeconomic status began to preschool with lower levels in terms of skills in reading and math than their peers and eventually sustained harm and suffered from these disadvantages that they experienced during their school years (Lee & Burkam, 2002).

Examining how early-life socioeconomic status is associated with differences in cognitive ability in early adulthood of 473 men who was born in 1934-1939, Olkkola (2015) found in his thesis study that differences in cognitive abilities were closely related to socioeconomic status in childhood. Income in early childhood was coherently associated with adult cognitive abilities and SES in the early phases of life consistently impacted the cognitive abilities in men born in the 1930's. He also asserted that educational stimulation and nutritional status mediated the relationship between childhood SES and differences in cognitive abilities. Studies revealed that in the beginning socioeconomic cultural inequalities considerably enhanced the academic achievement gaps with time and the impact of family poverty on cognitive development and academic performance began in early childhood and proceeded throughout school years (Entwisle & Alexander, 1993). Also, negative conditions in families such as poverty and the long of time continued in poverty played an important role in the cognitive, intellectual, acedemic development and school preparation of children younger than 5 years of age (Anand & Lea, 2011; Burney & Beilke, 2008). Evidence from branches of science such

as neuroscience, developmental psychology, and economics shows that early childhood is a basis for generating the greatest cognitive payback later in life (Phillips & Shonkoff, 2000). Children's neighborhood and their experiences during the first five years of life play an important role in forming the basis for their future cognitive development (Fox & Rutter, 2010; Knudsen, 2004; Nelson, Zeanah & Fox, 2019). The model of skill formation in a cumulative manner suggests that the investment made by parents in their children's initial skills consolidates the returns and gains of investments in human capital as later knowledge and skill acquisition (Cunha & Heckman, 2008; Cunha, Heckman & Schennach, 2010; Heckman & Masterov, 2007; Heckman, 2008). This theoretical and conceptual framework focuses particularly on the family environment and the importance of early childhood experiences, and emphasizes the changing nature of cognitive skill development throughout the human life cycle. Studies conducted on disadvantaged children have revealed that adverse and negative experiences during the first years of childhood may have long lasting deleterious effects on important cognitive outcomes in later stages of life, and that positive experiences in early childhood are linked to better cognitive and socio-emotional consequences (Schweinhart, Montie, Xiang, Barnett, Belfield & Nores, 2005; Shonkoff & Meisels, 2000). Social scientists and economists underline the importance of investing in disadvantaged children during early childhood as the most efficient method and way for increasing and strengthening the future workforce (Heckman, 2006).

Brooks-Gunn and Duncan (1997) analyzed data from longitudinal studies and discovered that poverty had a negative impact upon a range of mid- to long-term consequences such as cognitive competence, educational performance, school completion, and income in adulthood, especially in the early years of childhood. Childhood poverty has influenced the current and future cognitive outcomes of children through their roles in children's health and nutrition, parental health, neighborhood, home, family environment and parent-child interactions. Using the panel research on Income Dynamics, Duncan, Ziol-Guest, and Kalil (2010) argued that poverty suffered in early childhood had a substantial negative impact on earnings and working hours of adults. Dickerson and Popli (2016) established that persistent rather than episodic poverty had particularly detrimental effects on children's cognitive development later in life. Tomlinson and Walker (2009) indicated that poverty was a complex and multifaceted phenomenon that went beyond lack of income or specific home appliances. Poverty is associated with variables such as poor housing, limited access to services, parents' inability to support themselves, their mental health and sense of worth, which are variables that lead to parental stress. The family stress

model asserts that economic disadvantage puts pressure on parental mental health, and leads to adverse and detrimental effects on parental investments in children and their cognitive outcomes (Conger, Rueter & Conger, 2000; Conger & Elder, 1994).

Parental behaviours and practices, such as spending less time for their children, neglecting their care and making less effort to involve their children in activities that encourage cognitive development due to depression, distress, anxiety, anger and disappointment caused by poverty, damage cognitive development and socialization of children. On the other hand, poverty adversely impacts children's cognitive outcomes by restricting parents' ability to purchase goods, materials, services, and experiences that will help and contribute to their children's education. Parents able to invest less for educating their children because of limited economic or income resources (Lord, 2001). Socioeconomic disadvantages are most likely associated with parental beliefs and aspirations and can lead to poor parental investment behaviour (Stafford & Yeung, 2004; Wentzel, 1998). As an indicator of parental inputs, various possible measures as well as which parental inputs are influential and how much parental input is necessary have also been discussed (Kalil & Mayer, 2016; Waldfogel, 2016).

Studies have confirmed that parenting behaviours to socialize and educate children play a mediating role between poverty and cognitive or academic consequences of children (Kiernan & Huerta, 2008; Kiernan & Mensah, 2011). The way in which they socialize and educate their children reflects the wider social, educational and cultural resources in families (Sullivan, Ketende, & Joshi, 2013) or parenting style and educational activities of parents such as reading to and talking with children (Ermisch, 2008). However, it is found that overemphasizing the role of socializing and rearing children does not always yield the desired and expected results. Although there are appropriate interventions in parental practices for the socialization and education of their children (Cunha, Heckman, Lochner, & Masterov, 2006), politicians have started making more and more reference to parental behaviours and blamed parents for their children's negative outcomes rather than mentioning inadequate social protection and social service provision (Hartas, 2015; Main & Bradshaw, 2016).

Researchers have discovered that demographic features such as gender, ethnicity, and race are associated with poverty. In Great Britain and the United States, for instance, poverty affects blacks, Pakistani and Bangladeshi ethnic groups much more (Fisher & Nandi, 2015; Palmer & Kenway, 2007). The cognitive delays observed in 9-month-old infants in poor Pakistani and Bangladeshi ethnic groups disappear when factors associated with socioeconomic deprivation are improved (Kelly, Sacker,

Schoon, & Nazroo, 2006). While some social scientists from disciplines outside sociology tend to use income as a proxy of socio-economic status, sociologists share the understanding that social classes as positions are determined not only by income, but also by labor market position, power and status in market relationships (Sullivan, Ketende, & Joshi, 2013). Social class has been defined and measured as broad occupational categories, often reflecting positions displaying variations in business relationships (Goldthorpe, 2004). Drawing data from different sweeps of the millennium cohort study, researchers discovered that parents' social class had an independent impact on the cognitive outcomes of children aged 7 even after checking parental education, parental occupation, household income, and socialization and education practices undertaken by parents as well as the cognitive scores of children aged 5 (Sullivan, Ketende, & Joshi, 2013). In another study, Jerrim (2012) indicated that the occupational status of parents accounted for the national differences in the academic performance of the 15-year-old group considering the gender and immigrant status of children.

The present study focuses on the following assumptions: (1) When poverty directly affects cognitive mobility of children in time, children who have obtained points in the lowest decile section in the cognitive ability distribution of children aged 3 years, 5 years, 7 years are considerably more liable to remain in the lowest decile section when tested later at age 5, 7 or 11 if they come from families continually living in poverty, even after checking education, educational practices, occupation of parents. (2) Children who have obtained points above the lowest decile section in the cognitive ability distribution in one year are more inclined to drop into the lowest decile section the following year if they come from families continually living in poverty.

Data and Methods

The present study focuses on the family stress model and family investment theory, which attempt to explain the negative impact of poverty on cognitive development, cognitive skills and academic performance, and refers to the research studies and research findings linked with these two theories. Based on the concepts of the family stress model, the author concentrates on studies that address negative emotions such as demoralization, grief, anger, anxiety and frustration caused by poverty, and less sensitive, less warm and less loving as well as inconsistent and inattentive behaviors for their children. He conducts analyses in terms of weakening of parental interests, efforts, abilities and capacities in order to enhance, improve and boost the cognitive development, cognitive skills and academic performance of their children through emotions, attitudes and behaviors that disrupt and damage the processes of child

rearing, socialization and education. On the basis of family investment theory, the present study also reviews and examines the fact that poverty causes parents to have little or no opportunities to buy materials, goods, products, services, activities and experiences that contribute to cognitive and intellectual development, cognitive skills, and school performance of their children. The author prefers studies that deal with preschool and primary school children and their parents as a research sample in order to determine the impact of poverty on cognitive development, cognitive skills and academic performance. The present study refers to and introduces age-specific cognitive tests used as data collection tools as well as tests aimed at measuring reading and math skills.

The Millennium Cohort Study, which conducted a longitudinal survey on about 19,000 young people born across Britain in 2000-2002, administered age-specific cognitive ability tests to children at 9 months, 3 years, 5 years, 7 years, and 11 years of age and followed their lives across these ages (Bruckauf & Chzhen, 2016). The longitudinal survey was conducted in different sweeps with millennium cohort study 1 concentrating on children at age 9 months; millennium cohort study 2 on children at age 3; millennium cohort study 3 on children at age 5; millennium cohort study 4 on children at age 7; and millennium cohort study 5 on children at age 11. The Millennium Cohort Study is intended to examine the socio-economic status and demographic features in the families by concentrating on abilities, endowments, socialization and education practices of parents as well as inputs starting from the antenatal period. Data pertaining to the cognitive development of children were gathered as of age 3. In the study, samples were selected from low income families and children living in poor neighborhoods. A total of 18,552 families were interviewed in millennium cohort study 1. The researchers re-interviewed most of them (79%) and with 692 additional proper families for the first time in millennium cohort study 2 (Hansen & Joshi, 2007). As they lacked key predictors in millennium cohort study 1, these 'new families' were excluded from the multivariate analyses in this study. 13,287 families responded validly in Millennium Cohort Study 5. The proportion of all Millennium Cohort Study families who always responded, including the 'new families', was 69 per cent. Although loss of samples in a particular longitudinal study is an important problem, here it was suggested that sample losses during the first five sweeps of the study did not constitute a problem significant enough to disturb the nature of the research (Platt, Smith, Parsons, Connelly, Joshi, Rosenberg et al.2014).

Measuring Cognitive Development with Cognitive Tests

The Millennium Cohort Study applied age-appropriate standard cognitive tests to children starting from age 3. The raw scores were

completed so as to take into consideration the age of the children towards the nearest 3 months in the interview, and the difficulty of the item sets was standardized. The specific types of cognitive assessments applied to the Millennium Cohort Study children aged 3 years, 5 years, 7 years and 11 years were shown in Table 1 (Hansen, 2014). The researchers used diverse age-specific British Ability Scales tests in all four studies. Word Reading and Verbal Similarity scales were employed to measure 5 to 17 year-old children's capacities or abilities to read and reason verbally. In turn, the Naming Vocabulary scale measured verbal ability of young children. Pattern Construction scale tested spatial consciousness and awareness of children while the Picture Similarity scale assessed problem-solving capacities and abilities in children. The millennium cohort study user database indicated three types of British Ability Scales test points, namely raw points, ability points and t-points. These studies applied appropriate items for them depending on ages of children and used the t-points. In millennium cohort study 2, the Bracken School Readiness test was applied to young children at age 3 to assess their comprehending and understanding various educational concepts. The concepts employed used in millennium cohort study 2 included letters, numbers, counting, colors, shapes, sizes, comparisons. These concepts seemed to be associated with their reaching academic and intellectual sufficiencies for children preparing and starting formal school education. Researchers obtained a standard score regulated according to age by calculating correct respons by participants. The NFER Number Skills tests were applied in Millennium Cohort Study 4 in order to measure children's knowledge related mathematical concepts and skills in children. The study used the standardized age-regulated points provided in the Millennium Cohort Study dataset.

The two CANTAB tests applied in Millennium cohort study 5 were not used here in view of the fact that they not comparable to the rest of the tests.

Table 1 *Cognitive tests applied to children in millennium cohort study sweeps 2, 3, 4 and 5*

Millennium Cohort Study 2	British Ability Scales Naming Vocabulary	Bracken School Readiness	
Millennium Cohort Study 3	British Ability Scales Naming Vocabulary	British Ability Scales Picture Similarity	British Ability Scales Pattern Construction
Millennium Cohort Study 4	British Ability Scales Pattern Construction	British Ability Scales Naming Vocabulary	NFER Number Skills
Millennium Cohort Study 5	British Ability Scales Verbal Similarity	CANTAB Spatial Working Memory	CANTAB Cambridge Gambling

Hansen (2014, p. 62)

Despite the fact that the cognitive ability tests administered to children in the millennium cohort study do not assess innate intelligence and are just tests prepared to measure attainments based on the capability and motivation for completing a certain task under given conditions (Platt, Smith, Parsons, Connelly, Joshi, Rosenberg et al. 2014, p. 52), the cognitive ability tests are charactersitically employed as indicators of age- appropriate cognitive development in children (Waldfogel, 2013). Points obtained from different tests applied in the identical wave were mostly joined, and factor analysis or associated techniques were used to determine an underlying latent dimension of cognitive ability. Use of multiple scales helped reduce the measurement errors related to the test points and minimized the risk of revealing spurious shifts in the watched test scores with time (Jerrim & Vignoles, 2013).

Socioeconomic Status (SES)

In the research, poverty is associated with the main variable related to socioeconomic status. The researchers check for education level and occupational status of parents as well as their work status and household structure that reflect a couple household or a lone-parent household. Households material resources are distinguished from the human and social capital resources in households. The study uses highest parental occupational status which show their prestige positions in occupational hierarchy regarding the current or most recent job of the mother or father as an indicator of social class. The professional status of parents is determined on the basis of Goldhorpe's Class schema, which comprises (1) employers who buy the workforce of other individuals and thus control and have authority on other employees, (2) individuals who work in their own workplaces without employing wage laborers, and (3) individuals who sell their workforce to employers and therefore they themselves are under the control and authority of their employers as three main formations and seven major classes. In the stratification system, small proprietors, capitalists, higher-grade professionals and managers in the service class form Class I as the top category. Class II includes mid-level professionals, managers, white-collar workers, higher-grade technicians, managers in small industrial establishments and supervisors of non-manual workers. Routine non-manual employees in higher-grade administration and trade represent Class III a, while routine non-manual employees in med-level trade, sales and services represent Class III b. Class IV a comprises petit bourgeoisie: small proprietors and artisans with employees, and Class IV b comprises small proprietors and artisans without employees, whereas farmers and other self-employed workers in agriculture are in Class IV c. Class V includes lower-grade technicians and supervisors of non-manual workers. Class VI represents skilled manual workers. Class VII

a comprises semi and unskilled manual workers (other than agriculture), while Class VII b comprises agricultural laborers: agricultural and other workers (Erikson & Goldthorpe, 1993).

Parental Involvement

In the study, three measures of parental involvement checked at age 3 included (a) frequency of reading to children at home, (b) frequency of children watching television/video, (c) whether children have a regular bedtime. Answer categories regarding frequency of reading were determined as (a) (almost) never, (b) sometimes, (c) often, and (d) (almost) always on a 6-point scale. Frequency of watching television/video was measured on a scale presenting four response options, namely (a) 3 or more hours, (b) 1-3 hours, (c) less than 1 hour, (d) not at all. Not watching television/video at all did not mean that children interact with parents and other play or learning activities in this time and was not accepted as an optimal frequency of watching television/video at age 3. Watching television/video and regular bedtime are accepted in the literature as a marker of parental socialization, rearing and education styles for regulating their behaviours by setting rules and routines in order to socialize and educate children (Kelly et al. 2013). Watching TV and regular bedtime are used here as a categorical independent variable with answer options as (a) never, (b) sometimes, (c) usually and (d) always on a scale. Researchers suggest that there is a significant and positive association between parental help with reading and cognitive ability of children at age 5 but have also found that this relationship is not as strong as it is at age 3. It is also discovered that parents cognitively encouraging, stimulating and motivating them at age 3 such as helping children for alphabet, counting or maths teaching do not seem to be as strongly related with cognitive consequences at 3 and later ages as reading. The researchers indicated that most of the cognitive consequences reflected verbal ability which may be affected differently than other respects of cognitive development in children (Washbrook & Waldfogel, 2010).

Results

The research shows differential risks of getting points in the lowest decile of the cognitive ability distribution in children aged 3 years, 5 years, 7 years and 11 years.

Table 2 *Per cent of children in the lowest decile of cognitive ability distribution according to large and persistent inequalities or gaps existing between socioeconomic statuses or social classes and demographic characteristics*

		Millennium Cohort Study 2 Percentage Rate of Children Aged 3 Years (%)	Millennium Cohort Study 3 Percentage Rate of Children Aged 5 Years (%)	Millennium Cohort Study 4 Percentage Rate of Children Aged 7 Years (%)	Millennium Cohort Study 5 Percentage Rate of Children Aged 11 Years (%)
Child's Gender	Male	12,7	12,5	12	9,9
	Female	7,9	7,4	7,9	10,7
Child's Etnicity	White	7,7	8,3	9,1	9,7
	Mixed	13,4	11	10,9	7,7
	Indian	23	12,1	7,6	7
	Pakistani and Bangladeshi	50,8	34,1	21,2	22,2
	Black	29,7	20,5	17	9
	Other	25,1	19,4	9,2	11,7
Parental Marital Status	Married	8,5	8,2	7	8,5
	Cohabiting	10,6	11	11,4	12
	Lone parent	16,7	14,8	15,4	12,5
Parental Employment Status	Both working	5	6,1	6,1	6,8
	One working	11,6	11,5	11,7	13,7
	Neither working	23,2	21	21,5	18,7
Parental Occupational Status	Higher managerial and professional	3,8	4,4	3,5	4,7
	Intermediate	4,8	6,8	7,5	7,2
	Small employers and self-employed	10,2	9,9	8,6	9,9
	Lower supervisory and technical	11,7	11,6	12,5	12,9
	Semi-routine and routine	14,2	14	16,1	14,7
	Not in work or missing	21,5	20	19,6	18,6
Parental Qualifications	None	30,6	27,6	26,2	25,2
	National Vocational Qualification 1	21,5	21,6	21,3	16,5

	National Vocational Qualification 2	12,3	11,5	12,6	13,2
	National Vocational Qualification 3	8,7	9,3	9,2	9
	National Vocational Qualification 4	4,3	5	5	6,1
	National Vocational Qualification 5	3,7	3,7	3,2	3,9
Family Poverty Status (Current)	Non-poor	5,6	6,2	6,6	7,3
	Poor	21,6	18,5	18,4	21,1
Family Poverty Status (Wave 1)	Non-poor	5,7	6,2	6	6,5
	Poor	20,7	18,7	18,2	16,9
Country	England	11	10,1	10,1	10,1
	Wales	7,6	8,3	10,3	10,3
	Scotland	5,7	10,3	9,7	12,4
	Northern Ireland	8,4	8,7	9	8,7
Special Educational Need at Age 7	No			7,8	8
	Yes			34,3	24,3
	N(unweighted)	13,557	14,103	13,103	12,994

Millennium cohort study 2, millennium cohort study 5 (Bruckauf, Z. & Chzhen, 2016, p. 16).

It is shown that differences in the likelihood of taking place in the lowest decile of the cognitive ability distribution according to large and persistent inequalities or gaps existing between socioeconomic statuses or social classes. It is also indicated that these differences become smaller between children aged 3 and 11 years. These results are compatible with the literature stressing the importance of socioeconomic status or social class in early years and also suggest that formal education plays a balancing and equalizing role in the upward or downward cognitive mobility across cognitive ability distribution of children. It is found that 3-year-old children born into poor households and continually living in poor households get points nearly 4 times more in the lowest decile in the cognitive ability distribution compared to their peers from non-poor households, and it is also indicated that these differences drop at ages 5, 7 and 11 with respect to parental education level, parental occupation and household income. It is seen that the equalization impact for children who have unemployed parents is stronger. Children with parents who do not have paid jobs may obtain points nearly 5 and 3 times higher in the lowest

decile compared to their 3 to 11 year-old peers with employed parents. Nevertheless, it is observed that occupational status differences between parents worked in managerial/professional positions and parents worked in semi-routine/routine occupation positions, appear to be the largest at age 7. This situation indicates that the impacts of social-economic class or socioeconomic status do not seem necessarily decrease in a linear form over time.

Mobility across the Distribution of Cognitive Development between Ages 3, 5, 7 and 11

Figure 1 shows the Millennium Cohort Study distribution of children who obtained points in the lowest decile of the cognitive ability distribution in a given year at ages 3, 5 or 7 and who stayed in the lowest decile or mobilized up when they were tested later. 37 per cent of children who obtained points in the lowest decile in the following period stayed in the this decile for one year. On average children from income-poor families, namely 43 per cent, are considerably more liable to remain, in other word, sticked in the lowest decile of the distribution of cognitive ability compared to their peers from non-poor families, namely 28 per cent.

Figure 1. Distribution of cognitive ability at the next Millennium Cohort Study sweep for children who got points in the lowest decile in the prior sweep, according to contemporary income poverty status between 3, 5, 7 and 11-year-old children, per cent.

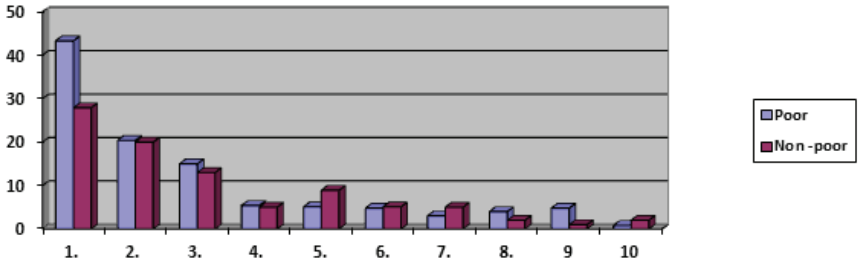

Figure 1. *shows the Millennium Cohort Study distribution of children who scored in the lowest decile of the Purple color: children from poor families; pink color: children from non-poor families. (Bruckauf, Z. & Chzhen, 2016, p. 20).*

Most children coming from both poor and non-poor families who leave the lowest decile climb up just a few deciles, whereas children born into non-poor families and continually living non-poor families advance a little farther across the distribution. While three in five or 60 per cent of children born into poor families and continually living in poverty can leave the lowest decile of the cognitive ability distribution and reach the

second or third decile in the cognitive ability distribution, almost the same proportion, 59 per cent to be exact, of children coming from non-poor families climbed up to the second, third or fourth deciles. Thereby, there seem to be a sticky floor for all children who have less cognitive points; however, a greater number of children who come from income-poor families may remain in this sticky floor

Family income predicts entering into the lowest decile in the distribution of cognitive developmental levels. Depending on obtaining points in a higher decile in one year, it is asserted that the predicted likelihood of entering into the lowest decile appears to be 3 scores higher for children in the poorest quintile of families compared to their peers in the richest quintile. Since the likelihood of dropping into the lowest decile in the ability distribution is at such a low level with 5 per cent on average, researchers have found that the impacts of income seem to be substantively very large. It is worth noting that there seem to be no important differences according to income in the probabilities of leaving the lowest decile. It is observed that with all other things being equal, children born into poor families and continually living in poverty obtain significantly and substantially higher points in the lowest decile in the first place (see Table 2).

Different indicators of socioeconomic status such as income, parental education and parental profession impact children's cognitive mobility at different rates. Nevertheless, parental occupational class affects the probability of children's entry into the lowest decile of children's cognitive ability distribution and there are significant differences in this effect, whereas it has been observed that the impacts of parental occupational class on the likelihood of moving up or exiting from this distribution are not statistically significant. The study has revealed that when compared to children of managerial or professional parents children of parents living in poverty and have never worked and, thus, do not ensure information about their occupational class, are more liable to leave the lowest decile or climb higher up in the cognitive ability distribution.

The study has found that parental education may considerably impact the likelihood of climbing up in the cognitive ability distribution and smaller but still substantially and significantly influences the likelihood of entering into the cognitive ability distribution. Children of parents with the highest education level values are 14 scores more liable to leave the lowest decile while 3 scores less liable to mobilize the lowest decile in the cognitive ability distribution. These conclusions show that among indicators associated with socioeconomic status or social class, education of parents seem to be the most effective in predicting mobilities, transitions, movements in and out of the lowest decile of the cognitive ability distribution. However, the impact of parental education can demonstrate an upward bias if it is

obtained through the inherited cognitive ability that do not observe and positive practices of parents that do not measure.

The three indicators of socioeconomic status or social class, namely parental education, parental occupation and household income, may differ in the degree of movement and mobility between waves. It is asserted that this vary is associated with parental education, parental occupation and household income that enter separately instead of combining them into a single indicator in the model. It has been observed that parental education emerges as the most stable factor, with the distributions of children in the same position between any two waves from millennium cohort study 2 to millennium cohort study 5 varying between the low of 82 per cent national vocational qualification 1 to the high of 97 per cent national vocational qualification 5. Here it is indicated that there seem to be slightly more movements and mobilities across occupational status of parents that reflect their prestige positions in occupational hierarchy. The distribution of children with parents worked in the same professional position between any two waves varies from the low of 61 per cent for parents worked in low supervisory and technical occupation positions to the high of 89 per cent for parents worked in manager and professional positions. The degree of mobility seems to be at the highest level for family income, with the distribution of children in the same quintile in both waves that vary from 39 per cent in the third quintile to 63 per cent in the highest quintile.

65 per cent of income poor children in a wave appear to stay poor in the next wave, whereas just 9 per cent of non-poor children fall into poverty until the next interview. When movements in and out of poverty in a given wave were to be controlled for, there would still be no substantial impact on the likelihood of leaving the lowest cognitive decile; however, there would seem to be substantial differences in the likelihood of entering into the lowest decile here. Compared to those who came out of poverty in both waves, the children who became poor between the two waves are 2 percentage scores more liable to move into the lowest decile in the cognitive ability distribution at the same time even all else is equal. Also, those who become poor in both waves appear to be also 2 percentage scores more liable to mobilize the lowest decile. Nevertheless, considering the duration between any two waves in the survey, the exact timing of poverty transitions is not known.

Although the 3-year-old children have a higher probability of moving up from the lowest decile by the next wave compared to children aged 5 or 7, it is reported that there seem to be no age-related differences in the risks of moving into the lowest decile. Here, there appear to be more movements along the ability distribution in the early years, and it seems that children who obtain points in the lowest decile after starting elemantary school can

remain more longer. Similarly, there are no differences according to ethnic group in the likelihood of moving out of the lowest decile of the cognitive ability distribution in children. However, it is asserted that, compared to their peers from other ethnic groups, both Pakistani, Bangladeshi and black children are considerably more liable to drop down into the lowest of the distribution between any two consecutive sweeps of the Millennium Cohort Study.

It is indicated that children of younger mothers and those with low birthweight have a higher probablity of dropping into the lowest decile from higher levels of the cognitive ability distribution. It is discovered that children breastfed for at least 6 months seem more liable to exit from and less liable to drop into the lowest decile. It is also established that children who have experienced a delay in developing gross motor functions have a lower likelihood of leaving and higher probability of moving into the lowest decile section of the cognitive ability distribution as they grow older.

Compatible with the cross-sectional results in Table 2, it is indicated that children who were permitted to watch any television and video at the age of 3 have a substantially lower probablity of exiting from the lowest decile of the cognitive ability distribution. However, there do not seem to be any differences in the risks of falling into the lowest decile. It has been found that regular bedtime at age 3 may protect children against falling into the lowest decile in the cognitive ability distribution and help them leave the lowest decile of cognitive ability distribution. It is asserted that although more frequent parental reading to children aged 3 years can keep them from dropping into the lowest decile, it does not impact the probability of moving up from the bottom decile.

Discussion and Conclusions

A large number of studies have been examining differences in the average cognitive scores of children according to the socio-economic status features of households and socialization and education inputs, investments or practices in families at a given time during the life cycle. Drawing longitudinal data from the Millennium Cohort Study in Britain, the present study examines the probability of children's mobilizing or passing into and out of the lowest section in the cognitive ability distribution by determining the factors related to socio-economic status and the family that facilitate displaying less cognitive test performance or poor academic performance and sustain the low achievement risks in children; and thus contributes to relevant literature in this particular field.

Research findings are consistent with those obtained in previous studies. Household income and other SES characteristics as well as gross motor delay in children with special education needs at the age of 9 months

all have substantial independent effects, and increase the probability of obtaining points in the lowest decile section of the cognitive ability distribution. When compared to parental occupational status and parental education, income poverty plays a significant role in the life-course alterations, demonstrating the relative importance of funds versus more consistent human capital and social status. It is discovered that differences in the likelihood of being in the lowest decile section in cognitive ability distribution according to family income appears to be larger at ages 3 and 11 compared to ages 5 and 7 with all else being equal. Considering the struggle that low income households put up to finance full time pre-school education and care outside the limited hours of subsidized provision supplied by the social state, it is understood that financial spendings for children's education and care seem to be most important during the pre-school years. Extra resources of the family can reduce disadvantages of lower-income households and can pay for the expenses needed for reaching after- school tuition and extracurricular activities. Although the impact of parental education level and occupational status is relatively stable during various phases of children's cognitive development, the net impact of parental education is found to be greater. Despite failing to explain school-level characteristics explicitly, it is observed that families in lower-socioeconomic status may possibly be living in financially disadvantaged regions. Schools in these areas may not have adequate resources that support and meet the needs of children with low school performance.

While findings indicate that over half of the children, on average, enter into and move up the lowest decile section in the cognitive ability distribution according to the next sweep of the survey, a comparatively high transition into and out of the lowest section in the cognitive ability distribution is observed starting from children aged 3 years. Meanwhile, a substantial 37 per cent of children remained in the lowest decile section of the cognitive ability distribution in two successive periods. While 28 per cent of the children came from non-income-poor families remained in the lowest decile section of the cognitive ability distribution in two successive periods, a more substantial 43 per cent among their peers came from income-poor families remained in this decile. When children born into poor families and continually living in poverty are compared with their non-income-poor peers (namely 28 per cent), they seem to be almost twice as liable to remain low achieving group for two successive periods compared to their non-income-poor peers. All children with poor cognitive achievement are on this sticky floor, but this is more probable for children coming from poor families.

When other essential child and family features were checked, it has been found that income no longer had any significant links with the

likelihood of leaving from the lowest decile section in the cognitive ability distribution according to the time of the next sweep of the Millennium Cohort Study for children who had obtained points in the lowest decile section in a given wave. As an indicator of socioeconomic status or social class, parental education has the largest net impact on the likelihood of leaving the lowest decile. Lifetime work of parents which shows whether at least mother or father had ever worked or not, has been determined as the second most effective variable after parental education. It is indicated that occupational status, just like income, has no independent relationship with the probability of climbing up from the lowest section of the cognitive ability distribution. Nevertheless, it is found that family income, parental education, parental occupation as indicators of socioeconomic status or social class are strongly and independently associated with the risks of dropping into the lowest decile section for children who have obtained points in a higher decile section in a specified wave.

These results display that parents in higher social class and families with higher income can protect their higher-performing children from falling into the lowest decile section in the cognitive ability distribution. However, higher social class and higher income do not necessarily aid children in exiting from the lowest decile section. Otherwise stated, cash and educational, social, cultural status can not ensure cognitive mobility from lower to higher decile sections. Conversely, it is seen that lack of money and educational, social, cultural status may put higher-achieving children at the risk of lagging behind their peers. On the other hand, parental education as an indicator of socio-economic status or social class can protect children from falling into the lowest decile section and aid them in moving up in case they get confused. When a range of parental behaviours towards 3-year-old children are checked, it is seen that parental education improves other unobserved strategies, beliefs and aspirations of parents that support relatively greater cognitive development in children.

It is established that regular bedtime at the age of 3 emerges as the most influential variable among the parental behaviour variables checked for. It is asserted that children whose bedtime is usually or always imposed at age 3 have a greater probability of moving out of the lowest decile section according to the next wave if they obtain points in the lowest decile section in any specified year and vice versa. On the other hand, it has been indicated that they drop less into the lowest decile section if they get points higher up the distribution. It is observed that this finding related to regular bedtime at an early age is considered important and essential in terms of implications for parenting programs and general policy guidelines that support socialization and education. It has been found that parents frequently reading for their 3-year-old children may protect them

significantly and importantly against approaching and entering into the lowest section of the cognitive ability distribution. Nonetheless, it has been established that frequent parental reading for children aged 3 years does not independently impact the likelihood of exiting from the lowest group of the distribution.

Socio-economic status or social class with indicators such as parental education, higher income play a great role in protecting children from moving into the lowest section in the cognitive ability distribution and this role can bear long-standing implications for societies. For instance, it has been established that vertical intergenerational mobility is lower in Britain compared to other wealthy countries that gather comparable data, in view of the fact that parental income very strongly predicts earnings of children in adulthood (Blanden, Machin, Goodman & Gregg, 2004). Compared to Australia and Canada, the socioeconomic status and social class variations existing in school readiness of children aged 4 or 5 years appear greater in Britain and the United States (Bradbury, Corak, Waldfogel & Washbrook, 2011).

The literature emphasizes the signifance of the earliest years in childhood. The researchers have found that the probabilities of mobilizing up the cognitive ability distribution from the lowest decile section seem highest between children aged 3 and 5 years in the pre-school period, and progressively decreased over time as children continue and progress their learning during primary school (Bruckauf & Chzhen, 2016). Children's prospects of going up the cognitive ability distribution between children aged 3 and 5 years during the pre-school years are seen as a chance for children who lag behind or obtain lower points in the distribution. Researchers have indicated that the position of children in the age-appropriate cognitive ability distribution is somewhat determined by economic, social, cultural and educational conditions during the pre-school period until they begin elementary school, and thus they have pretty narrow time for achieving substantial progress in later years.

Suggestions

Politicians, government officials, ministries of family affairs and education as well as parents must have a strong sensitivity and consciousness towards protecting children from the negative and detrimental impacts of poverty upon cognitive development, cognitive competence and skills. Politicians and the government should pursue certain policies designed to elevate families to an income level that can eliminate poverty and meet their basic, essential, urgent and vital requirements such as enough and regular nutrition, housing, clothing and health care. In order to protect their children from the negative and harmful effects of inadequate nutrition and

irregular eating habits upon mental development, poor families should be provided with the means to purchase basic, essential foods and nutrients in order to adequately feed the mothers and the babies on a regular basis during the prenatal and postnatal periods. At the same time, poor families should have sufficient income to access social, cultural and educational resources for their children's education and to purchase materials, goods, products, services, activities and experiences that contribute to their children's cognitive development, cognitive abilities and skills. Through educational programs, mothers should be provided with advisory and instructive information about regular breastfeeding in infancy or early childhood, good sleeping arrangements, harmful effects of watching television and giving children useful reading habits. Within the framework of educational programs designed for poor families, educators, clinical psychologists and educational psychologists should provide poor families with information about ideal relationships and interactions in the family as well as positive child-rearing, socialization and educational practices both through the media and by means of direct conferences in poor neighborhoods. These experts should emphasize the importance of parents' efforts towards getting involved in the education of their children, encouraging them to learn and participate in learning activities, and reading to them. They should bring forward suggestions and present models to poor families that will reduce or eliminate the disadvantages and adverse parental practices stemming from poverty and undermining cognitive development of children.

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CHAPTER 7

A NEW APPROACH TO TEACHER EDUCATION: "GROWING YOUR OWN TEACHERS" PROGRAM

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Introduction

The "Growing Your Own Teachers" (GYOT) Program, which was implemented in a northern state of the USA, is an effort to diversify the teacher workforce in the district by recruiting from within. Through this program, the faculty members of the School of Education in the district collaboratively planned and conducted a series of activities with the goals of raising the visibility of and promoting teaching as a profession with under-represented high school students. Students participate in summer and academic year programming designed to prepare students for college and careers in education. The programming included tutoring, college-level coursework, school visits from the School of Education faculty and staff in the city, job shadowing opportunities, and the exploration of financial support from the district and the campus for academically high performing students from diverse backgrounds who choose the faculty in the city for teacher preparation. The overarching goal of the program was to recruit a diverse pool of district students each year who have an interest in improving the educational opportunities for all students in the district. In this study, we aimed to share the perceptions of the program participants about the program implementation and effectiveness.

The project team has taken an innovative approach to "growing your own" teachers by recruiting and supporting the district students beginning early in their high school careers. This allows substantial time to help participants develop the foundations of the content knowledge they will need for teaching as well as prepare them for meeting university and education program entrance requirements. Starting this early limits the potential for examining the impact of the effort on workforce diversity since the first cohort of participants are at least five years away from beginning their teaching careers. In order for these students to enter the teaching pipeline, the program should provide support for student academic success by helping students develop the skills and prerequisites for admittance to and success in teacher preparation programs while in high school. Similarly, the program's provision of social support, role models, and assistance with navigating high school and college entry processes are also important in contributing to GYOT Program scholars' career commitment. In this study, to address the extent to which the stakeholders perceive that the program has supported students' success in high school and their plans for college, we aimed to answer the following research questions:

1. To what extent are high school students from under-represented groups aware of the program and see it as attractive?

2. What specific activities have students participated in as part of the program, and what are students' and teachers' perceptions of those

activities? What are the students' and teachers' goals for the program?

3. To what extent do current program participants perceive that the program supports their success in high school?

Method

In this study, we adopted a qualitative research design collecting data from the program scholars and students through focus group interviews. Four teacher coordinators and 15 students participated in a focus group to discuss their experiences in the program. The focus group and interviews were aligned with the program's theory of action for raising the visibility of and promotion of teaching as a profession with underrepresented students in the district. Namely, for this approach to succeed, district students from under-represented groups need to be aware of the program and see it as attractive. In the focus group interviews, 15 students in three different focus groups were asked to describe the activities they engaged in as part of the program, along with their perceptions of those activities and the overall goals they had for participating in the program. The researcher conducted one focus group with the teacher coordinators. The researcher developed the interview guides, which were informed by literature on topics including educator workforce development. In the instrument, questions were open-ended with follow-up probes to elicit further conversation and gain clarification on specific aspects of the program. The focus group interviews with participants were conducted after school, during a scheduled meeting date between the first and the fourth weeks of October 2018. The focus group interviews lasted 45-65 minutes. For the focus group interviews, digital recorders were used with the consent of interviewees. The audio files were destroyed once interview transcriptions were analyzed. Prior to their participation in the focus group, all participants provided written informed consent according to the procedures outlined by the Research and Program Evaluation Office in the district. For those students who were under the age of 18, parent consent was obtained prior to obtaining the student's assent. All participants were informed that their responses would be treated as confidential and that no individuals or schools would be identified in the results. Similarly, to help protect confidentiality in reporting the findings, all pronoun references have been changed to "he" and "him" regardless of the respondent's gender.

With regard to data analysis, transcriptions were analyzed using Nvivo software. An iterative process for coding interview transcripts was developed collaboratively by the researcher and another expert on qualitative data. This process resulted in three cycles of analyses: (1) descriptive, (2) pattern, and (3) conceptual model building. Descriptive coding was utilized to summarize passages of qualitative data in short

phrases. Following pattern coding, analysts developed conceptual models by linking themes and emergent codes generated from the first two cycles of analysis to create a higher-level understanding of the implementation experiences and outcomes of the teacher and principal induction programs across participating schools. In order to ensure inter-rater reliability when coding interviews, analysts chose a subset of interviews and coded each other's interviews for both descriptive and thematic codes. In instances where analysts were in disagreement, they met to discuss rationales for coding until they reached consensus, and codes were adjusted as necessary to reflect this shared understanding of codes.

Discussion and Conclusions

Overall Perceptions of the GYOT Program

Most of the students who participated in the focus group indicated that they initially heard about the program from their counsellor or a teacher and that their decision to participate in the program was influenced by their desire to pursue a career in teaching or a similar field such as social work. Several students said that a counsellor or teacher contacted them individually (i.e., via email, letter, or meeting) to inform them about the program and encourage them to apply. Meanwhile, one student learned about the program through a presentation at his school, while another learned about it from a friend. Some students felt that participating in the program would help determine if teaching was the appropriate career path for them, thus allowing them to "test out" a teaching career, while one student mentioned that he had friends in the program who could help him, which motivated him to apply. In addition, students agreed that the application process, which consisted of short answer questions and an interview, was "simple" and "relaxed." A few of the students also mentioned that the interviewers were welcoming and helped calm their nerves.

All four of the teacher coordinators interviewed cited the opportunity to work directly with students, alignment between program goals and their own goals as an educator, and the stipend as reasons they agreed to take on the role. Two of the four teacher coordinators who were interviewed had knowledge of the GYOT Program early on. One coordinator learned about it from a district newsletter, and the other as one of his students was applying to participate. Two of the participants also indicated that their principal recruited them to take on the position.

The GYOT Program scholars reported being involved in a variety of program activities during the summer, while activities during the school year were focused on college application essays. A few students completed an internship, and each of those students noted their appreciation for an

internship that they felt combined education and another field. A few students attended an academic camp at the faculty of education, in which they attended classes, explored the campus, and had the opportunity to "experience a little bit of college life." A couple of students completed a research project over the summer in which they observed classrooms, analyzed data, and worked together to create an "ideal classroom." A few students, including those who completed the research project, participated in panels or conferences, which included speaking with district teachers; students found these discussions to be helpful. Additionally, one student said that the ACT preparation helped him improve his score on the test. Though some students felt that, at times the summer activities could be tedious or too time-consuming, overall, the students felt the activities were worthwhile experiences that helped prepare them for college. With regard to activities during the school year, the students indicated that a major focus of their efforts had been working on college application essays with a professor at the faculty of education in the district.

When the teacher coordinators were asked to describe the activities they carried out, they cited planning weekly or monthly meetings with students, helping students plan for their school visits, checking in on students' grades, and planning for recruitment as the most dominant. For example, one teacher coordinator indicated that planning for the school visits had been the dominant activity so far this year and was more than he had initially anticipated, but that he expected the time commitment to this activity to level off after the visits.

When asked about their goals for participating in the GYOT Program, several students mentioned their interest in learning more about the educational system. These students cited a variety of topics they were interested in learning about, including disparities in education, school funding (e.g., differences in funding by school or district), strategies that teachers use in their classrooms, the lack of minorities in teaching positions, and why minority students may struggle in the classroom. Another student noted his interest in learning about the systemic gaps in academic performance and stated that he wanted to learn about "why students are underperforming and how it's not on an individual basis."

The teacher coordinators varied somewhat in their responses with regard to what they considered to be the goals of having students participate in the program. One coordinator was unsure about what the goals of the program were and often felt that the program was being designed as they went along, making it difficult to identify specific goals. Another coordinator said his focus for programs like the GYOT Program was to always think about how the program could contribute to his students' academic and personal success. He was focused on keeping

them on an academic track that would set them up for acceptance into and success at the faculty of education in the district while also exposing them to information about the teaching profession and the education community. He felt that individual coaching was a key component in achieving these goals. The third coordinator had similar goals early on and said that his initial goals were far more ambitious than they are now. While he initially had ambitions to show students some of the "behind the scenes" of teaching and professional development, those had faded somewhat. Two of the coordinators also discussed a focus on creating an additional layer of accountability and attention for the students above their traditional academics, especially in light of the fact that students in a large high school can sometimes feel disconnected from the school. Two of the coordinators also suggested that they and the program might benefit from access to a continuum of learning, which would outline how activities in each year scaffold to meet the intended goal. These coordinators expressed interest in receiving more information about what students need to know at the end of 12th grade, what activities they would do in 11th grade to support that, etc.

The majority of the GYOT Program scholars expressed an interest in applying to and/or attending the faculty of education in the district, with most indicating that this interest was a direct result of their participation in the GYOT Program. The students described the activities they had participated in and the connections they had made at the faculty of education during their time as GYOT Program scholars, with one student saying, for example, that "all the programs and things I've done have pretty much led me to go there." Another student stated that "going through the university system is ideal," while another said, "The faculty of education is the best option because we've received so much help getting into it". These students indicated that the appeal of the faculty of the education system was that they could potentially receive scholarships for their undergraduate education there, thereby allowing them to save money to attend a different college or university for graduate education.

Several students expressed concern and confusion over whether scholarships would be awarded to participants in the GYOT Program. Although most of the students expressed interest in attending the faculty of education, some students reported that they were initially led to believe that they would receive scholarships to the faculty of education if they participated in the GYOT Program but said they had not been provided with any updates on whether the scholarships would actually be awarded. This had caused anxiety among some students, who explained that they could be potentially ruling out other schools because they were anticipating scholarships to the faculty of education or that they could have to pay full

tuition when they expected financial assistance. Students were also unsure about whether the scholarship could be applied to non-education degrees or advanced degrees. In addition, one coordinator commented that some students had concerns about whether their standardized test scores would be high enough to get into the faculty of education, and he felt this made students anxious about their intended path.

Most of the students said that they were proud of their involvement in the program, that they regularly talked with their family and friends about their participation, and that the best part of the program was the relationships they had built with each other. Several students indicated that they "brag" about the program to their family and friends. They noted that their families and friends were generally supportive, interested in learning about the program, and aware of the opportunities it offers to the students that they otherwise might not have. For example, one student stated, "people think the program has really changed me." The students were almost unanimous in emphasizing the strong sense of community present among the students, as well as the freedom to discuss issues that may be deemed too controversial or sensitive for their regular classrooms.

When asked what they thought students liked about the program, teacher coordinators identified three elements: (1) feeling connected and getting extra support not always available in a big high school; (2) the opportunity to socialize and work with their peers; and (3) the prestige and recognition of participation in the program. One coordinator felt that having the opportunity to connect with one teacher in a large high school was a feature of the program the students liked. He stated, "I think they like feeling like they are connected and are noticed…it's an opportunity for them to have that additional support and a little something extra and special." One coordinator said he thought the students enjoyed working with the kids from other schools, which provided them with an enjoyable social component. Another coordinator agreed and said he thought students enjoyed the camaraderie among students in their cohort. However, the third coordinator indicated that there had been some challenges with the inter-grade level cooperation amongst students and that age differences could sometimes lead to struggles or conflict. Two of the coordinators said they thought students liked that they were part of a program where they were treated as important, were recognized, and that participation could set them apart from other applicants in the competition of college applications. One also felt that students enjoyed going to the faculty of education and working with the graduate students there and knowing that there are some "fairly famous professors in the world of education who know who they are."

Some students felt that the previous year of the program was disorganized and not rigorous enough but has since improved. Some students indicated that the group initiated various activities but did not complete them, that they did not meet as often as they would have liked, and that the planning and scheduling of program activities were inadequate. Some students also expressed frustration over a lack of leadership, which they attributed primarily to the first teacher coordinator leaving their school for another position during the prior school year. However, these students generally agreed that each of these aspects of the program had improved this year.

The coordinators identified a lack of clarity regarding their role, responsibilities, and the program's goals as a challenge in carrying out their role. Two coordinators said they were not always sure what they were supposed to do as coordinators, especially early on in the program. However, one coordinator indicated that this year there had been more effort to clarify some of their responsibilities and that they were now provided with checklists or reminders about upcoming events in which they should be involved. One coordinator said initially he was only told how much the stipend would be and that his responsibilities would focus on checking up on student participants in the building. He said with the new accountability systems and support, and his role became focused on handling logistics, such as permission slips and checking students' grades, while the faculty of education handles the bulk of the work with regard to educating the students about the profession of teaching. Another coordinator said that while the accountability systems had helped for some activities, there was still a lot about the program about which he was unsure. As an example, he indicated there were certificates that students were expected to earn but he was unsure about what was required to earn them and whether it was his responsibility or the students' responsibility to know what those requirements were. Furthermore, all four coordinators indicated that they received minimal training in their role, which may have contributed to their lack of clarity regarding expectations and responsibilities. One coordinator said the training had been primarily technical, such as directing him to a particular website to complete a form or confirming when the shuttle would pick up the students. Two of the coordinators suggested the lack of formal training was in part because the program was still in development.

A second challenge discussed by the teacher coordinators pertained to limitations on students' time, which came up repeatedly throughout the interviews. All four coordinators said it was sometimes difficult to find time when the students could or would attend meetings or other school-based activities. They also discussed the variety of other activities outside of regular academics that may be competing for students' time,

including participating in other programs, leadership roles, sports, college applications, and affiliated activities like standardized test preparation and summer jobs. All four coordinators felt that the large time commitment could deter students from the program and again cited the variety of competing activities for students. Relatedly, two coordinators brought up the lack of clarity regarding the reward at the end of the program and felt that students might dislike the time commitment in part because they are not always certain what the intended outcome of meeting those commitments will be. As one coordinator put it, "It's a fairly significant time commitment for something that might just look good on a resume." He went on to say, "I can't say if it is too much time or not because I don't know what they are going to get out of it. For most of these kids, money is key, and they don't know how they are going to pay for college. That's why they turn themselves inside out for these programs." In a similar comment, another coordinator expressed how the two-week summer commitment required of the program made it difficult for students to obtain or keep summer jobs.

Perceived Impacts of the GYOT Program

The GYOT Program scholars reported that the program had a positive impact on their perceptions of teaching, as well as their educational and career goals. In addition to more students wanting to become teachers after participating in the program, they also stated that they had more respect for teachers and realized the importance of both quality teaching and greater minority representation among teachers. One student said that he had never had a teacher of the same race and gender. He stated, "If you don't have that role model, you don't think you can aspire to those things." Several students said that they now had higher expectations for themselves; for example, a few students said that while they had always had an interest in attending college, now they were researching masters and doctoral programs. Other students felt that the program helped them develop specific educational and career goals, such as what subject to major in and what field to pursue professionally. A couple of students decided to pursue administrative positions because of the GYOT Program. Others felt more confident in applying for and attending college, with one student saying that the GYOT program made him feel "more capable" and "more supported in actually going through college." A few students reported that before the GYOT Program, the financial barriers to attending college may have discouraged them from applying, but much of that concern had been alleviated since participating in the GYOT Program.

Almost all of the GYOT Program scholars interviewed indicated that they would like to become a teacher. Several students said they would like to teach first and then advance to an administrative role in the school or

district or move into a different field, such as politics or law. One student expressed that "teaching would be a stepping stone to a different career. Having the experience as a teacher is vital because... [you are] actually teaching and interacting with students and seeing them grow."

When asked about whether they felt the GYOT Program would help them meet their career goals, the students' responses were overwhelmingly positive. Most notably, the students felt that the knowledge they had gained—about pedagogy, policy and funding implications, and administrative issues—would be valuable in their careers. A few students also mentioned that they had grown emotionally during their time in the program. For example, one student stated that the GYOT Program had taught him how to recognize his own biases and how to address them. Others said that they had "grown with the GYOT Program" and that it had helped them "develop who you are a person and who you're going to be as a teacher."

The GYOT Program scholars generally felt that the program provided them with the skills to be a high-quality educators and gave them a sense of empowerment. Throughout the discussion, the students regularly mentioned skills they had learned in the program and emphasized how those skills would help them become better teachers—ranging from strategies to help teachers better relate to and bond with their students to recognizing and addressing personal biases to eliminating the practise of tracking students based on ability. Several students also said that the coordinators in the program cared for them, advocated for them, and saw potential in them, with one student noting that many of their peers outside the GYOT Program did not receive the same type of support from their families or their schools. According to this student, "we know that people are rooting for us to do well."

The teacher coordinators felt that there were various academic benefits for their students to participate in the GYOT Program, citing the recognition and increased attention the students received, as well as enhanced confidence about pursuing postsecondary education. One teacher coordinator discussed how students were very proud to be a part of the program. This coordinator felt the program took the students very seriously and that students valued the recognition they got from both the district and the School of Education. Another coordinator said the benefit to his students varied based on the students' needs. He described one student who was really benefiting from the extra attention, and he thought the additional accountability was having a positive impact on that student's grades. The third coordinator felt the activities at the faculty of education and exposure to a lot of the language of education was positively improving his students' academic vocabulary. He added that he thought

his students would be more confident and comfortable on a college campus after high school because of these experiences. All of the teacher coordinators also felt that participating in the GYOT Program was helping their students look more critically at their own education. For example, one coordinator said, "I can hear kids start to shift from 'why are schools like this?' to 'how do adults let schools be like this and what can I do?'" He went on to say that his students were applying what they had learned to select their own classes and that his students "talk about good teachers or challenging teachers in a different way than their peers… the teachers they like are not necessarily the teachers that are popular." Another coordinator said he thought his students were learning a lot about the social justice aspects of education. The third coordinator said students were gaining an understanding of what teaching and learning look like at other schools relative to their own school.

The teacher coordinators had mixed responses with regard to the impact on them as teachers and whether they planned to continue in their role. Two of the coordinators valued the opportunity the program provided to build academic relationships with students. One said he enjoyed the activities when he could attend, but given the many other commitments he has in the building, this was often challenging. One coordinator stated that the program had a strong vision and mission but that he also had concerns about how it was carried out. While one of the four coordinators was confident he would stay in the coordinator position, the other two were struggling with the decision to continue and said they were planning to reevaluate their plans in the coming months. One coordinator also raised concerns about whether he was the right person for the job and if students would be better served by a coordinator who was themselves a young person of color. Meanwhile, another coordinator was unsure if he should stay in the role and was reluctant to participate in recruitment given his reservations about the program.

Finally, the GYOT Program seems to be taking preliminary but important steps toward potentially diversifying the teaching workforce in the district. When combined with the impacts of the induction and coaching strands on educators' capacity to address issues of equity in the classroom, as outlined above, these steps could help further efforts around enhancing equity and eliminating opportunity gaps for students in the district. There is an increasing amount of research literature demonstrating the importance of a diverse teaching workforce, specifically one that is aligned to local student demographic characteristics. Studies have shown that students, especially African American students, score higher on educational achievement tests when they are randomly assigned to same-race teachers (Dee, 2004; Dee, 2007; Egalite, Kisida, & Winters,

2015). These studies also indicate that a teacher's race can be a useful predictor of teachers' abilities to reduce gaps not only in educational achievement but also in other important areas such as levels of student attendance and disciplinary actions. Furthermore, research has shown that minority students have more favorable perceptions of minority teachers (Auerbach, 2007; Cherng, & Halpin, 2016; Quiocho, & Rios, 2000; Shipp, 1999), which is important given that more favorable student perceptions of teachers have been shown to translate into better outcomes in areas such as motivation, engagement, and grades (Midgley, Feldlaufer, & Eccles, 1989; Teven, & McCroskey, 1997; Wentzel, 2002). The results of these studies have important implications in light of the findings of this evaluation, which show that participation in the GYOT Program has positively affected students' interest in pursuing a career in teaching or a closely related field, as well as their expectations and levels of preparation for postsecondary success.

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CHAPTER 8

THE EFFECT OF USING ANIMATED CONCEPT CARTOONS ON STUDENTS' ATTITUDES TOWARDS SCIENCE LESSON

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Introduction

In teaching environments, the visual elements and tools can be used for many purposes, such as attracting students' attention, ensuring their participation in the lesson, creating an environment for discussion and questioning, summarizing and evaluating the topic, etc. One of these visual elements is cartoons. In the most general sense, cartoons come to the fore with their humor, satire, and memorability features. Kovalik and Williams (2011) describe cartoons as static or moving pictures used to elicit criticism, praise, and other emotional reactions of individuals. Cartoons are not only fun, but also a powerful tool for learning. Moreover, considering their psychological effects, cartoons are tools that have a significant impact on the learning process (Ugurel and Morali, 2006). Concept cartoons, which allow the use of cartoons in the learning process, differ from cartoons in that they do not contain elements such as humor and criticism.

Concept cartoons, developed by Brenda Keogh and Stuart Naylor in the 1990s, can be defined as drawings in which three or more cartoon characters have alternative views and thoughts about a daily life situation. Concept cartoons are visual tools that present a scientific event from daily life in the form of discussion with the help of cartoon characters and reveal different perspectives on the event (Keogh and Naylor, 2000; Naylor, Downing and Keogh, 2001; Stephenson and Warwick, 2002; Parkinson, 2002; Coll, France and Taylor, 2005; Koch, 2010). These drawings usually present three or more characters' mutual questions or ideas about a daily event (Ugurel and Morali, 2006; Sasmaz-Oren, 2009). Concept cartoons basically use a type of multiple-choice question that is expressed visually and verbally through a cartoon (Keogh and Naylor, 1999; Naylor and Keogh, 1999; De Lange, 2009). These tools are used in many teaching environments, especially to reveal students' scientific understanding of daily life situations and thoughts on the field of science (Feasey, 2007). One of the most important aims of science is to produce, increase and maintain knowledge. The close relationship between science and argumentation shows that argumentation is an important part of the science education (Naylor, Keogh, and Downing, 2007). Argumentation largely involves the processes of discussion, questioning and reasoning. According to Huang et al. (2012), concept cartoons create cognitive conflict in the minds of learners by enabling them to think from different perspectives and giving a in-depth thinking. Therefore, the visual stimulation and conflict of concepts created by concept cartoons help students see their own perspectives, and prompt students to search further for arguments to support their thoughts. According to Allen (2006), concept cartoons were developed to enable students to confront their own views on science concepts and to help them reach scientifically valid understandings. According to Keogh, Naylor, and Wilson (1998), in these visual tools;

- Short texts are used to make them appealing and accessible to learners of all ages despite limited literacy skills.
- Scientific ideas are designed in accordance with daily events so that learners can question the accuracy of the relationships established between scientific knowledge and the daily life,
- Alternative ideas should be research-based to clear up common misconceptions, as learners can defend many different ideas,
- Scientifically appropriate opinions are among the alternative considerations,
- The ideas put forward by the characters should be seen with equal probability so that students cannot easily discern which idea is correct, and cognitive conflict can be created in the minds of the students.

In the process of using concept cartoons in the classroom, the cartoon characters suggest alternative perspectives on the scientific situation in the event, and then the students are invited to participate in the discussion with the cartoon characters (Keogh, Naylor, and Wilson, 1998; Keogh and Naylor, 2000). In this sense, concept cartoons can have effects on increasing the purposeful discussion in science lessons, create a starting point for scientific discussion and research or a new topic, and contribute to students' thinking of opposing views (Rees, 2000; Naylor, Downing, and Keogh, 2001; Warren, 2001; Ryan, 2002; Keogh, Naylor, and Downing, 2003; Bing and Tam, 2003; Kinchin, 2004; Allen, 2006; Naylor, Keogh, and Downing, 2007). Chen, Ku, and Ho (2009) stated that concept cartoons could provide intense incentives to activate students' previous knowledge and experiences. The personalization of misconceptions with cartoon characters with concept cartoons makes it possible to reveal students' way of thinking before education and eliminate existing misconceptions (Saka et al., 2006; Ozyilmaz-Akamca, Ellez and Hamurcu, 2009; Ugurel, Kesgin, and Karahan, 2013). According to Liston (2011), concept cartoons draw attention to a wide range of possibilities by allowing students to prove their own thoughts and identify the parts they are not sure about. This process guides scientific research to reveal more information about the situation covered in concept cartoons. This is a very effective way to develop in-depth understanding.

Literature review

The relevant literature includes studies on the general features, benefits, and limitations of concept cartoons (Keogh and Naylor, 1996; Keogh, Naylor and Wilson, 1998; Keogh and Naylor, 1999; Keogh et al., 2001; De Lange, 2009); identifying misconceptions, revealing alternative conceptions, eliminating misconceptions, and their effects on conceptual

understanding (Stephenson and Warwick, 2002; Kabapinar, 2005; Saka et al., 2006; Ekici, Ekici and Aydin, 2007; Atasoy and Akdeniz, 2009; Ozyilmaz Akamca, Ellez and Hamurcu, 2009; Chin and Teou, 2010; Sasmaz Oren et al., 2010; Duran, Balliel and Bilgili, 2011; Say, 2011; Yavuz and Buyukeksi, 2011; Demir, Uzoglu and Buyukkasap, 2012; Erdogan and Ozsevgec , 2012; Ozmen et al., 2012; Atasoy, Tekbiyik, and Gulay, 2013; Taslidere, 2013; Turkoguz and Cin, 2013; Uzoglu et al., 2013; Demirel and Aslan, 2014; Gul, Kose and Konu, 2014; Meric, 2014); their effects on affective and cognitive characteristics such as academic achievement, inquiry-based learning, attitude, motivation, logical thinking, self-efficacy, and anxiety (Baysari, 2007; Balim, Inel, and Evrekli, 2008; Ozyilmaz Akamca and Hamurcu, 2009; Ozyilmaz Akamca, Ellez et al. Hamurcu, 2009; Evrekli and Balim, 2010; Sengul and Uner, 2010; Cicek and Ozturk, 2011; Evrekli, Inel and Balim, 2011; Inel and Balim, 2011; Golgeli and Saracaloglu, 2011; Sengul, 2011; Ozmen et al., 2012; Cetin, Pehlivan, and Hacieminoglu, 2013; Kaptan and Izgi, 2014; Sengul and Aydin, 2013; Tokcan and Alkan, 2013; Yolcu, 2013; Yilmaz, 2013; Demirel and Aslan, 2014; Cinici et al., 2014; Shadowli, 2012; Gul, Kose and Konu, 2014; Taskin, 2014; Topcubasi and Polat, 2014); its use as an assessment tool (Chin and Teou, 2009; Ingec, 2008; Sexton, Gervasoni, Brandenburg, 2009; Ormanci and Sasmaz Oren, 2011; Sasmaz Oren et al., 2012); the opinions of individuals from different stages and levels regarding concept cartoons (Inel, Balim, and Evrekli, 2009; Birisci, Metin and Karakas, 2010; Cengizhan, 2011; Ceylan Soylu, 2011; Inel and Balim, 2013; Duban, 2013; Sengul and Aydin, 2013; Balim et al., 2014; Sasmaz Oren and Meric, 2014); its effect on creating an in-class discussion environment (Webb, Williams, and Meiring, 2008); creating an evaluation form for concept cartoons (Sasmaz Oren, 2009); its effects on argumentation skills (Chen, Ku, and Ho, 2009); more effective use of cartoons (Kabapinar, 2009); its effect on the views on the nature of science (Cil, 2014). Some of these studies have similar and close features to the present research.

Keogh and Naylor (1999) examined the use of concept cartoons in the science education in learning environments. The data sources of the research were teachers, teacher candidates, and students in primary education. The research includes interviews, questionnaires, and classroom observations using case study and data triangulation, which are qualitative research methods. The data obtained from the research show that teachers and students think positively of concept cartoons and have opinions about the effectiveness of concept cartoons. İnel, Balim, and Evrekli (2009) tried to determine students' views on the use of concept cartoons in science teaching. In the semi-structured interviews conducted with ten students, the students stated that they encountered concept cartoons for the first

time, that concept cartoons benefited them in many ways, and that they wanted them to be used in other lessons. Ozyilmaz-Akamca and Hamurcu (2009) investigated the effects of science and technology education supported by analogies, concept cartoons, and prediction-observation-explanation techniques (Let's travel the world of living things unit) on the fifth graders' success in science and technology, attitudes towards science and technology, and permanence of knowledge. As a result, the research revealed that these activities caused a significant difference in success, permanence, and attitude. Baysari (2007) investigated the effects of using concept cartoons in the living and life unit of the fifth-grade science and technology lesson on students' success, attitudes, and elimination of misconceptions. The results showed that concept cartoons did not make a significant difference in students' academic success and attitudes. Evrekli, Inel, and Balim (2011) examined the effects of concept cartoon and mind map applications in the matter and heat unit of the sixth-grade science and technology lesson on students' (n=16) academic achievement, motivation towards science learning, perceptions of inquiry-based learning skills, and attitudes towards science and technology using a single group pretest-posttest model. The research showed that students' academic achievement and motivation to learn science increased significantly, and although their perceptions of attitudes towards science and technology and inquiry-based learning skills increased as well, this increase was not at a significant level. Erdogan and Ozsevgec (2012) investigated the effect of using concept cartoons on students' (n=17) misconceptions about the greenhouse effect and global warming within the scope of the seventh-grade science and technology lesson with a single group pretest-posttest model. As a result, it has been seen that concept cartoons contribute to the elimination of many of the misconceptions. Furthermore, in the interviews with the students, the students stated that concept cartoons made the learning process fun and facilitated remembering.

Inel and Balim (2012) reported the opinions of students (n=27) regarding the use of concept cartoons in problem-based learning in the substance and heat unit of the sixth-grade science and technology lesson. Participating students expressed their opinions that concept cartoons made the lesson fun, ensured their active participation in the learning process and provided permanent learning. Duban (2013) took the opinions of classroom teachers (n=7), who were continuing their postgraduate education, on preparing and using concept cartoons. The participants expressed their opinions that concept cartoons were a useful tool, that they could eliminate misconceptions and drew attention to the lesson, though it was difficult to draw during the preparation phase. Kaptan and Izgi (2013) tried to determine the effect of using concept cartoons in fourth and fifth-grade

science and technology lessons on students' (n=60) attitudes towards the science lesson with a pretest-posttest model without a control group. The researchers found that the use of concept cartoons significantly improved fourth and fifth-grade students' attitudes. Yilmaz (2013) investigated the effects of scientific stories supported with concept cartoons on the academic achievement, attitudes, and motivations of students in the human and environment unit of the seventh-grade science and technology lesson. It was determined that the use of concept cartoons caused a significant difference in students' academic achievement but did not cause a significant difference in their attitudes towards the science lesson and their motivation towards science. In his study, Yolcu (2013) investigated the effects of using concept cartoons on students' achievement, attitude, and logical thinking abilities in the light of the seventh-grade science and technology lesson. As a result of the study, it was observed that the use of concept cartoons increased students' achievement and attitudes towards science, but did not cause a significant difference in logical thinking. After the use of concept cartoons in the force and motion unit of the seventh-grade science and technology lesson, Sasmaz-Oren, and Meric (2014) investigated the students' opinions. The students stated that they encountered concept cartoons for the first time, that concept cartoons were fun and useful, and contributed to their in-depth learning. Goglili (2012) investigated the effects of using concept cartoons and the think-pair-share technique on students' achievements and attitudes in the sixth-grade science and technology lesson, in the unit of electricity in our lives (2012). The findings showed that concept cartoons were effective on students' academic success, but did not make a significant difference in their attitudes towards the lesson. Meric (2014) investigated the effect of using concept cartoons in the seventh-grade force and motion topic on students' conceptual understanding, motivation and attitudes. The findings demonstrated that the use of concept cartoons caused a significant difference in students' conceptual understanding and attitudes. Moreover, the study determined that concept cartoons significantly increased students' motivation levels for performance, and the post-test research motivation scores of the students in the experimental group were significantly higher than the pre-test. Taskin (2014) investigated the effect of using concept cartoons in the human and environment unit of the seventh-grade science and technology lesson on students' achievements and attitudes towards the science lesson. As a result of the study, it was concluded that the use of concept cartoons caused a significant difference in students' academic achievement and attitudes.

The literature shows that, in general, students think positively about concept cartoons, that their use in the learning process contributes to them, and they want them to be used in lessons (Keogh and Naylor, 1999; Balim

and Evrekli, 2009; Erdogan and Ozsevgec, 2012; Inel and Balim, 2012; Sasmaz-Oren and Meric, 2014). However, regarding the students' attitudes towards the lesson, studies found the use of concept cartoons both to be effective (Akamca and Hamurcu, 2009; Kaptan and Izgi, 2013; Yolcu, 2013; Meric, 2014; Taskin 2014) and ineffective (Baysari, 2007; Evrekli, Inel, and Balim, 2011; Golgeli, 2012; Yilmaz, 2013). In this sense, it was necessary to conduct the present study on the effects of concept cartoon applications on students' attitudes.

Problem of the Research

The main problem of the research was determined as "Is there a significant difference between the post-test scores of attitudes towards the science lesson of the experimental group 1 in which animated concept cartoons are used in science lessons, the experimental group 2 in which only concept cartoons are used, and the control group in which only the science curriculum is used?". Furthermore, within the scope of the research, students' opinions about the applications were tried to be obtained in order to examine their attitudes towards the course in more detail. In this sense, the second problem of the research was determined as "Regarding the applications, what are the opinions of the students in the experimental group 1, in which animated concept cartoons were used in Science and Technology Lessons, and the students in the experimental group 2, in which only concept cartoons were used?" .

Method

The study employed quantitative and qualitative research methods and techniques together. In the quantitative aspect of the research, an unbalanced-unequal pretest-posttest quasi-experimental design with a control group was used to determine the effectiveness of animated concept cartoon application on students' attitudes towards science lesson within the scope of the sixth-grade science and technology lesson "matter and heat unit" (Christensen, 2004; Marczyk, DeMatteo and Festinger, 2005; Cohen, Manion and Morrison, 2005).

Table 1. *Symbolic representation of the research*

	Pre-test	**Learning-teaching process**	**Post-test**
Experimental group 1	T1	Teaching with animated concept cartoons	T1, T2
Experimental group 2	T1	Teaching with concept cartoons	T1, T2
Control group	T1	Science and Technology Curriculum	T1

*T1= Attitude scale towards science and technology lesson, T2= Semi-

structured interview about applications,

In the qualitative aspect of the study, interviews were conducted with three students each from experimental groups 1 and 2, to determine the opinions of the students in the experimental groups about the applications of animated concept cartoons and solely concept cartoons (n=6).

Study Group

The study group of the research consisted of a total of fifty-one sixth grade students (n_{exp1}=17; n_{exp2}=17; $n_{control}$=17) studying in three different classrooms (A-B-C) in a secondary school in the Demirci district of Manisa province. All students in the groups were between the ages of 11-13. 47.1% (n=9) of the experimental group 1 were female and 52.9% (n=8) were male students; the students in the experimental group 2 and the control group were 52.9% (n=8) female and 47.1% (n=9) male.

Data collection tools

a) Attitude scale towards science/science and technology lesson

Within the scope of the research, an "attitude scale towards the Science/ Science and technology lesson" was developed to determine the effect of the animated concept cartoon activities on the attitudes of the students towards the science and technology lesson. For this purpose, an item pool was created by examining some of the attitude scales in the literature (Morrell and Lederman, 1998; Francis and Greer, 1999; Kan and Akbaş, 2005; Nadirova and Burger, 2008; Nuhoglu, 2008; Gokhale, Brauchle ve Machina, 2009; Cheung, 2009; Wang and Berlin, 2010; Koçakoglu and Turkmen, 2010; Zhang and Campbell, 2011; Shah and Mahmood, 2011; Pell and Jarvis, 2012) and general views of students studying at a school on science and technology lesson with the help of a semi-structured form (n=30). A total of thirty items were included in the preliminary form of the scale in this direction. As Tavsancil (2005) stated, it is considered appropriate to include around twenty items in attitude scales. The pre-expert opinion of the scale consisted of 30 items. Afterward, the scale was presented to the opinions of four instructors who were experts in the field, and the number of items was reduced to 28, taking into account the necessary feedback and correction suggestions, and the scale was corrected accordingly. Then, the pre-form mentioned above was applied to the sixth, seventh and eighth-grade students of central secondary schools in the Demirci district of Manisa province. Analyses of the scale were carried out on a total of 723 students.

Exploratory and confirmatory factor analyses were conducted to ensure the construct validity of the scale. In the exploratory factor analysis, first of all, the suitability of the data for factor analysis was tested with

the KMO and Bartlett tests, and the KMO value was determined as.94; Bartlett test, on the other hand, was found significant (χ^2=6538.46; df=378; p<.001). In the subsequent analyses, the equamax horizontal rotation technique and principal component analysis were used together. The factor analysis grouped the scale under five factors, but due to the factors being insignificant and containing less than three items, the scale was decided to consist of two factors. Then, the number of factors was determined as two and the analyses were repeated and items with a factor load below .50, and overlapping items were removed from the scale (4-6-9-10-13-14-15-16-20-21-22-26-27). The factor loadings of the items included in the scale after the exploratory factor analysis, and the item-total correlations are given in Table 3. The total variance value explained by the items related to the sub-dimension of attitude towards science lesson was 23.48, and the Eigenvalue was 3.52; the total variance value explained by the items in the sub-dimension of attitude towards extracurricular activities was 22.77, and the Eigenvalue was 3.42. The total variance explained by the scale was calculated as 46.26.

Table 2. *Factor loads and item-total correlation values of the items in the attitude towards science lesson scale*

Items/Factors	Attitude toward science course	Attitude toward outside activities	Item-total correlations
3	,763		,625
8	,706		,593
1	,692		,577
7	,689		,608
2	,663		,542
18	,594		,538
19	,576		,510
28		,713	,583
23		,711	,570
12		,701	,576
17		,600	,539
11		,582	,504
25		,580	,409
24		,529	,500
5		,528	,483

After the exploratory factor analysis, the confirmatory factor analysis was performed. The two-factor model, which was determined as a result of exploratory factor analysis, was tested in confirmatory factor analysis. In the analyses performed, the fit values were determined as follows;

AGFI: .94, GFI:.96; NFI: .92, NNFI: .94; CFI. .95; RMR: .033; SRMR: .038, RMSEA: .049; χ^2/df: 2.73. Then, the correction suggestions were examined, and the model was retested by adding error covariance since it was close in meaning between the first item and the second item and took place in the same factor. The new fit values were AGFI: .95, GFI:.96; NFI: .93, NNFI: .95; CFI. .95; RMR: .032; SRMR: .037, RMSEA: .046; χ^2/df: 2.49. The fit values indicate that the model shows a near-perfect fit. The path diagram for confirmatory factor analysis is shown in Figure 2.

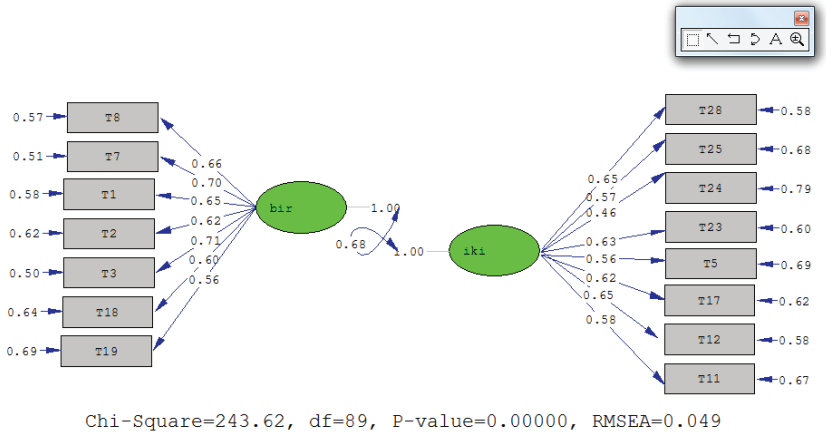

Figure 2. *Path diagram for the scale of attitude towards science/science and technology course*

After the exploratory and confirmatory factor analyses, Cronbach's alpha reliability coefficient was calculated to determine the reliability level of the scale. Cronbach's alpha reliability value was calculated as .82 for the sub-dimension of attitude towards science lesson and .81 for the sub-dimension of attitude towards extracurricular activities. The Cronbach's alpha reliability value for the entire scale was .87. These values showed that the reliability of the scale was high.

Semi-structured interview questions for applications

Semi-structured interview questions were prepared to determine the views of the students in the experimental groups participating in the research on the teaching of the lesson with animated concept cartoons and the teaching of the lesson using only concept cartoons. During the preparation process of the questions, firstly, expert opinion on the questions was taken (n=4), and then the form was finalized by making the necessary adjustments. After the application, a descriptive analysis of the

semi-structured interviews was conducted with six students, three from each of the experimental groups 1 and 2, by presenting quotations from the students' one-to-one opinions.

Preparation of activities and materials used in the research

During the preparation of the activities and materials used within the scope of the study, first of all, the attainments of the sixth-graders in the substance and heat unit, in which the application was made were examined, and the lesson plans were prepared according to the 5E learning model in this direction. The sample activities in the curriculum and the activities in the MEB textbook (Tunc et al., 2006a; 2006b; 2006c) were used jointly in the control and experimental groups and were transformed into a lesson plan within the scope of the 5E learning model. For the "Particulate nature of matter and heat", "Distribution of heat" and "Heat insulation" topics, the lesson was planned in parallel with the program as 4 hours, 8 hours, and again 4 hours, a total of 16 lesson hours. Then, concept cartoons were developed and incorporated in the teaching plan in the form of worksheets for the experimental group in which animated concept cartoons would be used (experiment 2) and for the experimental group where only concept cartoons would be used (experiment 1). Concept cartoons were mainly used to reveal students' views before the experiments, to enable them to share their thoughts, and to arouse curiosity. In total, twelve concept cartoons were developed for three topics and included in the lesson plan as worksheets. The worksheets included the students' preliminary opinions-estimates and the conclusion sections intended to compare their preliminary opinions or predictions with their observations. Concept cartoons prepared for the applications in the experimental group 2 were prepared with animation support and voiced.

Treatment

During the study, three determined sixth grade students (6A-6B-6C) in the selected primary school were assigned as experiment 1, experiment 2, and control groups, independently. Before the quasi-experimental application, the scale of attitude towards science lesson was applied as a pre-test. The applications were carried out by the researcher for sixteen lesson hours. The lessons were taught with animated concept cartoons as well as the activities in the science and technology curriculum in the experimental group 2, only with concept cartoons in addition to the science and technology teaching program, in the experimental group 1, and only on the basis of the science and technology curriculum in the control group. In the applications related to the concept cartoons in the experimental group 2, first of all, worksheets were distributed and the students were asked to read the scenarios, and then to listen to the opinions and watch

the animation by drawing their attention to the projected concept cartoons. Then, they were asked to write down which view they agreed with and their predictions on the worksheet. In the class, firstly, everyone expressed their opinions individually, and then different opinions were taken and an atmosphere of discussion was tried to be created. After these experiments and discussions, the students were asked to compare their observations and predictions and reach a conclusion. In the applications in the experimental 1 group, only the worksheets were distributed, but no projections were made. Similarly, students wrote their predictions, discussed their views in the classroom environment, and had the opportunity to compare their predictions and observations by making new observations. The worksheets completed by the students were collected by the researcher at the end of each lesson. Except for the concept cartoon applications, all applications were the same between the control and experimental groups. At the end of the study, the scale of attitude towards science lesson was applied to the students as a post-test. During the week of the post-tests, semi-structured interviews were conducted with the students about the effectiveness of the applications.

Data analysis techniques

In the analysis of the quantitative data obtained from the research, non-parametric tests were considered to be used primarily as the number of students in the groups was not suitable, but instead, the analyses were carried out with parametric statistical methods thinking that measurements should be made by taking the pre-tests under control and because a nonparametric equivalent of ANCOVA, one of the parametric tests, could not be found. In this context, ANOVA was used in the analysis of the pre-test data, and ANCOVA was used in the analysis of the post-test data. The t-test for dependent groups was used to compare the groups within themselves in terms of dependent variables. In the analysis of the interviews regarding the applications, a descriptive analysis was made by quoting one-to-one from the interviews.

Findings and comments

In this section, research findings and comments obtained from the research are presented. The descriptive statistics of the research groups' pre-test and post-test scores of attitude towards science lesson (ATSL) are presented in Table 1. Experimental group 1 was defined as the group in which animated concept cartoon applications were carried out, and the experimental group 2 was defined as the group where concept cartoon applications were carried out.

Table 3. *Comparison of the pretest and posttest scores of the experimental and control groups according to the dependent variable*

Dependent variable	Treatment group 1 (n = 17)				Treatment group 2 (n = 17)				Control group (n=17)			
	Pre test		Post test		Pre test		Post test		Pre test		Post test	
	X_{ort}	Sd	X_{ort}	Sd	X_{ort}	Sd	X_{ort}	Sd	X_{ort}	Sd	X_{ort}	Sd
FDYT	66,06	9,34	69,41	5,56	66,00	9,25	67,58	6,30	67,71	5,70	64,94	6,82

The comparison of the pre-test scores obtained from the experimental groups and control groups by ANOVA revealed no significant difference between the attitudes of the groups towards the science lesson ($F_{(2.50)}$= .233, p=.793). These findings indicate that the groups are similar to each other in terms of the mentioned variables.

Findings and comments on the first sub-problem

The first sub-problem of the research was determined as "Is there a significant difference between the post-test scores of attitudes towards the science lesson of the experimental group in which animated concept cartoons are used in science lessons, the experimental group in which only concept cartoons are used, and the control group in which only the science curriculum is used?" . For the solution of this sub-problem, the post-test scores obtained from the participants after the experimental application were compared with ANCOVA. According to the results of the analysis, there was a significant difference between the groups' post-test scores of attitude towards the science lesson ($F_{(2.47)}$=3.60, p=.035, η_p^2 = .133). According to the ANCOVA analysis results, which were examined to determine from which groups the said difference originated, the scores of the experimental groups 1 and 2 did not differ significantly between themselves (p=.349); however, the scores of the experimental group 1 differed significantly compared to the control group (p=.011). The comparison of the scores of the experimental group 2 and the control group revealed no significant difference between the groups, but the adjusted scores of the experimental 2 group were considerably higher than the control group (p=.095). Moreover, comparison of the pretest posttest scores of the individual groups using the t test for dependent groups showed that the pretest and posttest scores of the control group did not differ significantly in itself ($t_{(16)}$=1.61, p=.128); the pretest posttest scores of the experimental group 1 showed a significant difference within itself ($t_{(16)}$=2.41, p=.029) and the pretest and posttest scores of the experimental group 2 did not differ significantly within itself ($t_{(16)}$=.685, p=.503). Based on these findings, it was concluded that the animated concept cartoon applications affected the attitudes of the students positively. It can be said that the sole use of concept cartoons had no effect in this direction within the scope of the research.

Findings and comments on the second sub-problem

The second problem of the research was determined as "Regarding the applications, what are the opinions of the students in the experimental group 1, in which animated concept cartoons were used in Science and Technology Lessons, and the students in the experimental group 2, in which only concept cartoons were used?". For this purpose, semi-structured interviews were conducted with three students from each group. During this process, one-to-one quotations from the data were presented and code names were used instead of the real names of the participant students.

First of all, the students in the experimental groups were asked the question "Can you compare the teaching of the "Matter and Heat" unit in the Science and Technology lesson with the teaching of the previous units?" and they were asked to explain the similarities and differences between the previous lessons and the teaching of the unit in question. On this subject, the opinion of S5 from the experimental group 2 was "*There were differences. We did more experiments. We reinforced the subject more… In our other lessons, we had less opportunity to experiment. So we understood better by experimenting… For example, we made other concept cartoons… They also made us think and it was very good as a pre-entry… ";* S5 said "*We didn't do a lot of experiments before… Now we experimented… We've never done any other worksheets before… We made some predictions etc…"* , and S1 said "*There wasn't much, the only difference was that we did experiments… Similar aspects were explained in detail in both of them…"* . The opinions of the experimental group 1, in which the lessons were carried out with animated concept cartoons, were similar to those of the experimental group 2. Akif from the experimental group 1 answered the question as "*We did more experiments… In other lessons, it was not so much… There were cartoons…";* S2 said *"We made concept cartoons in the lessons… We did more experiments. We thought beforehand, realized our mistake, and then understood the subject better with the cartoons… We thought… Everyone gained the ability to express their thoughts…"* , and S4 said "*We didn't do much experimentation before... We did a lot of experiments in the Matter and Heat unit… There were cartoons…" First we wrote down our predictions… Then we did the experiment and wrote down our observation… Finally, we wrote the conclusion part…"* . Investigation of the opinions of the students in the experimental groups 1 and 2 when comparing the pre-application practices and the application process in general, demonstrated they mentioned that there were more experiments and concept cartoons in the application process, that they made predictions and carried out the experiments which brought them to the conclusion.

Secondly, the students were asked second question "What do you think about the work you did in the "Matter and Heat" unit of the Science and Technology lesson? What caught your attention the most?" and the students in the experimental groups were asked to explain their opinions about the practices and the work done in general. S5, one of the students in the experimental group 2, replied as *"It was good… We understood better… The topics were explained, we reinforced them with cartoons later, I think we remembered them better... The results of the experiments caught my attention the most…"*; S5 replied as *"It was nice… The experiments caught my attention the most… The predictions on the worksheet were good…"* , and S4 replied as *"We were writing on the worksheets… As we were writing, it stayed in our minds, and it also stayed in our minds by doing experiments… The experiments in the lesson caught my attention the most… For example, how heat is dissipated…"*. In the experimental 1 group, Akif said *"For example, the ways in which heat is spread… Because we learned the ways in which heat is radiated…"*; S2 said *"You know, we wrapped the ice in wool… It caught my attention... I was thinking that what is left open will melt later… It caught my attention a little…"*; S1 said *"It was fine… we were first making our guesses and then we were doing the experiment, it was very good…"*. These opinions indicate that the students mostly paid attention to the experiments and the results of the experiments. In line with these views, it is thought that the results of the experiment to come out as expected or not, helped to draw the attention of the students.

Thirdly, the students were asked the question "Do you think the animated concept cartoons/concept cartoons used in the "Matter and Heat" unit of the Science and Technology lesson have an effect on you? What kind of effects do you think they have?" and they were asked to explain their opinions. In the experimental group 2, S5 replied *"It had good effects… For example, I understood the subject better… I remembered it better… It made us all think as a class… We came up with different ideas, so we discussed… I think it's good that it happened.…"*; S5 said *"More creative… So more memorable… It made me wonder…"* and S1 said *"I'm thinking… It's catchy like this… When a topic comes up in the test, it makes us think of it… We made observations… We also shared our own thoughts… I was able to compare my own thought and conclusion…"*. In the experimental group 1, Akif said *"It taught us more… "*; and S2 said *"I expressed my own views… I thought about it before then realized my mistake... I understood... It helped me understand the subject…"*; and S1 said *"Yes… It gave examples from daily life, so it made it easier for me to understand…"*. These interviews show that the students' considered the concept cartoons to have effects such as remembering, enabling thinking, providing a discussion environment, contributing to learning and helping to see mistakes.

Finally, the students were asked the question "Concerning the teaching of the lesson with animated concept cartoons/concept cartoons; What parts did you like? What were the parts you didn't like?" and they were asked to explain their opinions. In the experimental group 2, S5 replied *"We thought and discussed in the class… We defended our ideas, it was better… There wasn't a part I didn't like... It made me think, I had some difficulty…"*; S5 said *"It allowed us to research and observe… There was no part I didn't like…"* and S1 said *"reading cartoons and writing my thoughts… I liked it visually… What I didn't like was writing too much…"*. In the experimental group 1 group, Akif said *"I enjoyed doing the experiments… I didn't like writing... "*; and S2 said *"It was fun… It sounded different as I heard different opinions from my friends… There wasn't a part I didn't like..."*; and S4 said *"We were experimenting… Writing a guess… There was no part that I did not like"*. In general, the students stated that they did not like to write in concept cartoons, but they liked that the concept cartoons promote research and uncover their thoughts, and were entertaining.

Discussion and conclusion

Discussion and conclusion on the first sub-problem

The findings obtained from the solution of the first sub-problem of the research "Is there a significant difference between the post-test scores of attitudes towards the science lesson of the experimental group in which animated concept cartoons are used in science lessons, the experimental group in which only concept cartoons are used, and the control group in which only the science curriculum is used?" were examined by comparing the corrected post-test scale of attitude towards science lesson with the pre-test scores. The results of the analysis show that the scores of the experimental groups in which animated concept cartoons and only concept cartoons were applied were higher than the control group, however, the post-test scores of the experimental group to which animated concept cartoons were applied differed significantly compared to the control group. There was no significant difference between the corrected scores of the experimental groups from the scale of attitude towards science lesson. From this point of view, it can be said that the use of concept cartoons, which are voiced and animated using animation, does not contribute to the improvement of students' attitudes towards science lesson. Kaptan and Izgi (2014), who carried out a study similar to the present research, found that the use of concept cartoons in fourth and fifth grade science and technology lessons improved the attitudes of the students significantly. Ozyilmaz-Akamca and Hamurcu (2009) determined that science and technology education supported by analogies, concept cartoons and prediction-observation-explanation techniques caused a significant difference on students' attitudes. The use of concept cartoons were found to cause a significant difference on

students' attitudes towards science lesson by Taskin (2014) in the human and environment unit of the seventh grade science and technology lesson; Meric (2014) in the seventh grade force and movement unit; Yolcu (2013) in the seventh grade science and technology lesson light unit. However, in the literature, there are also findings contradicting these findings. Yilmaz (2013) determined that scientific stories supported by concept cartoons in the seventh grade human and environment unit of science and technology lesson did not cause a significant difference in students' attitudes towards the science lesson. Evrekli, Inel, and Balim (2011) examined the effects of concept cartoon and mind map applications on students' attitudes towards science and technology in the sixth-grade science and technology lesson matter and heat unit by using a single group pre-test-post-test model and determined that it increased after the application, however, they stated that this increase was not at a significant level. Golgeli (2012) determined that concept cartoons did not make a significant difference in attitudes towards the lesson in the sixth-grade science and technology lesson, the unit of electricity in our lives. Similarly, Baysari (2007) stated that the use of concept cartoons in the fifth-grade living and life unit did not cause a significant difference in students' attitudes.

In this sense, the findings obtained within the scope of the research shows parallelism with the Kaptan and Izgi (2013) on fourth and fifth-grade science and technology lesson; the findings of Ozyilmaz-Akamca and Hamurcu (2009) on fifth-grade science and technology lesson "Let's travel the world of living things and get to know them" unit; the findings of Taskin (2014) in the human and environment unit of the seventh-grade science and technology lesson; the findings of Meric (2014) on the seventh-grade force and movement unit; the findings of Yolcu (2013) in the seventh-grade science and technology lesson light unit. However, the findings obtained within the scope of the research shows no parallelism with the findings of Yilmaz (2013) on the seventh-grade science and technology lesson, human and environment unit; the findings of Evrekli, Inel, and Balim (2011) on the sixth-grade science and technology lesson, matter and heat unit; the findings of Golgeli (2012) on the sixth-grade science and technology lesson, unit of electricity in our lives; and the findings of Baysari (2007) on the fifth-grade science and technology lesson, unit of living things and life. Balim, Inel, and Evrekli (2008) suggest that the use of concept cartoons in science lessons can create fun, visual, and knowledge-structuring environments where students can focus their attention on the lesson and discuss their views. Considering the characteristics of concept cartoons, it is thought that they can be effective in attracting the attention of especially primary and secondary school students. Especially in terms of students' participation in the lesson, seeing cartoon characters close to them allows

them to express their thoughts clearly. Besides, students can defend their opinions more easily when the opinions that they do not want to explain or that they think are wrong are defended by the cartoon characters. At the same time, students can compare their own views with those of their peers, produce evidence for why their own thoughts may be more accurate, and approach the thoughts of other peers critically. Black and Harrison, (2004) consider concept cartoons to be excellent activities to increase peer discussion as they encourage students to reveal what they know, partially know, and do not know about a concept or idea. It is thought that the use of concept cartoons in science and technology lessons may be effective in students' attitudes towards the lesson and their interest in the lesson since it contains visual stimuli and can also contribute to the creation of a learning environment where students can express their opinions comfortably. At this stage, it can be said that animating and vocalizing concept cartoons contributes to attracting students' attention. However, this attitude did not cause a significant difference in the attitudes of the students towards the science lesson. It is thought that especially the lower age group students are more interested in moving and vocalized objects. From this point of view, it is thought that the attention of the students can be drawn more easily and their attitudes towards the lesson can be improved by using animated concept cartoons for the students at the lower ages or for the grades with lower literacy skills for better understanding the concept cartoons.

Discussion and conclusion on the second sub-problem

For the solution of the sub-problem "What are the opinions of the students in the experiment group in which animation-supported concept cartoons are used in Science and Technology Classes and the students in the experimental group 2, in which only concept cartoons are used?", semi-structured interviews were held with the students in the experimental groups. In those interviews, students expressed their opinions that concept cartoons and applications related to concept cartoons attracted students' attention, contributed to their learning, enabled the creation of a discussion environment, and contributed to the retention of information. Additionally, students stated that they could freely express their thoughts, experimented, and had classroom discussions. These findings are compatible with the findings of similar studies in the literature (Erdogan and Ozsevgec, 2012; Ceylan Soylu, 2011; Inel, Balim, and Evrekli, 2009; Inel and Balim, 2012; Sasmaz Oren and Meric, 2014; Sengul, 2011; Sengul and Aydin, 2013). Concept cartoons are very effective visual tools in directing students to think, to share their thoughts, and to enable students to participate in the lesson (Cicek and Ozturk, 2011). Concept cartoons allow students to express their opinions clearly (Sengul and Aydin, 2013; Dabell, 2004), to compare and discuss their ideas in the classroom (Kinchin, 2004), and thus

contribute to learning and success (Golgeli and Saracaloglu, 2011; Ozmen et al., 2012; Tokcan and Alkan, 2013). According to Martinez (2004) and Balim, Inel, and Evrekli (2008), the use of concept cartoons in science lessons can create fun, visual, and knowledge-structuring environments where students can focus their attention on the lesson and discuss their views. Long and Marson (2003) suggest that concept cartoons help learners ask their own questions, reveal and develop the learner's thoughts, apply scientific ideas in daily situations, increase interest and motivation, and improve literacy and language. Kempton (2004) states that speech bubbles and pictures in concept cartoons increase students' motivation and that the biggest success of concept cartoons is that they develop problem-solving skills. In this sense, considering the findings obtained from the research and the relevant literature, it can be concluded that the use of concept cartoons can help students participate in the lesson, create an in-class discussion environment, attract students' attention, increase motivation and facilitate learning.

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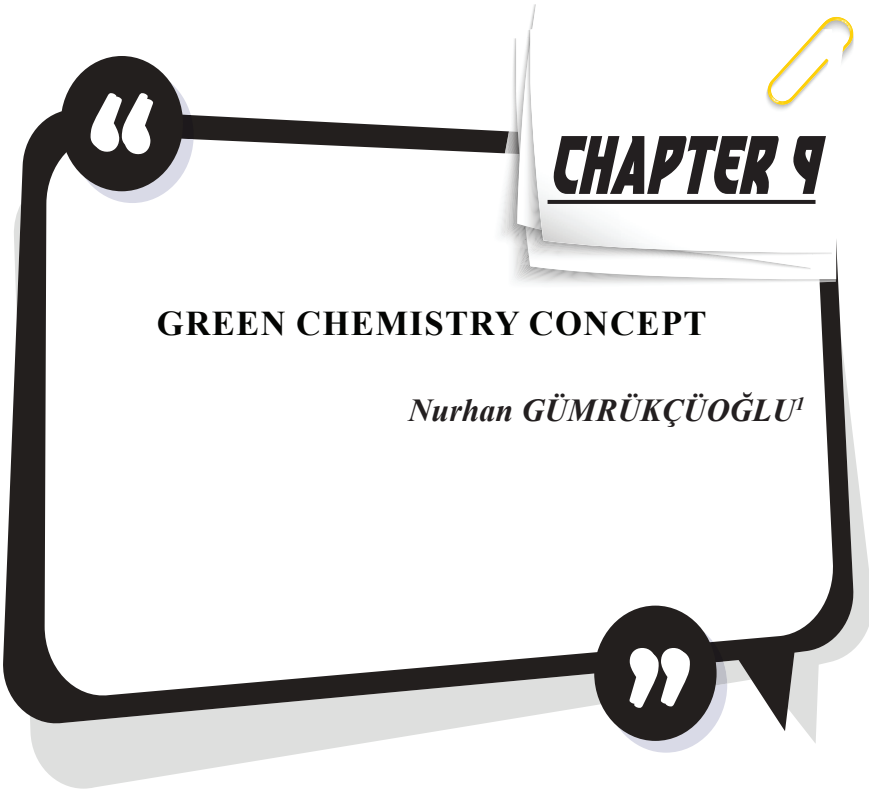

CHAPTER 9

GREEN CHEMISTRY CONCEPT

Nurhan GÜMRÜKÇÜOĞLU[1]

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Chemistry, which was initially thought to be the source of inventions necessary for modern life, is now seen by many as the main source of environmental pollution threatening our world. However, focusing on dangerous and harmful products, chemistry outputs that make our lives easier and more colorful such as medical products, plastics, cosmetics, fabrics, pesticides, liquid crystals, artificial organs should not be overlooked. Rapidly developing technology has brought along some problems such as ozone layer depletion, global warming, flue gases, acidification, eutrophication, carcinogens threatening human health, eco-toxicity, depletion of fossil fuels, excessive use of soil and water [1]. Although the source of many problems faced by humanity such as energy, transportation, heating, technology and enlightenment is chemistry, the solutions are also hidden in the science of chemistry. However, when considered in terms of energy, time and effort, eliminating the factors that cause the problem is a much more effective method than solving the problem. The method to be used to eliminate the negativities that occur with traditional chemistry methods at the source is green chemistry.

Green chemistry is a branch of chemistry in which studies are carried out that aim to minimize or completely eliminate the damage to the environment, nature and all living things in the production and all applications of chemicals. According to Paul Anastas, who is regarded as the founder of his field, the definition of green chemistry is as follows [2, 3].

Green chemistry is the use of a set of principles that reduce or eliminate the use or occurrence of hazardous substances in the design, manufacture and application of chemical products. The idea of green chemistry calls for the development of new chemical reagents and reaction conditions in chemical synthesis that can provide potential benefits in terms of resource efficiency, energy efficiency, product selectivity, operating simplicity, health and environmental safety.

The importance of green chemistry is increasing day by day as it meets environmental and economic targets at the same time. Green chemistry produces less waste and environmental emissions than conventional chemistry reactions; deals with the development of processes and technologies that result in more effective chemical reactions. As the amount of raw materials, products, by-products, solvents and reagents decreases with the application of the principles of green chemistry, both the risks related to the products and processes are reduced or eliminated, and the limits at the cost point are reduced [4].

Green chemistry has applications in numerous fields today. These applications can be seen in industries such as energy, chemicals, pharmaceuticals, food, waste recycling and treatment. There are twelve

basic principles of green chemistry put forward by Paul Anastas and John Warner [2]. These twelve basic principles are rather a summary of the studies in this field, rather than limiting the research topics of green chemistry.

Principle 1: Waste Prevention

Regardless of the formation process, unwanted and unusable materials are called waste. Many materials such as garbage, wastewater, industrial wastes can be given as examples of waste. The first principle of green chemistry is to prevent waste. According to this principle, chemical synthesis methods should be designed and developed to prevent waste. Any waste that can be cleaned or treated should not be released into the environment [5]. For example, green chemistry applications are important and frequently used in wastewater treatment. Examples can be listed as follows figure 1 [6].

Figure:1 *12 Principles of Green Chemistry*

- Removal of trace pollutants with membrane bioreactors used in wastewater treatment,
- Removal of traces of pollutants in wastewater by wet oxidation method,
- Ensuring the oxidation of endocrine disrupting compounds (for example, bisphenol-a and alkylphenols) by photo-fenton reaction and thus removing them,
- Water treatment by chemically assisted precipitation.

As these examples can be multiplied, there are many green chemistry applications for the treatment of many wastes, from solid wastes to radioactive wastes.

Principle 2: Atom Economy

Atom economy has been defined as the design of synthetic methods that will enable all materials entering the production process to be used

in the final product. In 1990, Barry Trost introduced the concept that "An ideal reaction should include all atoms of the reactants" [7, 8]. Atom economy provides more efficient use of raw materials, less by-products and waste savings. The best known value we can measure for a reaction is the reaction yield. While the reaction efficiency only considers the amount of the desired product, atomic economy considers all the reagents used and unwanted by-products along with the desired product [9]. As an example; New synthesis of ibuprofen, widely used as a pain reliever; This is an example of the application of atomic economics in green chemistry. Conventional ibuprofen synthesis consists of six steps. In this synthesis, which requires a large amount of solvent, only 40% of the starting materials are included in the desired product. In the newly developed technology, this synthesis takes place in three steps and involves the use of approximately 80% atoms. The use of anhydrous hydrogen fluoride as both catalyst and solvent provides significant advantages in waste reduction, and almost all starting materials are either converted into products or recovered as by-products [10].

Principle 3: Less Hazardous Chemical Synthesis

Chemical reactions often use reagents that are hazardous and toxic to human health and the environment. In these reactions, dangerous, toxic and by-products, as well as wastes, are formed. While selecting the reagents to be used in the reaction, the hazards associated with that reagent should be determined and the reagent should be analyzed. If it poses a threat, the analysis of the product, the waste as a by-product and the synthetic transformations depending on the use of reagents should also be done. Green chemistry tries to design synthetic methods that will enable the use and production of substances that have little or no toxic effects on the environment and human health [11]. One of the most successful examples of designing less hazardous chemical synthesis is cumene production. Approximately 7 million metric tons of cumene are produced annually in the world [10]. Cumene production by alkylation of propylene with benzene; carried out with solid phosphoric acid or aluminum chloride catalysts, which are generally classified as hazardous and have serious environmental problems. In the newly developed design, high product yield is achieved by using environmentally inert zeolite as catalyst [11].

Principle 4: Designing Safer Chemicals

Chemicals are used in many places in our daily lives, so one of the goals of green chemistry is to design processes that both preserve the functional effectiveness of chemicals and reduce their toxic effects [10]. However, with the understanding of the molecules affecting the environment, their properties and their transformations in the atmosphere, safer molecules

can be designed against the environment and people. Understanding the reaction mechanisms and toxic effects of chemicals allows chemists to better predict which compounds or which functional groups may pose an environmental hazard. Molecule analysis is a process for the design of safer chemicals, which is used to identify which part of the molecule provides the desired characteristic of the products or which part is toxic or responsible for the hazard [12]. Pollution by the unwanted growth of plants and animals on the ship's surface, costing the maritime industry about $3 billion a year; contributes to environmental pollution, global warming and acid rain. To prevent the growth of these plants on large ships; Organotin compounds, which are among the most toxic chemicals ever released into the marine environment, have been used [13].

Principle 5: Safer Solvents and Auxiliaries

This substance of green chemistry includes all substances that are not directly involved in the structure of the reaction product but are necessary for the chemical reaction or process to take place. Because these substances are part of the waste stream, many pose an environmental hazard. In this context; One of the most active research areas of green chemistry is solvents [3]. Solvents are used in many places. Compared to all other materials used in a synthetic conversion, high volumes of solvent are used. Because of the hazards associated with the use of solvents, the development and selection of solvents has always been important. When choosing solvents for various applications; meeting the desired performance is made by taking into account the properties such as solubility, polarity, viscosity, volatility. Some features such as natural toxicity, flammability, explosiveness, stratospheric ozone depletion, atmospheric ozone depletion, global warming potential, which are caused by solvents, should also be taken into consideration [14]. Many conventional solvents; It is poisonous, flammable and corrosive. Its volatility and dissolution properties have increased the risk of air, water and soil pollution and have led to serious accidents [7]. To counter these effects of traditional solvents, green chemists have focused on finding safer solutions. Solvent-free systems, water, supercritical fluids (SCF), and ionic liquids are some examples of solutions. Incorporating the excipient into the reaction means effort and energy to then remove it from the system. Therefore, efforts have been made to develop non-solvent systems. These systems; It is economical and environmentally friendly as it does not contain solvents. The reaction rate is high because more reagents are available, and the final purification step is not needed as it is not necessary to remove the solvent after the reaction is complete. Therefore, solvent-free systems are more advantageous [15].

Principle 6: Design for Energy Efficiency

A large amount of energy is used to change the pressure and temperature of the experiments. Energy; rather than reactions, it is used in solvent removal to set up the next reaction and to isolate the desired product or remove impurities. In order to minimize energy use, all reactions are tried to be carried out at ambient conditions, that is, at room temperature and atmospheric pressure [7]. The production of polyetherimide resin, a thermoplastic, involves various complex synthetic transformations and produces waste containing organic materials. Laboratory studies have shown that this amount of waste produced can be significantly reduced by using several members of a new class of catalysts. Compared to the old system, the new system uses 25% less energy per resin, consumes 50% less catalyst, produces 90% less organic waste for off-site disposal, and produces 75% less waste in the production of the catalyst [16]. Due to the increasing energy demand, alternative energy sources were needed. Many renewable energies such as solar energy, wind energy, water energy, geothermal energy have been defined in biofuel production. Green chemists have an important role in this new challenge, as they have both energy efficiency transformations and the ability to design materials or chemical systems that can be used to extract some of these renewable natural energies [17]. With the development of catalytic technologies, hydrogen gas and clean fuel production has provided some important gains, such as prevention of pollution. By redesigning chemical transformations, the amount of energy required and the environmental impact of this energy used can be reduced. Design for energy reduction is inherently tied to design for material efficiency in many ways. For example, when new solvents such as supercritical CO_2 are used, it often affects solvent separation, which requires significant energy inputs. Therefore, through the use of green chemistry methods, design changes are being made that provide extensive benefits for minimizing energy use [18].

Principle 7: Use of Renewable Raw Materials

A product goes through various stages during its life cycle. All the products we encounter in our daily life are produced from a raw material. For example, let's take the toothpaste that we use frequently in our daily life (I hope we use it often). The main raw materials used in toothpaste production are water, calcium carbonate, sodium bicarbonate, fluoride compounds and various surfactants and antibacterial chemicals[19]. The tube in which the paste is filled is also made of plastic.

When these raw materials are replaced with renewable alternatives as much as possible, the environmental damage of the manufactured product will be minimized. For example, if plastic and plastic-like renewable

materials made from biomass are used instead of petroleum-derived plastics for the tube and cap in which the paste is filled, the toothpastes used all over the world will become much more renewable products with a smaller carbon footprint. We can consider the same application for toothbrush.

The use of biomass instead of petroleum is an appropriate example of the use of renewable raw materials, which is a principle of green chemistry. In this way, carbon emissions and the carbon density in the products produced are significantly reduced.

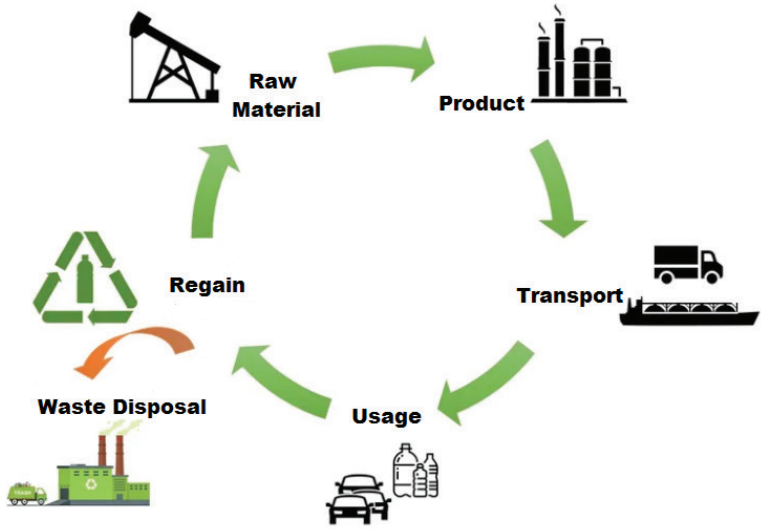

Figure 2. *Simplified Life Cycle of Petroleum Products.*

This is why it is important to determine the first point where raw materials are used by performing life cycle analysis for many products used in daily life. Reducing carbon emissions at every point in a product's life cycle and using renewable raw materials reduces carbon emissions and environmental damage for all countries, and contributes to the transition to a circular economy.

Principle 8: Reducing Derivatives

Reducing derivatives is an important principle in green chemistry applications. According to Anastas, this principle can be briefly explained as follows [2]. Steps such as creating unnecessary (chemical) derivatives should be reduced or avoided if possible, as they require additional reactants and can generate waste. The mentioned chemical derivatives are other chemical groups used for purposes such as blocking and protection in the production of a chemical. Temporarily altering the physical and chemical processes for the production of target products is one of the uses of chemical derivatives.

These derivatives result in the use of additional raw materials and energy. In addition, they can cause the formation of chemical wastes. Therefore, the use of derivatives in chemical synthesis should be reduced as much as possible.

One of the best ways to reduce chemical derivatives is to use enzymes and catalysts. For example, in the industrial production of semi-synthetic ampicillin and amoxycillin antibiotics, enzymes are used to avoid the use of protective chemical derivative groups and cleaning processes. Today, more than 10,000 tons of 6-APA (6-aminopenicillinatic acid) antibiotics are produced by processes using enzymes, and the chemical derivatives used in the production of this antibiotic are now used [20].

Principle 9: Catalysis

Catalysis, the ninth principle of green chemistry, promotes the use of catalysts in chemical reactions. According to this principle, which states that selective catalytic reagents are superior to stoichiometric reagents, switching from stoichiometric methods to catalytic processes plays a key role in increasing the reaction efficiency.

Catalysts reduce the activation energy of chemical reactions, thereby reducing the energy requirement of the reaction. In addition, catalysts that increase the surface area increase the product selectivity and increase the amount of product formed as a result of the reaction. In this way, chemical reactions are realized with less energy use, less waste generation, less raw material use and much higher product conversion [2]. All of these ultimately contribute to the sustainability of the world economy by minimizing the harm of chemicals to the environment, nature and people.

Catalysts used in the manufacture of chemicals. Catalysts reduce the activation energy of chemical reactions and increase the surface area thanks to their porous structure, increasing the rate of contact of the reactants with each other.

Principle 10: Degradable Design

According to this principle of green chemistry, chemical products should turn into harmless decomposition products at the end of their life and should not remain as a waste in the environment. For this reason, all chemical products must be designed to be degradable.

It is possible to give an example of the importance of degradable design from daily life. Methyl tertiary butyl ether (MTBE for short) is widely used as a fuel additive to prevent engine knocking in cars. Although MTBE is not a carcinogen, it can cause billion-dollar environmental clean-up works due to significant groundwater and soil pollution [21, 22]. Dimethyl

carbonate compound instead of methyl tertiary butyl ether compound, which is a frequently used but toxic fuel additive [23].

Dimethyl carbonate is an environmentally friendly, non-toxic chemical that does not have any toxic effects in its production, can degrade spontaneously in the atmosphere [22]. Since dimethyl carbonate decomposes slowly into carbon dioxide and methanol in nature, it does not cause serious harm to the environment compared to many other hydrocarbon compounds [24]. In addition to being used as an electrolyte in lithium-ion batteries, it is also used as a raw material in the production of polycarbonates [25]. Recent studies have shown that dimethyl carbonate can be used as a fuel additive. Dimethyl carbonate reduces the emissions caused by evaporation by lowering the vapor pressure of the fuels [26].

Due to its environmental advantages, dimethyl carbonate was excluded from the list of volatile organic compounds by the US Environmental Protection Agency in 2009. In this way, dimethyl carbonate can be used as an important alternative chemical solvent in areas where many toxic volatile organic compounds are used [27]. The widespread use of dimethyl carbonate, which can exhibit the same properties, instead of MTBE, which has been categorized as a compound potentially harmful to human health by the US Environmental Protection Agency, is of great importance in terms of environmental protection. Moreover, since dimethyl carbonate can be produced from carbon dioxide, it can play an important role in reducing the effects of global warming [22].

Principle 11: Real-Time Analysis for Pollution Prevention

Environmental pollution is perhaps one of the most important problems affecting the world. Green chemistry aims to use real-time analysis to minimize environmental pollution in any environment where chemicals are present.

One of the main goals of green chemistry is to carry out all kinds of chemical measurements and analysis, both in laboratories and in the industry, without causing any harm to the environment or in a way that minimizes the damage. This research field, which is called green analytical chemistry, develops and aims to expand the use of analytical methods that are much safer for both human health and the environment and generate much less waste. Studies are carried out in the field of green analytical chemistry in order to use safer and harmless analysis methods in terms of health and environment in processes.

Principle 12: Inherently Safer Chemistry for Accident Prevention

Security can be defined as the control of accepted hazards to achieve an acceptable level of risk. The 12th principle of Green Chemistry is known

as the “Safety Principle”. It may be the most overlooked of the twelve principles, but it is the logical corollary of most of the other principles. Since the essence of green chemistry is to reduce or eliminate the use of hazardous substances, it has a real connection with laboratory safety [20].

Accidents in industries where chemicals are heavily used and produced often make headlines. Because these accidents are not only environmental disasters in terms of size and scope, but also cause injury and even death of many people. Perhaps one of the best examples of this from the modern age is the Bhopal disaster. On December 2, 1984, at least more than 3,000 people died as a result of the methyl isocyanate gas leak at the Union Carbide company’s pesticide factory in Bhopal, India. 500,000 people were poisoned or suffered from various ailments due to the effects of the gas [28]. Even today, various bodily disorders and ailments are seen in the children of people affected by the gas caused by the accident [29].

The accident was so great that the exact number of those affected is still a matter of debate even today. In addition to being a great tragedy, it is an undoubted fact that the accident is a real environmental disaster due to the damage it caused to the air, soil and underground water resources in the region [30, 31].

Hazardous materials and processes are quite abundant in our work environment and an accident can happen at any time. To prevent accidents, physical and chemical hazards such as toxicity, explosiveness or flammability and global hazards need to be addressed in the design of chemicals and processes. Operations should be designed to minimize accident risks and necessary safety precautions should be taken.

CONCLUSION

Chemical; It is used in many fields such as medicine, pharmacy, food. Chemical reactions use or produce hazardous and environmentally harmful substances. Green chemistry is a solution to this problem. Green chemistry is a branch of chemistry that is of great importance not only for human health, but also for the protection of the environment and nature, and not to cause any harm to wildlife.

Each of the principles of Green Chemistry offers successful modifications to traditional chemical syntheses, turning conventional reactions into environmentally friendly ones. The principles of green chemistry, which are strongly interrelated, have designed green processes as a whole. Greening of chemical methods is an inevitable end in terms of human health, environment and safety. Green chemistry and its principles are an excellent guide for us. All the principles are developing green processes in wonderful interconnection. With the right design, pollution can

be prevented in many ways. Green Chemistry methods can simultaneously eliminate many problems that cause pollution. Thus, while saving waste, energy can be saved at the same time.

It is clear that green chemistry practices will guide humanity in many important issues, from the prevention of the dangers that arise with the development, growth and progress of the industry day by day, to taking steps for a sustainable world by ensuring efficiency in all fields in terms of energy and raw materials.

Green Chemistry, which was introduced in various science fairs in developed countries to raise awareness of all people, starting with young children, is a new trend that includes solutions to eliminate existing pollution problems within the framework of certain principles, and as a new trend, the use of materials that pose a danger to human and environmental health in the fields of design, production and use of chemical products and It is made available to humanity to eradicate its emergence. In this way, people are encouraged to prefer innovative technologies.

To summarize, Green Chemistry, a science that aims to highlight the development of chemical methods and substances to protect the environment, not only provides economic benefits by making it possible to obtain new reactions that will reduce the production cost, but also realizes energy savings by designing efficient reactions that take place at lower temperatures. The use of Green Chemistry not only provides suitable solutions in the field of economy and energy, but also creates less waste material and reduces the risk of accidents because it leads to reactions that proceed through safe ways. This approach, which ensures the protection of human and natural health in general, plays an active role in the prevention of environmental pollution.

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CHAPTER 10

OPINIONS OF SCIENCE TEACHER CANDIDATES ON GENERAL CHEMISTRY COURSES IN DISTANCE EDUCATION

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INTRODUCTION

In recent years, the world has faced significant global epidemics. The pandemic, which started in Wuhan, China in 2019, is one of them and still continues today. The Covid-19 pandemic can potentially continue for a long time, and its effect on contemporary science and society is likely to be felt for a long time (Erduran, 2020). The pandemic problem has affected all our lives, especially education, health, and economic issues. In the meantime, educational institutions at all levels closed at different times and switched to distance education. In this unexpected situation, many educational institutions and educators faced educational problems because they were unprepared and tried to develop solutions to these problems. For instance, UNESCO has founded an international partnership named the Global Education Coalition. This coalition aims to help countries implement "innovative and contextual solutions to deliver distance learning by leveraging high-tech, low-tech and no-technology approaches" and as an international partnership "to reduce the immediate disruption caused by COVID-19 and to develop more open and flexible educational systems for the future" (UNESCO, 2020). After the Covid-19 pandemic in Turkey, educators and students were faced with a different education system than ever before. The Turkish Higher Education Quality Council (2020) evaluated the method applied in this process as "Emergency Distance Education." Bond et al.(2021) states that emergency distance education is an unplanned practice and there is no choice but to use all kinds of offline and online resources. According to Wang et al. (2020), it is an alternative and temporary teaching method developed in response to a particular crisis and is therefore decidedly different from typical distance education. Bozkurt (2020) defined the differences between distance education and emergency distance education as follows;

"*Although emergency distance education is necessary, distance education is an option. Emergency distance education tries to produce temporary solutions for the current need, and distance education tries to produce ongoing and permanent solutions within lifelong learning. Whereas emergency distance education is an effort to keep education alive in times of crisis, distance education attempts to make education sustainable with planned and systematic activities in line with a specific purpose, with the theoretical and practical knowledge specific to the field*".

During the pandemic, distance education has increased its popularity, and studies on this subject have intensified in our country, just as it has in many countries. Many universities and K-12 schools used various online applications to the courses as if they were face-to-face (Zan & Zan, 2020). It is a matter of curiosity how and to what extent these online applications will affect education. Because in the distance education process, there

are some problems experienced in teaching at all levels. Due to the rapid development in technology and the increasing needs as a result of the integration of this development into teaching, teachers have difficulties in keeping up with new technologies and are faced with stress (Dong et al., 2019). According to Doğrukök et al (2021); Not having sufficient internet infrastructure in every house, not having a personal computer or mobile phone for every student, having many students in the family, economic and social level of the family and digital device capabilities are among the problems experienced by the students in distance education-teaching. For this reason, according to Doğrukök et al. (2021), it is very important to fully meet the infrastructure requirements for students to benefit from distance education adequately.

When literature is examined, many studies have been carried out by Telli & Altun, 2021; Akyavuz & Çakın, 2020; Çiftçi, & Aydın, 2020; Bakioğlu, & Çevik, 2020; Yurtbakan, & Akyıldız, 2020 to determine the opinions of teachers in distance education. In these studies, suggestions were made by including the opinions of teachers for a healthier conduct of distance education.

For example, Telli and Altun (2021) stated in their study that the students could not take their own learning responsibilities adequately as a result of the teacher's inability to act as a "guidance and facilitator" in the online learning environment, and this situation could prevent students from actively participating in the lesson. In the study conducted by Bakioğlu and Çevik (2020) with science teachers, it was stated that they encountered problems such as communicating with students in the distance education process, internet connection, and low rate of students' participation in classes. In addition, teachers also stated their concerns such as not being able to complete the distance education curriculum and laboratory activities.

In the literature, there are not many studies on science teacher candidates and chemistry courses. As concerns about the effectiveness of education programs have increased with the transition to distance education, it has become important to focus on the problems experienced in distance education and to eliminate the deficiencies of this teaching method. For this, research is needed, and especially the problems experienced by pre-service teachers in this process should be revealed. This research was planned in the light of this thought. In this context, the general purpose of the research is to evaluate the opinions of teacher candidates studying in the science teaching program in the distance education process about the teaching of the General Chemistry course.

The sub-problems of the research were determined as follows.

1. What are the problems faced by pre-service teachers studying in the science teaching program in the teaching of General chemistry courses in the distance education process?

2. What are the situations that pre-service teachers studying in the science teaching program see as advantages and disadvantages in the teaching of General chemistry courses in the distance education process?

3. What are the opinions of prospective teachers studying in the science teaching program on the effect of teaching general chemistry courses through distance education?

METHOD

To find an answer to the question "What are the opinions of pre-service teachers studying in the science teaching program about the teaching of General chemistry course in the distance education process?", "case study", which is one of the qualitative research methods, was used in the research. Case study is a qualitative research method in which the researcher examines one or more situations in depth and reveals the themes related to these situations (Creswell et al., 2007). In this research, the General Chemistry course, which was offered through distance education due to the pandemic, was the subject of this research and provided a case study.

Study group:

The study was carried out with 49 science teacher candidates studying at the Faculty of Education of a State university in Bursa in the fall semester of the 2020-2021 academic year. Teacher candidates were determined on a voluntary basis by criterion sampling method. For this purpose, the pre-service teachers' taking General chemistry courses was determined as a criterion in the study.

Data collection and analysis process

In the study, 4 open-ended questions were prepared by the researcher. These questions were finalized by taking the opinion of another lecturer. Since face-to-face interviews were not possible, the research questions were sent to the candidates via Google forms. The questions in the form sent to the candidates are shown below:

1. What are the problems you encounter regarding the General chemistry course in distance education?

2. What are the advantages and disadvantages of taking the General Chemistry course remotely?

3. How did distance education affect your effective learning of the topics of the General Chemistry course?

4. While you were doing problem solving and experiments for the General Chemistry course, did you experience the effect of distance education on learning, if so, can you tell us about them?

Content analysis was applied for the data obtained from the pre-service teachers in the electronic environment. The analysis of the data was carried out independently by two academicians who are experts in the field of science, and then the codes, categories and themes that emerged were compared by bringing them side by side. Situations with differences were discussed and evaluated, and the final shape was given by reaching a common conclusion. The findings were interpreted and tabulated, and the results of the study were revealed. To protect the confidentiality of the prospective teachers, the candidates were coded as S1, S2…. and such.

FINDINGS

Findings of the first sub-problem: The findings regarding the problems faced by the pre-service teachers studying in the science teaching program in the teaching of general chemistry courses during the distance education process are presented in Table-1.

Table 1

Problems encountered in the teaching of general chemistry courses with distance education

Codes	f	*Categories*	*Theme*
Internet outage	7	Internet related problems	Distance chemistry lesson
Internet slowness	6		
unable to attend class	11		
expulsion from class	2		
Sound and camera flickering, freezing	3		
Distractibility focus problem	3	Learning Problems	
Inability to understand the numerical lesson	2		
inability to communicate	2		
Not understanding the solutions to the questions	2		
Inability to go to the laboratory	4		
	1		

As can be seen in Table 1, two categories emerged from the answers of the pre-service teachers studying in the science teaching program regarding the problems encountered in the teaching of chemistry courses in the distance education process. While most of the pre-service teachers

(f=39) stated that they encountered various problems during the distance education of the chemistry course, a small number of candidates (f=10) did not state any problems.

Some opinions stated by the candidates in the written forms regarding the categories belonging to the first sub-problem are as follows.

Comments on the category of Internet-related problems:

S25: **"***Sometimes I have the problem of internet freezing and no sound..''*

S38:" Internet infrastructure is problematic and a big problem, and the internet is not enough most of the time.

S44:" There may be interruptions in the sound due to the Internet. We cannot express ourselves comfortably , we cannot attend the class as we wish .''

Comments on the category of learning problems:

S37: "*The examples and the solution of the questions are fast and not well understood due to distance education.''*

S45:" I have difficulty concentrating on the lessons and we have difficulty understanding the questions because we have no basis in some things.''

S21:" I'm having trouble focusing."

Findings of the second sub-problem: Findings related to the sub-problem "What are the opinions of pre-service science teachers studying in the science teaching program on the advantages and disadvantages of distance teaching of general chemistry course?" are shown in

Table-2.

Table 2

Advantages and disadvantages of teaching general chemistry courses with distance education

Codes	f	Categories	Theme
Listening in a comfortable environment	4	Environment	Advantage
Not to waste time	2		
Being with family	4		
Not experiencing problems in dormitory	3		
Being able to attend the class in the environment I want	4		
Being at home in a healthy environment	2		
Adaptation in my own home and city	3		
have no trouble	2		
Get enough sleep	1		
Not having food shortages			

Time to study after class	4	Teaching	
Being able to watch the lecture again from the link	2		
Ease of taking notes	3		
Ability to record the lecture	2		
Thanks to the Ukey program, you can easily take your lecture notes.	3		
Equal education for all	2		
Spending less by living with a family	3	Economy	
No transportation costs	2		
Inability to show the necessary interest in the lesson	4	Teaching	Disadvantage
Failure of classes	3		
Inability to focus on the lesson-distraction	5		
Verbal explanation of practical questions	2		
Difficulty focusing	2		
Trouble understanding	2		
Lessons are not as productive as face-to-face	2		
Having problems with the internet	5	Internet problems	
Insufficient infrastructure	5		
Student presence without a computer	4	Economy	
Having students without internet access	3		
Lack of internet in crowded homes	2		
Inability to live in the university environment	2	Environment	

As can be seen in Table 2, the advantages provided in the distance teaching of chemistry lessons by science teacher candidates were evaluated in 3 categories, and the disadvantages were evaluated in 4 categories. 6 of the candidates stated that it is an advantage to conduct the chemistry course with distance education, while 3 candidates stated that it is a disadvantage. The other 30 pre-service teachers did not express their opinions about the situation.

Pre-service teachers' opinions in the categories belonging to the second sub-problem are as follows.

Pre-service teachers' opinions in the category of the environment advantage:

S3: "We spent too much time going to school and now we are in class in two minutes. In addition, the biggest advantage is that we can watch the lecture recordings later."

S5: "It's great to be able to take classes in any environment."

S23:"Since we are at home with our family, our basic needs such as shelter and food are provided."

Pre-service teachers' opinions in the category of the teaching advantage:

S20:" After a topic is covered, we have enough time to do the homework for that lesson.."

S27:" Thanks to the Ukey program, we can access slides and notes."

S32:" Being able to watch the course recordings later."

Pre-service teachers' opinions in the category of the economic advantage

S4:" *Being with my family and less in the money"*

Pre-service teachers' opinions in the category of the teaching disadvantage:

S1: "*Not being able to show the necessary interest in the lesson because I am in a comfortable environment..*"

S4: "We listen to the answers to the questions that require practice like a verbal lesson."

S25:**"** *I don't think it is as productive as face-to-face training and I can't focus very much, which affects my understanding."*

Pre-service teachers' opinions in the category of internet problems:

S31:" The lesson is incomprehensible unless it is face to face. It's always a problem, either the internet goes out or the sound goes out.

S39**: "***Internet is not available most of the time.*

Pre-service teachers' opinions in the category of the economic disadvantage:

S12:" Not everyone has a computer, not enough internet"

Pre-service teachers' opinions in the category of the environment disadvantage:

S17: **"***We cannot live in the university environment."*

Findings of the third sub-problem: The findings obtained from research questions 3 and 4 regarding the sub-problem "What are the views of pre-service science teachers on the effect of distance education and chemistry courses on learning?" are shown in Table-3. According to the data obtained, f=26 of the candidates stated that distance learning chemistry course affected learning negatively, f= 6 of them stated that it

had a positive effect, and f=7 students stated that it did not affect learning positively or negatively.

Table 3

The effect of online processing of chemistry courses on learning

Codes	f	Categories	Theme
The way of explanation and examples are sufficient.	3	Positive impact	Impact on learning
The advantage of being able to instantly ask the questions in our minds	2		
Useful as materials are shared	1		
		Negative Effect	
The solutions to the problems of the subjects are not understood	2		
Topics remain superficial.	2		
Some abstract issues are getting harder	2		
Learning of knowledge is not consolidated	3		
The subjects are difficult to understand because chemistry experiments are not carried out.	4		
No effective learning	3		
Difficulty in learning numerical lessons	2		
Lack of laboratory information	2		
Learning by doing is not supported because there is no experiment	3		
Difficulty in recognizing laboratory materials used in chemistry class	3		

As can be seen in Table 3, a category was created regarding the views of pre-service science teachers on the effect of distance learning of chemistry courses, including the positive and negative effects of the theme of impact on learning.

Pre-service teachers' opinions in the categories belonging to the third sub-problem are as follows.

Opinions on the category of positive impact on learning:

S3: "Chemistry class is fine. The way of explanation and examples are also sufficient. I am satisfied.."

S5": The advantage is that we can immediately ask the questions in our minds, either verbally or in writing. However, applied training for the chemistry course will be much more effective."

S26:" I did not have any problems, it works well."

Opinions on the category of negative impact on learning:

S41: "I think it's too bad, because chemistry is a subject where experiments are made, so distance education makes it difficult to understand.."

S5: Not being able to experiment is the negative side of distance education.

If these opportunities were provided, a more permanent and effective education could be provided."

S25: : "We can't do experiments because it is online, I think it would be more understandable if practice was made in the chemistry class."

S32: "We want to go into the laboratory and see the equipment closely and experiment, but we cannot do it."

CONCLUSION AND DISCUSSION

In this study, it was aimed to determine the opinions of pre-service science teachers, who were educated by distance education due to the pandemic, on the functioning of General chemistry courses.

Regarding the question "What are the opinions of the pre-service teachers studying in the science teaching program about the problems they encounter in the teaching of General chemistry courses in the distance education process?" as can be seen from Table 1, the pre-service teachers stated that they could not attend the class due to internet problems and various infrastructure problems in the category of internet-related problems. In the category of learning problems, the candidates mentioned problems such as not being able to understand chemistry lessons, focusing problems, distraction, not understanding the solution of questions, not being able to communicate and go to the laboratory. Similar problems have been encountered in almost all studies on distance education. For example, these findings coincide with the findings of Pınar & Akgül (2020) that the efficiency of education decreases due to the problems and deficiencies related to technical infrastructure and internet access in the distance education process. Learning problems are compatible with the findings of Zan (2021) in his study with Chemistry teachers.

Regarding the question "What are the situations that pre-service teachers studying in the science teaching program see as advantages and disadvantages in the teaching of General chemistry courses in the distance education process?", the advantages of distance education are

indicated to belong to environment, teaching and economy categories. The disadvantages are indicated to be education, internet-based problems, economic problems, and environment. In the study, the conditions such as being with the family, not losing time during the commute, not having problems in the dormitory, being in your own city and at home, and having ready meals were expressed as advantages. In the teaching category, it was stated as an advantage by the candidates that there was time to study, being able to watch the lecture again from the link, and lecture notes being available on the "Ukey " system. Being with their families at home and not having transportation costs were also mentioned as an economic advantage. These findings are consistent with the findings of Pınar & Akgül (2020) in their study. In the category of teaching, which is seen as disadvantageous in the distance education process, the candidates stated that they could not show the necessary interest and focus on the lessons in distance education, the lessons were inefficient, and they could not understand. Apart from these, other category titles that are seen as disadvantages are the internet and economic problems. In addition, two candidates complained about not being able to experience the university environment. Many of these findings are supported by the findings of literature studies. For example, Karakaya et al. (2020) coincide with the findings of inefficiency, lack of motivation and technological infrastructure.

According to the results of the content analysis for the question "What are the opinions of prospective teachers studying in the science teaching program on the effect of teaching general chemistry courses in the distance education process on learning?", two categories emerged under the theme of impact on learning: positive and negative impact. While only six candidates expressed a positive opinion about the distance teaching of chemistry courses, the majority of the candidates expressed a negative opinion. Problems such as not being able to understand the solutions of the problems of chemistry subjects, difficulties in learning abstract subjects, not being able to conduct experiments in the laboratory, not having effective learning, and not consolidating the information were mentioned. These findings are in line with the findings of Pınar & Akgül (2020) not being able to conduct experiments and asking for problem solutions in distance education.

As a result, it seems that distance education will take place in our lives as a complement to face-to-face education in the coming years. For this reason, it is important to investigate the positive and negative experiences of teachers and students in the distance education process carried out during the pandemic. Considering the structure of courses with laboratory applications such as chemistry, it is very important to create original content for distance education for these courses.

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CHAPTER 11

EXAMINING THE EFFECT OF LEARNING ANALYTICS ON SELF-REGULATED LEARNING[1]

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1. Introduction

Justified as technology usage became widespread, differences occured in educational processes. Nowadays when an approach focused on learner is dominating, changes have also occured in the roles of school, learner and teacher. As the usage of learning management systems such as Moodle, Blacboard, Canvas became widespread, this has opened the way for realization of learning and teachning process in online environment. Learning management systems bear various tools supporting learning and teaching process such as assignment, exam, forum, assessment, file sharing within their body. But studies being realized have shown that these functions which learning management systems have are not used equally by users (Fathema and Sutton, 2013; Walker, Lindner, Murphrey and Dooley, 2016). In the process where online learning environments first began to become widespread, it is seen that these environments are mainly used for the purpose of sharing of lesson material and giving assignment and collecting (Lonn and Teasley, 2009). But there is also interaction between learner-educator, learner-learner and learner-environment which affect learning process in these environments (Holmes and Prieto-Rodriguez, 2018; Swart, 2015). Interaction between learner-environment in learning management systems enable for various data that may affect learning process of individual to be stored in system logs (Fırat, 2016). One of the most important disadvantages of online learning environments being frequently used today is that these environments do not provide adequate information about learning process to the individuals (Nurakun-Kyzy, Ismailova and Dündar, 2018). This situation causes for individual to be deprived of sufficient support as he regulates his own learning process. Especially learner's not being informed about his own learning process gives rise for him to give up from using these environments (Wandler and Imbriale, 2017).

In order for the learning environment to be used effectively, it is required for individual to monitor his own learning process in this environment and to evaluate himself in a correct way (Paris and Paris, 2001). This can be possible since the data left by individual in online learning environment are included in the process. At this point the idea of making data become meaningful and transferring them to learning process have caused the emergence of concept of learning analytics. Learning analytics enabled the data stored in the system logs to be analyzed and reported to the stakeholders in the process (Ferguson, 2012). In this way, learners, trainers and other stakeholders who are in the training process had the opportunity to have the information that will make the process become more effective (Mamonov, 2016). With the collection, analysis and reporting of the data being stored in the online learning environment and presenting it to the

individual, meaning with the use of learning analytics, the individual has also gained the opportunity to make self-regulation (Pardo, 2014).

Self-regulated learning is defined in a way such that individual determines his own learning goals in an active and constructive process and he organizes his cognition, motivation and behaviors in order to be able to achieve the determined goals. (Pintrich, 2000). Self-regulation helps the individual have learning habits and to improve his working skills (Wolters, 2011), to determine learning strategies and to improve learning outcomes (Carson, 2011; Chang, 2007), to increase satisfaction level in online learning environments (Kuo, Walker, Schroder, & Belland, 2014). Learning outside of school is seen as an important predictor of self-regulated learning (Lai and Gu, 2011). It has been shown with various researches being conducted that self-regulation skill of individual also plays an important role in improving academic success (Ergen and Kanadlı, 2017; Kayıran and Doğanay, 2017; Sahranavard, Miri & Salehiniya, 2018).

Today methods called blended learning, hybrid learning, inverted classroom model, where both classroom and e-learning environments are used together are frequently being used (Hubackova 2015). Besides this there are online learning environments that enable the individual to learn in an independent way. These environments are called open massive online learning environments (MOOC). With MOOCs that are widespread in recent years indiviual can carry out the whole learning process on his own and he can certify this process in the end. Despite all these opportunities that are provided, rate of number of individuals successfully completing the learning process in these environments is quite low (Jordan, 2014; Rostaminezhad, Mozayani, Norozi and Iziy, 2013). Inadequacy of self-regulation skill of individual is one of the factors which causes this situation (Geduld, 2016). Due to some reasons such as inability to determine the correct strategy, lack of metacognitive knowledge, inability to provide motivation and lack of experience in learning environments, the individual can not carry out the learning process in a successful way and as a result, he cannot benefit from these environments adequately (Li et al., 2017). In the literature it has been emphasized by many researchers that learning analytics has an important potential in education process (Ahern, 2018; Grover and Korhonen, 2017). Learning analytics can also provide the instructor and other stakeholders of the process various information about the effectiveness of the teaching process and the learning status of learners (Ifenthaler and Widanapathirana, 2014). Both learner's and educator's being informed about the process provide opportunity to intervene with problems that may arise (Wise, 2014), and learning analytics also enables for individual to plan his own learning process in online learning environment in a better way (Schumacher and Ifenthaler, 2018). This situation enabling for indiviual to undertake responsibility

during learning process is also related with self-regulated learning. When literature is examined, it is observed that the impact of learning analytics on self-regulated learning of learners has not been investigated adequately. The purpose of this research is the determine the effect of learning analytics on self-regulated learning of learners.

2. Methodology

2.1. Research Design

In this research embedded design being among mixed research methods has been used. Mixed research method is the research method where qualitative and quantitative research methods are used together to support one another (Baki and Gökçek, 2012). In the mixed research method, blending of qualitative and quantitative research methods enable for research problem to be better understood (Creswell, 2011). According to Yıldırım and Şimşek (2018) in embedded mixed research design one of the qualitative or quantitative methods come to the forefront and the method that is in secondary status can not provide answer to a research question alone. In this study, it was aimed to diversify the data by using the Online Self Regulatory Learning Scale together with the qualitative data being obtained from focus group interviews and learning analytics reports. In the quantitative dimension of research single group pre-test post-test model that is among simple experimental methods has been used. Karasar (2016) states that the single group pre-test post-test model is suitable for use in situations where in-depth comprehensive observations are desired, and that this model enables for determining whether there is a change in the behavior of the subjects within time. Fraenkel, Wallen, and Hyun (2014) also argue that the single group pre-test post-test model is the most appropriate research model at the point of directly affecting a certain variable and testing hypotheses about cause and effect. The particular that all preparatory classes in the higher education institution where the study was conducted use the same learning management system has been another reason for preferring a single group pre-test post-test pattern. .

2.2. Study Group

Research has been carried out at a state university in Turkey in 2018-2019 autumn period. Application has been realized with 46 students in two preparatory classes in Foreign Languages Higher Education School. Among participants 31 were women and 15 were men. Age average of participants was 20.6 and all of them had previous e-learning experience. During application process while lessons were realized in class environment in the form of face-to-face education, online learning environment was used for supportive purpose. Lesson books had by learners are present in online learning environment. Learners can do homework activities in

the online environment and they also have the opportunity to do other learning activities. They can use all the contents independently in online environment. Even though teaching staff give assignments to learners in online learning environment from time to time, learners have used this environment mostly to manage their own learning processes. Teaching staff have used online learning environment to monitor learning process of learners. While lesson processing was done face-to-face in class, online learning environment was used within process. While teaching staff planned the process with the data they obtained from this environment, at the same time in required cases they have intervened with learners both in online learning environment and in class environment.

2.3. Data Collection Tools, Data Collection and Analysis

T Qualitative data were obtained from learners with whom research was carried out, from focal group discussions and learning analytics reports. The purpose of the focus group meeting is to obtain the perspectives, experiences, tendencies, perceptions, attitudes, thoughts and feelings of individuals about a subject in detail (Krueger & Casey, 2014). During focus group discussion when number of individuals in group is high this makes the control become difficult and this causes a situation that prevents some participants from expressing their opinions (Barbour and Morgan, 2017). Due to this, learners were divided in two groups and in this way focal group discussion was realized. Semi-structured discussion form was used in focus group discussions. Besides, by getting permission from participants in discussion recording was made with sound recording device. Semi-structured discussion forms were used when data were collected.

In the quantitative dimension of the research, the Online Self-Regulatory Learning Scale was created by Barnard, Lan, To, Paton and Lai (2009) and adapted into Turkish by Yetik (2011). Application permits required to use the scale have been obtained beforehand. Reliability coefficient of scale was 0.89 for the version adopted to Turkish. Scale is composed of 24 articles. The scale has six sub-dimensions which are determining task strategies, goal setting, setting the environment, self-assessment, seeking help, and time management. Data have been collected from participants by using scale at the beginning of period and at the end of period.

Qualitative and quantitative data being obtained were analyzed separately. For analysis of qualitative data first of all data were transfered to a written environment and each student was coded as OGR. Content analysis was used in analysis of qualitative data. Purpose in content analysis is to reach to concepts that can explain data being obtained and to reveal relationship between these concepts (Yıldırım and Şimşek, 2018). During data analysis process keywords have been determined with support

of field experts and code, category and themes have been formed. In the analysis of quantitative data, the difference between pre-application and post application was tried to be determined by using the pre-test post-test dependent groups t-test. Findings obtained from qualitative and quantitative data were interpreted together.

2.4. Findings

Primarily analysis of quantitative data was made. In this context, it was tried to determine tests to be used for correctly analyzing data obtained from scale at the beginning and end of the application. In this frame it was worked to determine whether parametric tests would be applied in data analysis or not. According to Field (2009) in order to apply parametric tests it is required for data to reveal normal distribution and for group variances to meet equality terms. Again in order to apply parametric test it is required for sample size to be at least 30. It was determined that sample size was bigger than 30 and it was tried to determine whether data showed normal distribution or not with normality test. Data obtained from Kolmogorov-Smirnov test are shown in Table 1.

Table 1.

Kolmogrov-Smirnov test result

	Kolmogorov- Smirnov		
	Statistics	Sd	p
Pre-test	0,90	46	0,061
Post-test	0,118	46	0,03

As a result of Kolmogorov-Smirnov test being conducted it is seen that pre-test value is p=0,61 and post-test value is p=0,03. While this situation shows normal distribution for pre-test, regarding post-test it shows that data do not reveal normal distribution. Barrett, Morgan, Leech and Gloeckner (2012) have stated that even if data obtained from this test do not show normal distribution, if kurtosis and skewness values are in interval of -1 and +1 it will be assumed that these data showed normal distribution. As a result of analysis being made kurtosis and skewness values relating with pre-test an post-test were determined and shown in Table 2.

Table 2.

Kurtosis and skewness values for pre-test and post-test

		Statistics	Std Error
Pre-test	Skewness	,34	,251
	Kurtosis	-,338	,498
Post-test	Skewness	-,430	,251
	Kurtosis	-,179	,498

When data in Table 2 are examined it is seen that skewness and kurtosis values for both pre-test an post-test were in the interval of -1 and +1. In this situation by assuming that data showed normal distribution it was decided to use parametric tests.

In order to reveal the difference between the self-regulated learning levels of the learners at the beginning and end of the application, dependent groups t test was applied and the data obtained are shown in Table 3.

Table 3.

Pre-Test and Post-Test Dependent Groups T-Test Result for the Whole Scale

Test	N		SS	t	df	p
Pre-test	46	85,67	13,16	11,81	45	,012
Post-test	46	91,39	12,08			

When data in Table 3 are examined it is seen that pre-test and post-test results are in interval of (p=0,05>0,012; d=-1,72). This situation shows that there is a significant difference between results of two tests.

Self-regulated learning scale is composed of six sub-dimensions. One of the questions for which answers were sought in the study is whether the effect of learning analytics on self-regulated learning differs in the sub-dimensions of the scale. Below results of analysis made for each sub-dimensions is shown.

Target determination is sub-dimension that contains first five articles of scale. Dependent groups t test was applied to reveal difference between results obtained at the beginning and end of application. Findings obtained are shown in Table 4.

Table 4.

Pre-Test and Post-Test Dependent Groups T-Test Results for the Goal Setting Sub-Dimension of the Scale

Test	N		SS	t	df	p
Pre-test	46	18,6	3,62	7,892	45	,037
Post-test	46	19,78	3,02			

When the data in Table 4 are examined, it is seen that p = .037 <.05. In this case, it is observed that learning analytics reveal a significant difference between the pre-test and post-test results in learners' goal setting sub-dimension.

In the findings obtained from focus group interviews, it is understood that learning analytics benefit learners when they are setting goals. Some of the learner views on this are as follows:

OGR3: *Subjects are very joyful and they are very useful for learning English. I am determining targets about when I will complete.*

OGR8: *I am setting targets for myself by looking at reports all the time.*

Findings obtained from OGR3 and OGR 8 overlap with findings obtained from scale.

Another sub-dimension of scale is environment structuring dimension. 6th, 7th, 8th and 9th items of scale are part of environment structuring sub-dimension. Dependent groups t test results used to determine difference between ata of learners for environment structuring sub-dimension at the beginning and end of application are shown in table 5.

Table 5.

Pre-test and post-test dependent groups t-test result for environment structuring sub-dimension of scale

Test	N		SS	T	Df	p
Pre-test	46	16,61	2,50	-5,73	45	,067
Post-test	46	17,09	2,19			

When the data in Table 5 is examined, the pre-test average is = 16.61, while the average of the post-test is = 17.09. When significance level of difference between averages is examined it is observed that p=.067>.05. In this case, the use of learning analytics did not reveal a significant difference between pre-test and post-test results in the environment structuring sub-dimension.

In focal group discussions being made different findings have come out regarding environment structuring. Some learners' opinions relating with this particular are as follows.

OGR14: *I also stay in the dormitory. When I study, I go to a room with internet and work on my own.*

OGR7: *Unfortunately we can not create our own working environment in dormitory. There is usually a problem on the internet anyway. That's why I do it either at school or at the dormitory, but I don't create a special working environment.*

Data obtained from learners show variation. While OGR14 is successful in environment structuring OGR7 states that there is no opportunity for environment structuring. It is understood that findings obtained from scale and findings obtained from discussions differ at this point.

Another sub-dimension of scale is time management. 14th, 15th and 16th items of scale are items that measure levels of participants regarding

time management. Dependent groups t-test has been conducted to determine difference between pre-test and post-test results of time management sub-dimension. Data being obtained are shown in Table 6.

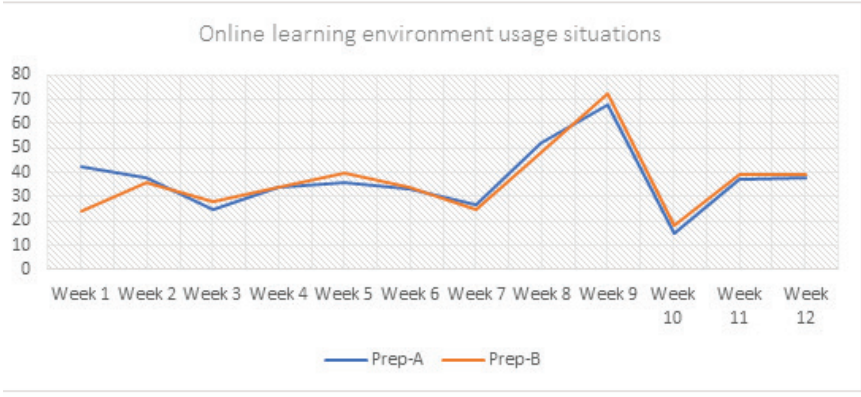
Table 6.

Pre-test and post-test dependent groups t-test result for time management sub-dimension of scale

Test	N		SS	t	df	P
Pre-test	46	14,12	3,41	-7,349	45	,000
Post-test	46	15,07	3,06			

When data in table 6 are examined it is seen that average of responses given to time management sub-dimension at the beginning of application is =14,12 and that post-test average was =15,07. It is seen that between two results p=000 <0,05. In this situation it is seen that there is a differentiation in favor of post-test between pre-test and post-test.

The effect of learning analytics on learners' time management has also been tried to be obtained from the reports. The average of the duration of the online learning environment use of the learners who study in two separate classes in which the study was conducted during the twelve-week research process is shown in Graphic 1.



Graphic 1. *Classes' usage of online learning environment*

When data in graphic 1 are examined it is seen that learners use online learning environment densely. It has been determined that preparatory-A and preparatory-B classes used online learning environment most in nineth week and least in tenth week. Realization of exams in nineth week has caused learners to use this environment more. But when all the period of twelve weeks is examined it is seen that learners are stable in using online learning environment.

In focus group discussions being conducted it was tried to determine the impact of learning analytics on time management. Relevant opinions of participants are as follows:

OGR5: *I must log in to the site and complete the activities. I set a specific daily time for this.*

OGR10: *I try to use it daily, even though we don't have homework. It's good to have reports. Because you can always compare yourself to other people.*

OGR11: *Sometimes I log into the site 5 times a day. Every day I complete certain activities myself, except for homework.*

When findings obtained from interviews are evaluated together it is seen that learning analytics provide benefit to learners regarding time management. This finding supports the finding obtained from the scale.

Another dimension of the self-regulated scale is seeking help. The scale is 17-20. items measure this sub-dimension. The pre-test and post-test results of the help search sub-dimension are shown in Table 7.

Table 7.

Pre-test and post-test dependent group t-test result for help search sub-dimension of scale

Test	N		SS	t	Df	p
Pre-test	46	13,85	3,22	-8,465	45	,102
Post-test	46	14,15	2,79			

When data given in table 7 are examined it is seen that total score average of pre-test items is =13,85 and total score average of post-test items is =14,87. When it is examined whether there is a significant difference between two tests it is found that p=.102> 0,05. This shows that a meaningful difference has not occured between pre-test and post-test outcomes.

OGR4: *I get help from my friends in some activities.*

OGR7: *I can not find the correct answer, although I sometimes try the correct answer many times, especially in the exercises we have written. Then I ask my friends.*

Data obtained from scale show that there is no significant difference in seeking help sub-dimension. However, the findings obtained from the focus group interviews differ with the findings obtained from the difference scale.

Determination of assignment strategies is another sub-dimension of

self-regulated learning. 10th-13th items of scale are use to measure this sub-dimension. Dependent groups t-test was used to determine whether there was a differentiation between pre-test and post-test results of sub-dimension of determining task strategies at the beginning and end of study. The findings obtained from the dependent groups t test are shown in Table 8.

Table 8.

Pre-Test and Post-Test Dependent Groups T-Test Results for the Sub-Dimension of Determining Task Strategies of the Scale

Test	N		SS	t	Df	p
Pre-test	46	12,89	3,08	- 9,629	45	,083
Post-test	46	13,62	3,01			

When the data in Table 8 are examined, the average pre-test score is = 12.89, while the average of the post test is = 13.62. The significance level of this difference between pre-test and post-test results is p = 0.83> 0.05. This shows that there is no significant difference between pre-test and post-test results in task strategy determination sub-dimension.

Self-assessment is one of the sub-dimensions of self-regulated learning and the last four items of the scale are used to measure this dimension. The data obtained were analyzed using dependent groups t test and the results are shown in Table 9.

Table 9.

Pre-test and post-test dependent groups t-test results for self-assessment sub-dimension of scale

Test	N		SS	t	Df	p
Pre-test	46	14,12	3,41	-7,349	45	,000
Post-test	46	15,08	3,06			

When the data in Table 9 is examined, the total score average of the answers given to the pre-test items is = 14.12, while the average of the scores obtained from the post-test is = 15.08. When the significance level of the difference between the pre-test and post-test scores is considered, it is seen that p = 0.00 <0.05.This situation shows that there is a significant difference in favor of post-test between post-test and pre-test results. In other words, learning analytics caused a significant difference in the self-assessment sub-dimension of the scale. The opinions of the participants on self-assessment in focus group interviews are as follows.

OGR2: *In fact, learning analytics allow the person to constantly evaluate himself. Whenever you complete an activity, you immediately see*

that it is considered. That's why I look at what I have done missing or wrong in the activities and try to see what I lack.

OGR14: *I think most important thing is to evaluate yourself constantly and to identify your shorcomings. If you get too much red in relation to a subject, you have too many deficiencies in this matter.*

OGR2 states that the activity he performed was taken into consideration immediately, while OGR14 stated that the activities he completed were shown to them in colors. Said situation is related with learning analytics. Similar findings were obtained from the learning analytics reports. It has been determined that learners repeat the quizzes frequently.

When findings of learning analytics reports and focus group interviews are evaluated together it is seen that use of learning analytics enables learners to perform self-monitoring and self-assessment. As a result of the self-assessment, it is seen that the learners try to make up their deficiencies by repeating the activities.

3. Discussions, Conclusion and Suggestions

Within the scope of the study, the impact of learning analytics on learners' self-regulated learning was tried to be determined. When the focus group discussions, learning analytics reports and the findings obtained from the scale used are examined, it is seen that learning analytics affects learners' self-regulated learning levels positively .As a result of data analysis it is seen that a meaningful difference occurred before and after application for whole scale. Within the scope of this research, self-regulated learning level was measured using the scale. The scale used has six sub-dimensions. When impact of learning analytics on self-regulated learning was examined based on sub-dimensions it was seen that while self-assessment, time management and goal setting sub-dimensions had a significant difference, it was observed that there was no significant difference in sub-dimensions of determining task strategies, setting environment and looking for help. Learning analytics collects and analyzes data which is stored in system logs and transforms them into meaningful data and shares them with stakeholders in the education process. It is important for learners to have information about their own learning process and for them to be able to evaluate their own learning in developing self-regulation skills (Panadero, Jonsson and Botella, 2017). When impact of self-regulated learning on academic success (Bol, Campbell, Perez and Yen, 2016; Kayıran and Doğanay, 2017) is considered, it is seen that it has an important role in shaping learning process. When literature is examined, studies investigating effect of learning analytics on self-regulated learning were found (Kim, Yoon, Jo and Branch, 2018; Lodge, Panadero, Broadbent and Barba, 2018; Winne, 2017; Montgomery et al, 2017; Silva et al, 2018;

Tabuenca, Kalz, Drachsler and Specht, 2015; Yamada et al, 2017). In these studies, it was determined that the mixed research method was preferred generally and the scale, interview forms and observation forms were used as data collection tools. In this study scale was used in order to see status of all learners involved in process while semi-structured interview forms were used in focus group interviews to obtain in-depth information. Within each sub-dimension of the scale, the effect of learning analytics was tried to be determined. These sub-dimensions of self-regulated learning are interrelated with each other.

Time management is one of the sub-dimensions of self-regulated learning. There is limited number of studies examining the effects of learning analytics on time management (Il-Hyun, Kim, & Yoon, 2015). In the study they conducted, Tabuenca, Kalz, Drachsler, and Specht (2015) concluded that using learning analytics in the mobile environment improves the time management skills of learners. It is seen that the results obtained from these studies and the results obtained from the current study support each other.

Self-assessment is one of most important stages of self-regulated learning. It enables the person to evaluate his own learning process and to restructure his own learning process with the data he will obtain at this stage. According to Hadwin and Webster (2013), individual goal setting requires self-monitoring, self-evaluation and self-regulation that will lead to these goals. Learning analytics allow the individual to evaluate his own learning process by providing feedback. According to Roll and Winne (2015) while learning analytics enable the indiviual to make self-assessment, it also provides opportunity to evaluate environment and the context. Kalshetti, Kulkarni, Patel, and Nimbalkar (2017) also designed an environment in which learning analytics is used, and the learners were provided with the opportunity to self-assessment by providing feedback. The environment provided reports to trainers as well as learners, making it possible to have early intervention against incomplete learning. When the findings obtained from the literature are examined, it is seen that similar results with the current study are obtained.

Seeking help is beneficial for the individual in accessing information and resources in self-regulated learning. In the current study, it is seen that no significant difference came out regarding learning analytics in help seeking sub-dimension of self-regulated learning between pre-test and post-test results. When the literature is examined, there is limited study investigating the effect of learning analytics on help seeking. Berland, Baker, and Blikstein (2014) state that learning analytics can increase help seeking skills while Du, Xu and Fan (2015) mention that seeking help is an important factor for self-regulated learning and seeking help

has an important role in improving academic success. Daley, Hillaire, and Sutherland (2016) tried to improve learners' help seeking skills by using data. With the help of the environment created as a result of the study, a positive change occurred in the learners' help-seeking skills. Cross, Waters, Kitto, and Zuccon (2017) also tried to determine learners' help-seeking behaviors using learning analytics. Du, Zhang, Olinzock and Adams (2008) concluded that seeking help differs between online learning environment and face-to-face classroom environment because in online learning environment there is little interaction with individuals. Besides, Roll, Aleven, McLaren, and Koedinger (2011) found that in the online learning environment where learning analytics are used, metacognitive feedback improves learners' help-seeking skills. As a result of literature review, it was observed that there are very limited studies that investigate relationship between help seeking and learning analytics. But the data obtained from the limited number of studies reached and the data obtained from the current study differ. While the benefit of learning analytics at the point of seeking help was determined in these studies, it was not reached to a similar result in this study. It is thought that this difference is caused by the reasons such as new acquaintance of the learners with each other, the effect of culture and the easy access to information today.

In the current study, usage of online and classroom environment together in the teaching of the lessons comes out as a limitation in terms of clearly demonstrating the effect of learning analytics. For this reason it is considered that testing a study to be conducted in MOOC system will make it possible to have more detailed information while determining impact of learning analytics on self-regulated learning. This study was carried out at the higher education level. It is anticipated that carrying out similar studies at different educational levels in future will contribute to showing the impact of learning analytics more clearly and it is recommended for studies to be made in this direction.

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CHAPTER 12

SCIENTIFIC FIELD TRİPS WITHIN THE SCOPE OF EDUCATION FOR SUSTAINABLE DEVELOPMENT

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INTRODUCTION

Education is considered as crucial in terms of providing the necessary awareness and sensitivity in solving both environmental and economic and social problems (Demir & Atasoy, 2021). As a matter of the fact, it is emphasized by scientists that education is the most effective tool for solving experienced problems in sustainable development (Hotinli et al., 2013 p. 5). In this context, it is fair to say that education is necesary for a sustainable world based on the philosophy of sustainable development (Demir & Atasoy, 2021). Inasmuch as today, there is a period when the limited capacity of the world is extremely difficult to meet the unlimited needs of mankind. With the rapid population growth, pollution in water, soil and airspace, global warming, the extinction of some species and the danger of extintion of many are just a few of environmental problems. Rapid depletion of resources, borrowing, dependence on the outside, increasing in the gap between rich and poor people, excessive consumption, unlimited growth ambition and desire to produce, economic crises in undeveloped and developing countries are some of the economic problems of today's world. Issues such as hunger, poverty, conurbation, migration, ethnic and religious conflicts, and racism are among the social problems felt globally. Today, with the increase of economic, environmental and social problems, the concepts of "sustainability", "sustainable development" and "education for sustainable development" have become topics that are frequently on the agenda in the education and political environment, media and science world. As a matter of the fact, the concepts of "sustainability", "sustainable development" and "education for sustainable development", which have gained popularity in recent years, constitute one of the significant issues of education discipline (As cited in Demir & Atasoy, 2019, p. 203). Especially as economic, environmental and social problems began to increase, the term "education for sustainable development" has frequently been used in the field of education in order to overcome these problems. Hence, there are many studies within the scope of "education for sustainable development" by different disciplines in the field of education literature.

When the literature is examined, numerous theoretical studies have been reached within the scope of "education for sustainable development" on both international and national basis (Alkış, 2007; Alkış, 2008; Alkış, 2009; Bonnet,1999; Demir & Atasoy, 2019; Elgin, 2012; Foster, 2001; Hopkins, 2012; Jickling, 1992; Kaya & Tomal, 2011; Kaya, 2012; Kopnina, 2014; Laurie et al., 2016; Tanrıverdi, 2009; Teksöz, 2014; UNESCO, 2005; Vare & Scott, 2007; Venkataraman, 2009). In addition, it is seen that a large number of applied studies are carried out in which knowledge, attitudes, perceptions, opinions and evaluations of teacher candidates, teachers, academicians and managers about "education for sustainable development"

are taken (Birdsal, 2013; Borg et al., 2014; Cheong, 2005; Cross, 1998; Derman & Hacıeminoğlu, 2017; Er-Nas & Şenel-Çoruhlu, 2017; Gökmen et al., 2017; Kılınç & Aydın, 2013; Nikel, 2007; Qablan, 2005; Quablan et al., 2009; Sağdıç & Şahin, 2015; Summers & Childs, 2007; Tamkan, 2008; Tuncer, 2008; Tuncer et al., 2006; Türer, 2010; Zachariou & Kadji-Beltran, 2009). Hence, it can be said that more theoretical studies and applied research for adults are carried out within the scope of "education for sustainable development" both internationally and nationally (Demir & Atasoy, 2021). In addition, in recent years, it has been seen that within the scope of "education for sustainable development", a number of practical studies have been carried out in which children's knowledge, perceptions, attitudes, opinions, behaviors regarding sustainable development are taken at both international and national levels (Berglund et al., 2014; Demir & Atasoy, 2021; Olsson et al., 2016; Michalos et al., 2012; Petersen & Alkış, 2009; Spiteri 2018; Walshe, 2008). In these studies, various recommendations on how the education process should be carried out within the scope of "education for sustainable development" have been included. In addition, some practical studies have also been carried out on how to bring the objectives and behaviours included within the scope of "education for sustainable development", albeit in limited numbers, to students with an educational model in the educational process. In other words, there are various studies designed with experimental methods to teach students the goals and behaviours that are intended to be gained within the scope of "education for sustainable development" by different teaching methods such as drama (Erdoğan & Tuncer, 2009; McNaughton, 2004; Feriver, 2010; Keleş, 2007).

However, no study has been found in which the importance of scientific field trips is discussed through examples within the scope "education for sustainable development". Hence, in this study, the importance of scientific field trips within the scope of "education for sustainable development" has been discussed through the examples. Accordingly, the location, importance and effectiveness of scientific field trips in terms of environmental, economic and social goals of sustainable development have been evaluated together with the examples. It is worth clarifying the concepts of "scientific field trips" and "education for sustainable development" before discussing the importance of scientific field trips within the scope "education for sustainable development".

SCIENTIFIC FIELD TRIPS

Garipağaoğlu (2001, p. 14) defines scientific field trips as observing the places where the events occured and continued in person, making on-site assessments and detecting the correlations between events. Meydan (2009), on the other hand, considers scientific field trips as trips covering

activities such as research, examination and investigation organized by the school administration for educational purposes during the educational process. Güngörgör (2002, p. 17) defines scientific field trips as all activities related to the trip organized by the school in order to realize their educational objectives, whereas Atayer and Tozkoparan (2016) define it as a method that allows students to study and understands facts, tools, events, objects and people that cannot be brought into the classroom in real life within a pre-prepared plan.

Alkış (2008), on the other hand, defines scientific field trips as activities organized by the school in order to see any place or the results of an event/event that took place/occured in that place or to see the physical and human characteristics of that place and to examine them directly in their real environment in line with the achievements in the curriculum. Based on these definitions, planned and scheduled trips to out-of-school environments such as the school's immediate surroundings, archaeological excavation sites, workshops, museum-cities, official apartments, exhibitions, historical sites, historical buildings, in accordance with the main objectives and achievements of the course can be considered as scientific field trips (Demir, 2021).

Selanik-Ay (2010) states that trips to various institutions with students are important in terms of developing of students' observation skills and establishing a connection between course subjects and daily life. With these trips, students can be directly or indirectly awarded many skills such as especially research, environmental literacy, geography literacy, critical thinking, empathy, entrepreneurship, observation, map literacy, communication, review, collaboration, use of evidence, decision making, location analysis, space perception, problem solving, social participation, innovative thinking. Moreover, scientific field trips are very important in terms of perception of the multidimensionality of events and realizing the dimension of the relationship between human-environment and human-space.

In the literature, It has been revealed in various researches that scientific field trips made in line with the achievements of the curriculum have many benefits for students in the educational process (Alkış, 2008; Atayeter & Tozkoparan, 2016; Aydın, 1998; Behrendt & Franklin, 2014; Çetin et al., 2010; Doğanay, 1993; Garipağaoğlu, 2001; Gazel & Yıldırım, 2014; Güngördü, 2006; Korkmaz, 2006; Mazman, 2007; Özay, 2003; Şenşekerci & Şenyurt, 2013; Tozkoparan, 2013).

The benefits of scientific field trips can be listed as follows:

✓ Scientific field trips contribute to the formation of a culture of sightseeing and travel in students.

✓ Since scientific field trips activate many sensory organs at the same time and embody many abstract concepts in the educational environment, it provides a better understanding of the subjects and achievements by the students.

✓ Scientific field trips contribute to the construction of a society that has gained awareness of historical environment and conservation.

✓ With scientific field trips, students have the opportunity to observe, research or study the materials or primary source in the natural environment by going to the location of the teaching material or primary source.

✓ Scientific field trips improve students' ability to relate to human-environment, human-nature, human-event and human-space.

✓ With scientific field trips, students have the opportunity to evaluate where the events occurred and to relate to the events.

✓ Subjects and achievements related to scientific field trips are more easily learned by students and increase the permanence of the learned knowledge.

✓ Scientific field trips improve students' environmental awareness by enabling them to better understand the natural beauties and resources in a region or country.

✓ With scientific field trips, students have the opportunity to get to know their near and distant surroundings better.

✓ Students who are constantly within the school boundaries are moving away from the classroom environment with scientific field trips and this situation provides both joy and spiritual satisfaction in the students.

✓ Scientific field trips make the educational process more meaningful and lively

However, it is known that scientific field trips have many benefits in the educational process, it is also known that there are some limitations and difficulties in carrying out these trips. Practitioners may experience some difficulties in all stages of scientific field trips, including "before application", "application phase" and "application phase". Considering the literature, it is observed that these obstacles are collected in topics such as "bureaucratic obstacles, economic difficulties, transportation difficulty, time pressure, additional responsibilities, security risk and lack of information". Certain measures must be taken to minimize such obstacles or limitations. In this context, good planning should be designed first when organizing scientific field trips. Because scientific field trips

should not be considered as an unplanned trip where only interesting things are seen and enjoyed. On the other hand, the fact that scientific field trips offer interesting experiences to students and are fun is undeniable. However, it is essential to prepare a good itinerary plan in order to achieve the gains in the curriculum and to ensure that the knowledge learned is permanent (Bozdoğan, 2007). A well-planned scientific field trip is crucial for both teachers and students. Since there is a particularly limited time, the slightest glitch may prevent planned goals or gains from being achieved. For this reason, a careful and well-prepared itinerary is needed to get the most out of scientific field trip applications (Akdağ, 2015; Atayeter & Tozkoparan, 2016; Bozdoğan, 2007) Planning in scientific field trips is usually discussed in three stages and some studies are carried out at each stage. These studies can be listed as "before application", "application phase" and "after application" (Figure 1).

1.Before Application
1.1. Start of planning and obtaining legal permissions
Consult with school officials
Consult/support relevant institutions and organizations
Oofficial permits
1.2. Organization stage
Visit to the place where it is planned to go
Preparation of itineraries and schedules
Financial matters
Transportation
Insurance regulations
Connections and permissions to parents
1.3. Preparation phase
Preparation of welding/vehicles/equipment.
Preparation and training of students, skill development.
Clothes and supplies.
Providing information/instructions to officials and assistants, sharing responsibilities
2.Application phase
2.1. Realization of scientific field trips
Going to the sightseeing place
Compliance with safety and code of conduct
Scientific field trip activities/activities
3.After Application
3.1. Studies and evaluations after scientific field trips.
Providing information/ reporting to the administration.
Classroom work such as demonstrations and projects.
Evaluation of students
Evaluation of stuff.
Forward planning

Figure 1. *Studies to Be Done for Scientific Field Trips*

EDUCATION FOR SUSTAINABLE DEVELOPMENT

It is worth mentioning the concepts of "ustainability" and "sustainable development" briefly before clarifying the concept of "education for sustainable development". Although some researchers have taken the emergence of sustainability as a concept to 18th and 19th century economists, it is generally accepted that this concept emerged in the 20th century, at a time of heightened environmental concerns (Yeni, 2014, p. 183). The concept of sustainability was first raised globally in 1972 in the report "Limits of Growth" published by the Roman Club. (Meadows et al., 1972). However, the widespread use of this concept all over the world was realized by the "Common Future" report prepared by the "World Commission on Environment and Development" (WCED) and published in 1987, also known as the Brundtland Report. The concept of "sustainability", which means "always exist", can be defined as a combination of social and economic developments and environmental concerns (De Pauw et al., 2015). This concept is not in a short period of time, but permanently, an economic growth that will not go upside down afterwards; an economy that does not cut the branch it rides and maintains the balance between development and nature; it can also be defined as a sustainable economic development in the long term based on applications that enable the use of nature without consuming it (Kışlalıoğlu & Berkıs, 1990, p. 238). The concept of sustainability brought with it the concept of "sustainable development".

The concept of sustainable development is generally defined as the development process in which the needs of the present generation can be met without taking away the opportunities to meet the needs of future generations (WCED, 1987). Ruckelshaus (1989) defines this concept as a doctrine in which economic growth and development within the broadest boundaries of ecology will be achieved through mutual interaction and preserved over time. Maurice Strong, Secretary General of the 1992 Rio World Summit, briefly defines sustainable development as development without destruction (Evren, 2016). According to another definition, sustainable development is the elimination of long-term losses for future generations as a result of the overuse of the world's scarce resources for short-term gains for economic reasons and its reshaping with a global development strategy to be developed (Demir & Çevirgen, 2006). In the Environmental Law, it refers to development and development on the basis of balancing environmental, economic and social goals that ensure that today's and future generations live in a healthy environment (As cited in Terzi, 2017, p. 5). The reflection of sustainable development (McKeown et al., 2002), which has three components: environment, society and economy, in education is conceptualized as "education for sustainable development".

"Education for sustainable development" is to establish the understanding of "sustainability" in the education system and to gain the necessary awareness and behavior to achieve environmental, social and economic balance both locally and globally (Hotinli et al., 2013, 44). "Education for sustainable development"; it helps individuals understand the relationship between environmental, economic, social and cultural needs, social solidarity between people and adopt behaviors that will maintain world balances. "Education for sustainable development" aims to raise awareness in hundreds of different areas. Solidarity, nutrition, health, new energy sources, global economy, biodiversity, waste sorting, disaster management and land degradation are just a few of them. "Education for sustainable development"; It can be considered as a concept that guides our lives in a sustainable world, seeking a balance between the environment, economy and society. "Education for sustainable development"; supports understanding, respecting, embracing different cultures, and values traditional knowledge (Kartal-Güngör, 2012, p. 27). Much more than basic knowledge of the environment, economy and society, "education for sustainable development" also covers skills, different perspectives and values. This understanding of education; it both motivates and guides people to pursue sustainable livelihoods, participate in a democratic society and live a sustainable life (McKeown et al., 2002, 16). "Education for sustainable development" requires an awareness of how the global system works and how all parts are interconnected, as well as having a deep concern about the planet's prosperity, ecosystems, culture and people. This training is crucial for people to understand that nature is part of a larger system and to examine problems holistically (Qablan, 2005, 24). As a matter of fact, the idea of sustainable development, which has been gaining importance for half a century, has gradually gained momentum towards the idea of "education for sustainable development". In this context, UNESCO's change of the "International Environmental Education Program" implemented between 1975 and 1995 to "Education for a Sustainable Future" is an example (Tanrıverdi, 2009). Moreover, in January 2005, the United Nations recognized the period between 2005 and 2014 as "Ten Years of Education for Sustainable Development" in order to raise awareness of the idea of "education for sustainable development" (Calder & Clugston, 2005, p. 7). These developments are very important in terms of emphasizing how important education is in terms of sustainable development. In other words, education has become an important argument for sustainable development (Tanrıverdi, 2009). "Education for sustainable development" is of great importance for the upbringing of individuals who are conscious and personally responsible for sustainable resource conservation (Teksöz, 2014). Undoubtedly, the most important way to solve social processes and achieve the goals of sustainable development is

through education. To ensure that every individual who has the chance to study, educate and learn for sustainable development is informed about the use of natural resources and the effectiveness of a sustainable way of life (Gökmen et al., 2017, p. 466).

Kartal-Güngör, (2012, p. 27) lists what needs to be done within the scope of "education for sustainable development" as follows:

✓ First of all, teachers who have grasped the philosophy of sustainable development and can pass it on to their students should be trained. In this context, in the short term, teachers should be given in-service trainings, and in the long term, courses related to sustainable development should be put in the programs of institutions that train teachers.

✓ Since sustainable development education requires an interdisciplinary approach, educational institutions should effectively reflect the philosophy of sustainable development into their curriculum. Concerns about the common future of humanity should be shared in curriculums and textbooks. In this context, many issues that fall into the field of sustainable development such as climate change, new energy sources, biodiversity, land degradation, water management, chemicals, disaster risk management and early warning systems should be given more space in the curriculum.

✓ Poverty reduction within the scope of "education for sustainable development" should include issues such as citizenship, peace, morality, responsibility in the local and global framework, democracy and governance, justice, security, human rights, health, gender equality, cultural diversity, rural and urban development, economy, common responsibility, environmental protection, management of natural resources, biological and visual diversity.

✓ For sustainable development, common awareness should be created in children and young people within the scope of education.

✓ In addition to systematic and critical learning, the use of creative thinking in both local and global frameworks should be encouraged and lifelong learning should be supported.

✓ Learning teaching strategies should be developed for sustainable development within the scope of education.

"Scientific field trips" can create one of the learning teaching strategies that can be used within the scope of "education for sustainable development", or even one of the most important. Because it is known that scientific field trips have many benefits for students during the education process. One of them is that the idea of observation, one of the most

fundamental and important of the scientific research method, gradually begins to settle in students. It is also necessary to add another important benefit, such as the rooting of the idea of establishing a relationship between environment and people and events (Doğanay, 1993). Therefore, the fact that scientific field trips provide an examination and evaluation of an event, fact or existence within the natural conditions in which it exists can have important consequences within the scope of "education for sustainable development".

SCIENTIFIC FIELD TRIPS WITHIN THE SCOPE OF EDUCATION FOR SUSTAINABLE DEVELOPMENT

Unfortunately, it is seen that the educational activities that are expected to be in life and society are carried out in classroom environments in a limited way and dependent on textbooks. This situation causes both teachers and students to become alienated from social experiences and to be condemned to content disconnected from dynamic public life. It is very important that the education process is supported by various activities to be carried out in out-of-school environments in order to transform these negatives into behavior by evolving into positive purposes, skills and values in individuals (Simsek & Kaymakcı, 2015). Scientific field trips, which constitute an important part of out-of-school teaching activities, stimulate students' senses such as hearing, vision and touch. This situation ensures that permanent learning occurs in students. Undoubtedly, one of the objectives of the education system is to provide permanent learning in the students who enter the system. The more permanent the system can provide learning, the more successful it is and serves its purpose. In order to ensure permanence in learning, it is necessary to appeal to the senses of the individual. The more senses enter the teaching environment, the more permanent the learning (Gazel & Yıldırım, 2014, p. 250) Therefore, it can be said that scientific field trips that appeal to many sense organs of students can be used in order to ensure that the knowledge, skills and values that are intended to be given within the scope of environmental, economic and social goals of sustainable development are permanent in the students.

Scientific Field Trips for Environmental Goals of Sustainable Development

The environmental dimension of sustainable development can be defined as maintaining what is valued or qualities in the physical environment (Sutton, 2004). The environmental dimension of sustainable development envisages a system that does not approach the environment with economic concerns (Bilgili, 2017), manages its own resources and does so without harming the environment (Evren, 2016). In its broadest definition, the environmental dimension of sustainable development includes actions that

pay attention to the characteristics of ecosystems to reinvent themselves and do not reduce biodiversity, taking into account the principles of resilience, resilience and connectivity of ecosystems that enable people to provide for their needs. The environmental dimension of sustainable development is to be careful not to compromise on the sustainability of the ecosystems that provide them while meeting the resource and service needs of current and future generations (Morelli, 2011). "An environmentally sustainable system must keep the resource foundation stable, avoid the exploitation of renewable resource systems or environmental investment functions, and consume only those that have been adequately replaced by investments from non-renewable sources. This process should include the preservation of biodiversity, atmospheric balance and other ecosystem functions that are not classified as economic resources" (Harris, 2000).

The basic principles of the environmental dimension of sustainability, which is an integral part of sustainable development, can be listed as follows (Moldan, Janousková & Hak, 2012, p. 6):

✓ To protect the integrity of ecosystems with efficient management of natural resources.

✓ Improve information for decision-making (measuring progress through indicators).

✓ Developing social and environmental interfaces (improving quality of life).

✓ Ensuring global environmental commitment (improving governance and collaboration).

✓ To pay attention to recycling.

✓ To prevent the release of hazardous and pollutants into the environment.

✓ Efficient use of non-renewable resources (substituted for renewable sources).

✓ Develop a long-term perspective (without any set time limit).

✓ To take into account feedback, to pay attention to recycling.

✓ Caring about different scales (in time and space).

✓ Being flexible (reacting to a changing situation, learning by doing)

✓ Respecting nature and biodiversity.

Education on the environmental dimension of sustainable development (Knowledgeable, 2017), which attaches importance to the objectives

of sustainable development such as climate trend, life on land, aquatic life, as well as the basic principles of ecosystems such as resilience, resilience, self-reproduction, carrying power and diversity, is requisite for a sustainable world. In this context, many topics and concepts such as raw materials and energy, water and air, flora and fauna, habitat and human settlements, health, hygiene and nutrients, emissions and wastes (Evren, 2016) should be included in the curriculum within the scope of the environmental dimension of sustainable development. Within the scope of the environmental dimension of sustainable development, it is very important for "education for sustainable development" to bring the subjects, concepts, values, goals and achievements included in the curriculum to students with a permanent approach to learning, such as a scientific field trip. Because it is possible to make sense of the education that is intended to be given within the scope of the environmental dimension of sustainable development with scientific field trips and to make this education more vivid. Moreover, in line with the basic principles and objectives of the environmental dimension of sustainable development through scientific field trips, it is possible to process the subjects, concepts, values, goals and achievements to be processed in the course by sourcing first hand. In particular, students have acquired many subjects in the classroom such as environmental ethics, ecology, environmental policies, conservation (e.g. national parks), wildlife/ wildlife, environmental change, waste/ waste management, rainforests, conservation, biodiversity, environmental degradation, endangered species, ecosystems, global climate change, desertification, human-environmental interaction, environmental protection, environmental responsibility, renewable/non-renewable resources, endangered species, water resources, recycling and pollution, theoretical knowledge containing concepts and values can be obtained by examining them in a concrete way on site. For instance, a recycling center within the scope of recycling, waste and waste management; to the city dump within the scope of pollution, degradation and environmental change; Students can be given unforgettable experiences with scientific field trips to national parks within the scope of environmental ethics, environmental policies, environmental protection and environmental responsibility.

Scientific Field Trips in Terms of Economic Goals of Sustainable Development

The economic dimension of sustainability is often defined as the protection of capital and the prevention of deterioration (Goodland, 2002, p. 2). According to this understanding, a sustainable economic system requires maintaining the manageability of government and external debt, as well as being able to produce goods and services on the basis of ongoing principles, and avoiding sectoral imbalances that harm agriculture and

industrial production (Harris, 2011). Economic dimension of sustainable development; it addresses a sustainable system that produces goods and services by preventing excessive consumption of natural resources (Evren, 2016). Therefore, awareness is important for the economic dimension of sustainable development to have the potential to deplete resources. Because they have the potential to run out of resources, sustainable development always puts renewable natural resources at the heart of the economy. It incorporates many applications such as the use of less materials in the delivery of goods and services in the economic dimension of sustainable development, the conversion of energy and materials back into raw materials, and the recycling of wastes resulting from production processes by consumers or producers (Vivien, 2008).The economic dimension of sustainability that is inseparably linked to the environmental and social dimension of sustainable development (Reddy & Thomson, 2015) should focus on the relationship between people and nature, be long-term and not intrinsically move towards an uncertain future, as well as between current and future generations, based on the normative foundations of justice between people and nature (Baumgartner & Quass, 2009, p. 2). Undoubtedly "an ideal and sustainable economy is the one that provides the highest amount of overall prosperity with minimal resource use and environmental damage. Economically, to be truly sustainable, the overall demand for natural resources must be less than nature's renewable resource supply" (As cited in Gedik, 2020, p. 211). Many applications related to the economic dimension of sustainable development, such as awareness of the potential for depletion of resources, orientation to renewable natural resources, minimizing the use of goods and services, reuse or recycling of waste resulting from production and consumption by producers or consumers, can only be brought to individuals through education. In this context, an educational approach focused on the economic dimension of sustainable development includes manufacturing and sourcing, foreign exchange and money transfer, accounting and regulation, consumption and use, labor and prosperity, technology and infrastructure, wealth and sharing (Evren, 2016), as well as many issues such as decent work and growth, responsible production and consumption, reuse of goods, recycling, waste, savings, limited resources, transportation and transportation, concept and value. This topic, concepts and values should be included in the curriculum. Especially in the curriculum, the objectives and achievements given to the economic dimension of sustainable development can be realized by providing students with the opportunity to examine them in an on-site, concrete way with scientific field trips. It is possible to say that the educational process will be more effective and meaningful if the objectives and achievements given to the economic dimension of sustainable development in the curriculum are given to students through

scientific field trips. As a matter of fact, with a scientific field trip to a factory, students can obtain permanent information about many subjects such as the production stages of a product, manufacturing and sourcing. In addition, students can be taken to a depleted mine area or oil refinery in the context of limited resources and reviews and evaluations can be made in these areas. Moreover, in the context of consumption and waste, students can be taken to a city dump within the scope of a scientific field trip and examined and evaluated by showing primary hand source regarding the impact of waste and excessive consumption in this area, as well as the losses experienced when recycling does not ocur.

Scientific Field Trips for Social Goals of Sustainable Development

Since the end of the twentieth century, discussion of socio-economic issues such as poverty, as well as social exclusion, gender inequality, democracy, participation and community empowerment have brought up the social dimension of sustainability (Wise, 2001). In this context, "the social dimension of sustainable development includes its sensitivity to society and social problems, the creation of physical, cultural and social spaces that promote social welfare, and the process of interacting with people living in these areas" (Palich & Edmonds, 2013, p. 1). In addition, the social dimension of sustainable development can be considered as combining physical space design such as infrastructures, social facilities, areas for people's participation and development with social space design (Woodcraft et al., 2011, p. 16). "The social dimension of sustainable development, defined in general as creating positive conditions in society" (Morelli, 2011, p. 3), "can be considered as a process of understanding what people need where they live, work, and create sustainable places that provide prosperity" (Woodcraft et al., 2011, p. 16).

Education on five key principles equality, diversity, commitment, quality of life, democracy and governance (McKenzie, 2004) is crucial to building a socially sustainable society. "Organization and governance, law and justice, communication and criticism, representation and negotiation, safety and compliance, dialogue and reconciliation, ethics and accountability" (Knowledgeable, 2017) as well as social capital, protection of socio-cultural characteristics, end poverty, end hunger, healthy individuals, qualified education, gender equality, sustainable cities and communities, peace, justice, multiculturalism, partnership for strong institutions and goals, concepts and values should be included in the curriculum within the scope of the social dimension of sustainable development. As in other dimensions, it is possible to bring the goals and achievements included in the curriculum within the scope of the social dimension of sustainable development to students through scientific field trips. For instance, in the context of violence against women and

social inequality, students can gain the social dimension of sustainable development through scientific field trips to women's shelters. At the same time, scientific field trips to national assemblies or non-governmental organizations in the context of democracy and social participation can also provide students with research and assessments on issues related to the social dimension of sustainable development. Again, various scientific field trips to aged care homes, child welfare institutions, backs of the city or backward areas for the social dimension of sustainable development can be arranged. With these trips, many issues such as justice, peace, hunger and end poverty can be addressed with scientific field trips, especially strong institutions, gender equality, sustainable cities and communities, multiculturalism, protection of socio-cultural characteristics, for the social dimension of sustainable development.

CONCLUSION

In this study, the importance of benefiting from scientific field trips within the scope of "education for sustainable development" is discussed together with examples. Scientific field trips, which constitute an important part of out-of-school teaching activities, stimulate students' senses such as hearing, vision, hearing and touch. This situation ensures that permanent learning occurs in students. Undoubtedly, the more permanent learning the education system can provide, the more successful it is and serves its purpose. In this context, it is possible to say that the education planned to be given within the scope of "education for sustainable development" with scientific field trips will be more successful and suitable for its purpose. As a matter of fact, with scientific field trips, many skills related to the environmental, economic and social dimension of sustainable development such as research, study, problem solving, innovative thinking, critical thinking, environmental literacy, empathy, entrepreneurship, observation, communication, cooperation, evidence use, decision making, perception of space, social participation can be directly or indirectly introduced to students. In order to ensure that many goals, objectives, principles, knowledge, skills and values that are intended to be given within the scope of environmental, economic and social goals of sustainable development are permanent in students, scientific field trips can be considered as a teaching model. For instance, a recycling center for issues such as recycling, waste and waste management within the scope of the environmental dimension of sustainable development; to the city dump for issues such as pollution, degradation and environmental change; Permanent learning can be provided by providing students with unforgettable experiences with scientific field trips to national parks for issues such as environmental ethics, environmental policies, environmental protection and environmental responsibility.

In particular, issues such as the resilience of ecosystems, emissions and waste, resilience, flora and fauna, habitat and human settlements, raw materials and energy, hygiene and nutrients, climate trends, life on land, self-reproduction, health, water and air, aquaculture, carrying power and diversity can be effectively and meaningfully introduced to students through scientific field trips within the scope of the environmental dimension of sustainable development. Undoubtedly such an education is essential for the environmental dimension of sustainable development.

An educational approach focused on the economic dimension of sustainable development through scientific field trips will undoubtedly have many positive repercussions for sustainable development in terms of education In particular, many subjects such as labor and prosperity, recycling, manufacturing and sourcing, decent work and growth, waste, foreign exchange and money transfers, limited resources, reuse of goods, accounting and regulation, wealth and sharing, responsible production and consumption, savings, transportation and transportation, technology and infrastructure, consumption and use can be brought to students with scientific field trips. As a matter of fact, many subjects, gains and goals can be directly or indirectly awarded to students within the scope of the economic dimension of sustainable development through scientific field trips to a factory, city dump, recycling center, depleted mine site or oil refinery.

Many topics such as justice, commitment, peace, diversity, multiculturalism, democracy, dialogue and reconciliation, safety and cohesion, equality, ethics and accountability, strong institutions, partnership for goals, communication and criticism, violence against women, law and justice, qualified education, organization and management, healthy individuals, social capital, protection of socio-cultural characteristics, sustainable cities and communities, representation and negotiation, social inequality, gender equality, quality of life, end of hunger, end poverty and governance can be brought to students with scientific field trips. In this context, various scientific field trips can be organized to national councils, non-governmental organizations, women's shelters, child welfare institutions, aged care homes, backs of the city or backward areas for the social dimension of sustainable development.

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