The Effect of Simulation- Supported Environmental Education on the Environmental Success of Teacher Candidates

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Abstract: The aim of this study is to determine the effect of simulation-supported environmental education on the environmental success of teacher candidates and to reveal the views of teacher candidates on the simulation-supported environmental education process. The study group consists of 56 teacher candidates studying in the 3rd grade of Trakya University Faculty of Education, Science Education Department in the 2017-2018 academic year. A semi-structured interview form was used as a data collection tool in the research. Content analysis was applied to analyze the data of the qualitative study. As a result of the research, it was determined that simulation-supported environmental education significantly increased the environmental success level of pre-service science teachers. Most of the pre-service teachers stated that they felt positive emotions after the simulation, learned about the environment, and wanted to act for a better environment. Some of them stated that the inadequacy of the economic conditions and the non-environmental policies of the countries constitute an obstacle to taking action. According to the results of the research, it was found useful to use environmental simulation applications to increase the success levels of individuals towards the environment.

Key Words: Environmental Education, Simulation, Environmental Success, Pre-service Teachers

Simülasyon Destekli Çevre Eğitiminin Öğretmen Adaylarının Çevresel Başarısına Etkisi

Özet: Bu çalışmanın amacı simülasyon destekli çevre eğitiminin öğretmen adaylarının çevreye yönelik başarıları üzerindeki etkisini belirlemek ve öğretmen adaylarının simülasyon destekli çevre eğitimi sürecine ilişkin görüşlerini açığa çıkarmaktır. Çalışma grubunu 2017-2018 öğretim yılı Trakya Üniversitesi Eğitim Fakültesi Fen Bilimleri Öğretmenliği bölümü 3. sınıfta öğrenim görmekte olan 56 öğretmen adayı oluşturmaktadır. Araştırmada veri toplama aracı olarak yarı yapılandırılmış görüşme formu kullanılmıştır. Nitel verilerin analizi için ise içerik analizi uygulanmıştır. Araştırma sonucunda simülasyon destekli çevre eğitiminin fen bilimleri öğretmen adaylarının çevreye yönelik başarı düzeylerini anlamlı ölçüde artırdığı tespit edilmiştir. Öğretmen adaylarının çoğu simülasyonun ardından olumlu duygular hissettiklerini, çevreye yönelik bilgi edindiklerini, daha iyi bir çevre için harekete geçme isteği duyduklarını dile getirmişlerdir. Bir kısmı ise ekonomik şartların yetersizliğinin ve ülkelerin çevreci olmayan politikalarının harekete geçmek için engel teşkil ettiğini belirtmişlerdir. Araştırma sonucuna göre bireylerde çevreye yönelik başarı düzeylerini artırmak için çevresel simülasyon uygulamalarından yararlanılabilir.

Anahtar Kelimeler: Çevre Eğitimi, Simülasyon, Çevresel Başarı, Öğretmen Adayları

1. INTRODUCTION

While living things need nature to sustain their generation, nature must provide a continuity of balance between living things to provide the resources that can meet these needs. The human-environment relationship that has been going on since the existence has been moved to different dimensions because of human beings, who have prevailed in living things other than their own, in shaping their environment according to their own conditions (Şenyurt et al., 2011; Özcan, 2016). In parallel with the rapidly increasing population of human beings, their needs have increased. This has led to selfish consumption of environmental resources and destruction of the environment. It is known that nature has the capacity to renew itself. However, the fact that human beings think that natural resources are unlimited, use these resources unconsciously, and increase their consumption without allowing nature to renew itself have created environmental problems. These problems are an observable result of people's environmental behaviour.

Although environmental problems occur regionally, they reach the global dimension and affect all living and inanimate beings. Environmental problems negatively affect the quality of life of both the current and future generations. The basis of these problems is the unconscious behaviour of people towards the environment. It is difficult to observe

behaviours towards protecting and improving the environment from an individual who is not environmentally conscious and has negative attitudes towards the environment. Therefore, eliminating unconscious human behaviour is the first step to resolve these problems. Environmental education is the most effective way to raise awareness of individuals and provide behaviour change in individuals (Ertürk, 1979).

The concept of environmental education was defined by Stapp (1969) as "the process of creating a motivated citizen who has knowledge about the bio-physical environment and environmental problems and has the ability to solve these problems". This definition has formed the basis for scientific research conducted after 1969 and has been developed by researchers and reached today. The widely accepted definition of environmental education was developed at the Tbilisi Conference in 1977 with the support of UNESCO. According to the new definition, environmental education is “activities that increase the knowledge and awareness of the society about the environment and environmental problems, develop high-level skills in problem solving, make and implement appropriate decisions, and support taking responsibility (UNESCO, 1978). The main purpose of environmental education is to raise a conscious human model who can keep personal consumption in line with needs, is conscious of consumption, is aware of environmental problems, and feels responsibility towards future generations and nature (Kurgun et al., 2003).

To raise and guide individuals who are environmentally conscious, there is a need for teachers who internalize environmental awareness and adapt it to their life, who have a positive attitude towards the environment and who can be a role model for their students with their positive behaviour towards the environment. The acquisition of these qualifications for teacher candidates is directly proportional to providing an effective environmental education in education faculties (Büyükkaynak and Aslan, 2019). The first aim of environmental education, which is a compulsory course in teacher training programs, is to provide pre-service teachers to comprehend the complex relationships between environment and sustainable development and to raise awareness about the negative effects of economic growth plans on the environment. The second aim is to strengthen the value judgments towards the environment in order to carry out environmental education efficiently and effectively. At the same time, in order to improve the environment, it is to train active teachers who have knowledge about environmental problems that may arise due to socio-cultural developments and the solutions to these problems. Finally, it is to provide teachers with the confidence to understand the necessity of environmental education and to include new practices in environmental education (Özdemir, 2003).

Given the environmental problems that increase its impact day by day, it is clear that theoretical lessons on environmental education are currently insufficient to provide the desired results in educational institutions. Therefore, there is a need to support theoretical education with different applications. Various applications should be utilized in which students can get rid of traditional methods and feel themselves as part of the learning process, be active throughout the process, positively affect their motivation, and develop their scientific thinking skills and creativity. For an effective and functional environmental education, materials that will add visual and auditory richness, different teaching methods and techniques should be used to keep the students' interest in the lesson alive and to make the lesson dynamic and fun. Educational technology tools can be used to make the learning-teaching process interesting, to activate more than one sense organ at the same time, and to make meaningful and permanent learning (Aslan Efe, 2015). While educational technologies allow students to learn at their own pace, they also affect students' motivation positively (Chae et al. , 2014). The performance satisfaction of the teacher will be at higher levels by making the learning process enjoyable and providing effective, permanent, and fast learning as an output of the process (Hashim and Mustapha, 2004).

Simulations, which are one of the educational technology tools, are defined as a controlled representation of real-life events or imitation of real situations (Ateş et al., 2009). In this way, the student has the opportunity to learn by imitating a situation or event, making it similar to real life, and learning by doing living (İpek, 2001). In the simulation programs, an increase in the sense of responsibility and self-confidence can be achieved by the student taking an active role in the teaching environment (Şen, 2001). By including simulation applications in the learning-teaching process, students can change the variables of any situation or event. Thanks to this opportunity, students' interest in the process and their ability to explore are increased. Thanks to simulations, the results of events that can take a long time to be observed can be observed in a much shorter time. Simulation applications can be included in the simplification of a complex system,

in examining costly and dangerous situations (Altın, 1994).

Simulations can quickly increase the student's capacity to understand a mechanism, situation, and event. Compared with learning with simulation learning life experience, it is seen that it has a great advantage in terms of time allocated for learning. Since the learner examines the event in depth and participates in the process, simulation applications allow the learner to show his performance (Siddiqui et al., 2007). Thanks to the simulation applications, a long-term experimental study, which cannot be examined in the classroom environment, can be observed step by step from the start to the end. The stages of a decision can be evaluated without experiencing (Ateş et al., 2009).

According to Akpınar (1999), the advantages of simulations can be listed as follows:

• It provides imitation of cases that are dangerous or take a long time to be examined in real life and allows learners to experiment and examine them.

• It makes situations and events that are complex to understand simpler.

• It saves time and cost.

• It minimizes the details about the subject first and then gradually increases the intensity of these details systematically and provides the examination of the case.

• It allows the student to change the variables of the event and to observe the results of this change on the graphs instantly.

According to Perkins et al. (2006), an accurate simulation enables students to increase their level of success. Therefore, abstract concepts can be learned well without direct experience by using an effective simulation. Sönmez (2006) stated that the simulations provided the opportunity to reinforce the right behaviours and correct the wrong behaviours, thanks to the feedbacks given after each step. The creation of knowledge in teaching with simulation depends entirely on the learner, because simulation is carried out by the learner by examining from different angles, thinking, making decisions and taking certain steps (Akpınar, 1999). Simulation applications can be used to provide new information to the student as well as to make permanent learning by enabling the student to associate and make sense of the new information acquired with the existing information and transfer it to long-term memory (Yiğit, 2007). In this context, it is thought that the use of simulation applications in environmental education will be functional and effective. From this point of view, in this study, the effect of simulation-supported environmental education on the success levels of science teacher candidates towards the environment and their views on environmental education were examined.

2. MATERIAL AND METHODS

2.1. Research Design

The aim of this study is to determine the success of simulation-supported environmental education on the environment and to reveal the opinions of the teacher candidates about the simulation-supported environmental education process. The study, in which the semi-structured research method was used, consists of the data of the "Interview Form" used to determine the views of the pre-service teachers on the simulation-supported environmental education process and the analysis of these data.

2.2. Study Group

While sampling of the study group, suitable sampling method, which is not random, is preferred. The reason for this choice is to prevent the loss of time, money, and workforce during the research process and to ensure that researchers do not have problems in terms of transportation and leave. Trakya University Faculty of Education, Department of Science Education, 3rd class teacher candidates in Edirne city center is the working group of this research. There is a total of 56 teacher candidates in the study group. The reason for this is that 3rd grade prospective science teachers have not taken the environmental education course yet but are ready to take it. Participants in the 3rd grade of science teaching did not take the environmental science course in their previous grades. Because VII of the science teaching program. It is a 2 credit course taught in the second semester. In addition, it is thought that environmental education supported by simulation applications will bring a different perspective to prospective teachers in the digitalized education age.

2.3. Application Process of Simulation Supported Environmental Education

“World Climate Simulation” was used in the research. World Climate Simulation is based on the implementation of a similar copy of the United Nations climate change negotiations for smaller groups. The purpose of this simulation is to create awareness of climate change and enable people to experience the dynamics that have arisen in UN climate negotiations. The application is framed by current science of climate change using interactive C-ROADS computer simulation, which allows participants to observe how their proposed policies

affect the global climate system in real time. The interactive computer simulation application called C-ROADS has been used at senior government, company and NGO levels and by those who participate in or monitor UNFCCC negotiations. It has been stated that through interactive simulators such as C-ROADS, policymakers and the public can explore the risks and dynamics of climate change and help build a common understanding of the options faced, based on the best available science (Sterman et al., 2012).

Prospective teachers were asked to prefer more formal clothes for this application. Prospective teachers were divided into 6 different groups. One representative from each group was selected and asked to randomly choose one of the 6 different country groups (the United States, the European Union, Other Developed Countries, Developing Countries, China, and India) in the bag. As a result, the United States, the European Union, Other Developed Countries, Developing Countries, China, and India sat at tables with their own flags. In order to reflect the difference of economic income levels, a different number of dollars was left on each table in proportion to their budgets. Up-to-date information on CO_2 emissions was shared and possible consequences of this way were discussed. The painting to be lived due to the rise of the sea level has been exposed in a more concrete way by using the address http://flood.firetree.net/. Using the Earth Viewer application, the global temperature increase and its change over time were examined. The purpose of the Earth Viewer application is to include sea level maps for the last 21,000 years and 8,000 years later, global temperature maps for the last 100 years, game modes and animations in line with the content of the study. With this feature of the Earth Viewer application, numerical data has been transformed into visuals and made more understandable. After the presentation of the program to be implemented, the targets were explained to the groups and they were asked to keep the expected global temperature increase at +2 degrees and to develop policies accordingly. The groups started researching and creating road maps. Suggestion forms have been filled. The pre-service teachers reflected the data they created with the Pathways application they downloaded on their smartphones to the future.

2.4. Data Collection Tools

An interview form was developed by the researcher in order to determine the opinions and experiences of the science teacher candidates, who constitute the sample of the study, regarding the application process. The interview form prepared as 4 question items was evaluated by taking expert opinion. As a result of the evaluations, it was decided that the re-edited form was appropriate. The questions in the form are as follows:

• How did the simulation application make you feel?

• What did you learn during the simulation application?

• How would you use what you learned? What would you like to do with what you learned?

• What are the situations (s) that will prevent you from taking action to improve the environment?

2.5. Data Collection and Analysis

In the study, content analysis was applied to the qualitative data obtained from the participants. Before starting the interviews, the researchers explained to the participants that the audio recording of the interview would be taken and the purpose of using these recordings, and their permission was obtained. In the next step, the questions in the interview form were directed to the participant in order. In line with the feedback received from the participants, drilling questions were asked when necessary, the answers were deepened, clarified and the process was managed. In cases where short answers were given by the participant, the researcher asked, “Is there anything else you would like to add?” It was tried to obtain more detailed information by asking the question. Each of the interviews lasted approximately 30 minutes. Voice recordings were taken using the telephone, then uploaded to the computer environment, processed in "sound speed reduction" programs and made ready for analysis. During the interviews, the participants were addressed by their names, but during the deciphering of the voice recordings, different codes were given to each participant, keeping their identity confidential. These code names were also used during the analysis of the data. During the interview, importance was given to creating a safe environment where teacher candidates could express themselves comfortably. Then, the common aspects between the codes were determined and categories were created. Finally, the themes, which are a more general topic, were revealed by combining the relevant categories. Pre-service teachers' opinions were examined in 4

different themes and 8 different categories. The frequency values of each statement given by the pre-service teachers were calculated.

3. FINDINGS

C-ROADS computer simulation was used in the World Climate Simulation study. Through the C-ROADS simulator, the participants sought to build a shared understanding of the options faced by science and through which the public could explore the risks and dynamics of climate change. Participants were divided into 6 groups, namely the United States, the European Union, Other Developed Countries, Developing Countries, China and India, reflecting the difference in economic income levels. Thus, current information on CO2 emissions was shared and the possible consequences of the trend were discussed. With the Earth Viewer application, the global temperature increase and its change over time were examined. Participant groups representing different countries were asked to keep the global temperature rise at +2 degrees and develop policies for this. The pre-service teachers projected the data they created with the help of the Pathways application they downloaded to their smartphones into the future as in Figure 1 and Figure 2.

Figure 1: Pathways Application Login

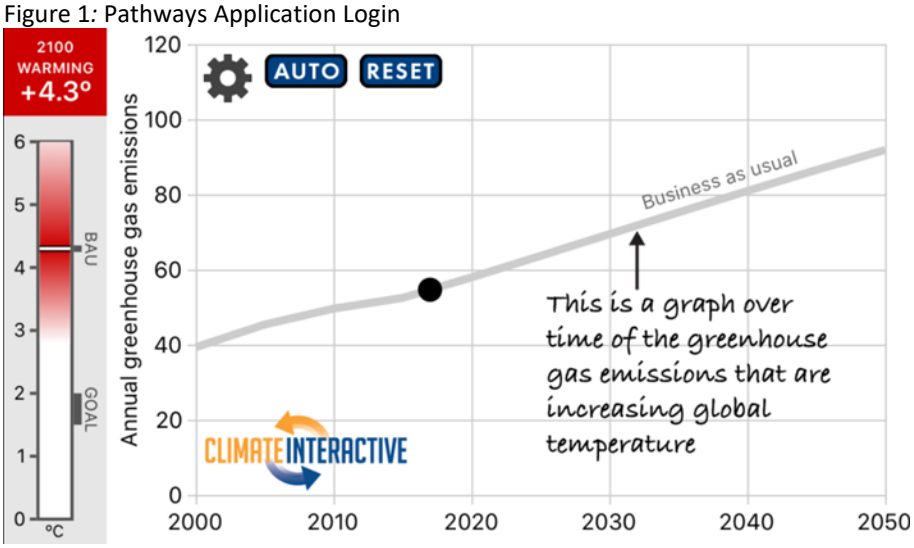
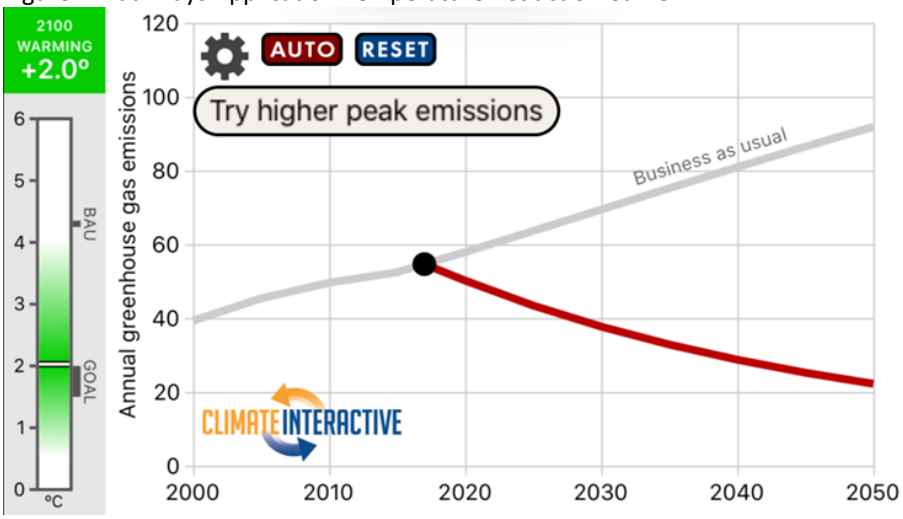


Figure 2: Pathways Application Temperature Reduction Curve



The characteristics of the countries they belong to, how they can guide the climate process issue and how they interact with which countries were discussed among the participants. Two representatives from each group took turns to present the results and practices, shared information and promised sustainability. The data obtained by the participants were processed into the C-ROADS simulation by the facilitator and the effect of these practices on the current temperature

increase was examined. If the current situation continues, the temperature curve will be +4.5 degrees Celsius as seen in Figure 3. However, as seen in the simulation environment, it has been reduced to 2.4 degrees Celsius in Figure 4, thanks to the environmental policies to be implemented by the countries.

Figure 3: C-ROADS Initial Temperature Curve

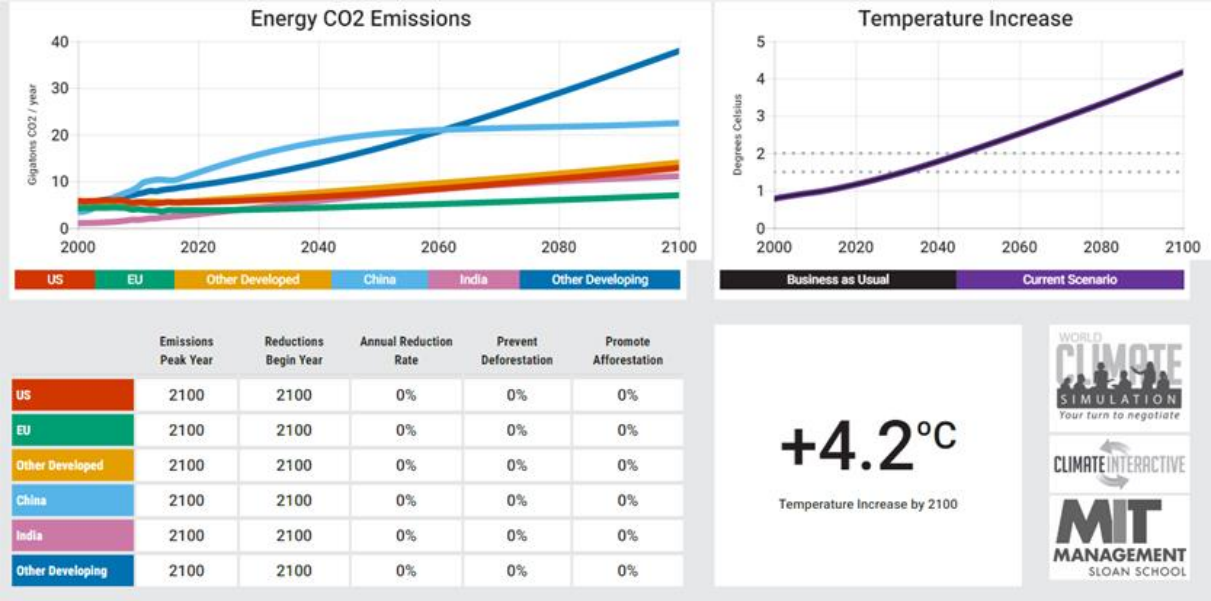
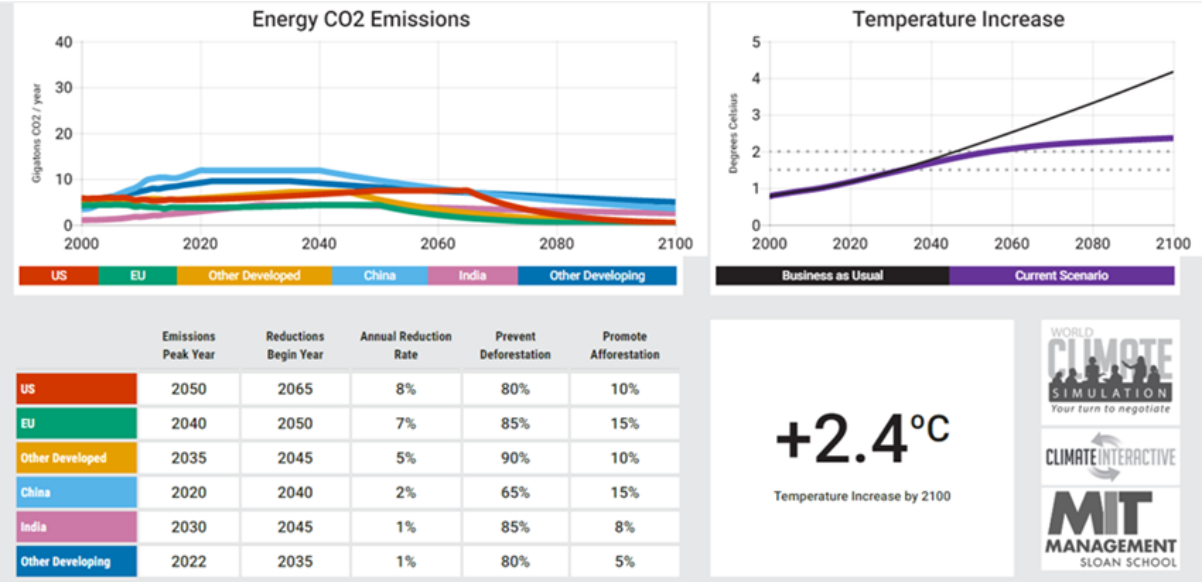


Figure 4: C-ROADS Resulting Temperature Curve



After discussing the results, the cuvette diagram for carbon dioxide emissions is explained. The idea was that the best was possible, but the goal would be achieved only if acting together. As a result of the simulation application, the opinions of the teacher candidates about the process were taken.

At the end of the application process, the opinions of the participants regarding the simulation assisted environmental education process were tried to be determined through the form of specifying opinions from teacher candidates. The answers of teacher candidates are analysed and presented in Table 1.

When the Table 1 is examined, the opinions of teacher candidates on C-ROADS simulation application are discussed in 8 different themes. The pre-service teachers who felt positive emotions after the simulation application frequently stated that they felt “happy” and “accomplished”. In pre-service teachers who felt negative emotions, it was observed that these emotions were coded as

"anxiety". With the simulation application, teacher candidates both learned new information and made inferences in the light of this information. The majority of teacher candidates stated that they learned the factors that increase CO_2 emissions and how they can reduce CO_2 emissions. On the other hand, the inference of prospective teachers is that international agreements are important in environmental targets and that we should act together. According to this majority, when CO2 emissions are controlled, people will achieve the result they want to have. The changes they want to realize in the light of the information they have acquired with the simulation application are handled under two themes, individually and socially. Pre-service teachers stated that they aim to keep their carbon footprints to a minimum in terms of individual and they want to raise awareness of individuals in their close circle, especially their students. Considering that individual changes will affect the society, they stated that decisions should be taken to reduce CO_2 emissions from a social perspective. While most of the teachers did not see an obstacle to accomplish what they wanted to do, some stated that factors such as economic inadequacies and selfishness of individuals and societies constitute an obstacle.

Table 1: Opinion Form Data

Theme	Category	Code	Frequency
Feelings / emotions after simulation practice	Positive Emotions	I feel happy	29
		I feel successful	17
		I feel hopeful	13
		I feel responsible	12
		I feel knowledgeable	12
		I feel aware	10
		I feel excited to act	8
		I feel confident	6
		I feel fun.	3
	Negative Emotions	I feel anxious.	6
		I feel hopeless.	3
		I feel sad.	2
		I feel guilty.	2
Contributions of the simulation application	Learning	I learned the economic situation of countries.	6
		I learned the relations of countries with each other.	7
		I learned the hazard dimension of CO_2 emissions.	28
		I learned the factors that increase CO_2 emissions.	31
		I learned how we can reduce CO_2 emissions.	35
		I learned the effects of country policies on the environment.	22
	Implication	I think international agreements are important and they should act together.	48
		A little movement can heal our planet.	27
		I think it is in our hands to control CO_2 emissions.	39
		I think we should act without wasting time.	21
What you want to do with what you learn	As an Individual	I will keep my carbon footprint to a minimum.	46
		I will raise the awareness of the people around me, especially my students.	45
		I want to carry out projects for the improvement of our environment.	9
		I will change my eating habits.	2
		I will continue to improve myself in this regard.	15
	As a Society	Decisions should be taken to reduce CO_2 emissions.	49
		Fossil fuel consumption should be reduced.	26
		Our forests should be protected and planted trees.	24
		Public transport research should be used.	16
		Recycling should become widespread.	16
	Yes	Economic conditions do not allow.	12
		Unconscious behaviour of people.	6

Is there a situation that will prevent you from acting?	Selfish policies of countries.	6
No	No obstacles.	40

4. CONCLUSIONS AND DISCUSSION

Educational technology tools, which are frequently used in educational environments in recent years, have brought a different dimension to the education-training process. Computers and various educational computer programs, which are the leading tools of these tools, provide convenience for teachers and students. Thanks to educational technology tools, materials for different levels and fields can be prepared and applied.

Among the educational technology tools, the use of simulation applications created with interactive multimedia technologies in environmental education are the applications that enable the recognition and comprehension of ecological relationships, reveal the consequences of an environmental problem in the future, and thus provide permanent learning, at the same time. In terms of these features, simulation applications can be effective in increasing student success.

The use of simulation in the educational process carried out within the scope of the research had an impact on the creativity of students by using their imaginations. Through these elements, the opportunity to witness events that are difficult to observe temporally and spatially was reached. It is also thought to be effective in easier understanding of complex ecological relationships and environmental problems. Thus, it is thought that there is an increase in academic achievement. The findings obtained from the research show that the effect of simulation applications on student achievement is compatible with the results obtained from other studies Lee and Hwan, 2015; Köklü, 2015; Gömez et al., 2011). The results of a few of the studies done with simulations are discussed here. Hegarty (2004) stated that with the use of simulation, students take an active role in the learning process and can adjust their learning speeds according to themselves without time limitation. Tambade and Wagh (2011) stated that interactive computer simulations and animations are an effective way for students to focus and understand the subject. It has been determined that these practices increase the learning levels of students. Akkağıt and Tekin (2012) stated that simulation-based teaching has a positive effect on students' academic success in basic electronics and measurement lessons. Ersoy and Dilber (2014) and Pfefferová (2015) determined that simulation applications increase the success rate of students. Kukkonen et al. (2014) found that simulation applications help students better understand the facts and enrich the content they use in their studies in which they investigated the effectiveness of simulation-based teaching in greenhouse effect modelling. Akkağıt (2014) states in her master's thesis titled " The Effect of Web-Based Teaching Using Simulation and Animation on the Achievement of the Ninth Grade Students in the Electricity and Magnetism Unit" that web-based education supported by simulation and animations is more effective than teacher-centered methods in increasing student success. Lee and Hwan (2015) found that using the simulation program developed by them as lesson material provides an increase in students' achievements. Pfefferová (2015) concludes that simulations have a positive effect on students' level of knowledge. Koçer (2015) and Köklü (2015) found that the use of simulation applications in physics education increases students' motivation, attracts attention, and makes it easier for students to understand the subject. Jaakkola and Veermans (2015) concluded that simulation applications facilitate students' conceptual understanding and improve learning process by reducing learning time. Konak (2019) concluded that simulation-supported teaching has a positive and significant effect on students' ability to establish hypotheses from scientific process skills.

Another result of the research was obtained from the pre-service teachers' views on the simulation-supported environmental education process. By examining these views, prospective teachers stated that they obtained new information on the subject and wanted to integrate their experiences and learned. They stated that they wanted to take steps to reduce their carbon footprints and learned how to do this. This may be due to the fact that the simulation application provided the prospective teachers with the opportunity to test their decisions and to observe their results in a short time. Prospective teachers made inferences about the causes and consequences of environmental problems with the information they obtained. By analyzing why environmental problems occur, they have produced ideas on what can be done for the solutions of the same problems. From this point of view, it can be said that simulation applications encourage pre-service teachers to use scientific thinking and creativity skills as well as increase their

environmental success. This may be due to pre-service teachers observing how environmental problems threaten our planet and disaster scenarios that may occur if action is not taken. These scenarios may have evoked the urge to act on pre-service teachers and take remedial actions for the environment. Some of the pre-service teachers felt anxious at the end of the application process may have been aware of the seriousness of environmental problems and the unconscious behavior of people at the basis of these problems. The majority of prospective teachers expressed that they felt happy and successful at the end of the application process. The reason for this is that they have managed to stop or even reduce the temperature increase with the projects they have developed by applying environmentally friendly policies, and they have made small but important changes during the simulation application.

As a result, it can be said that simulation-supported environmental education is effective in increasing the environmental success of science teacher candidates. It can be said that the simulation application is effective in keeping the attention of teacher candidates alive, and it provides active learning opportunities with the participation of teacher candidates in the learning process. Thanks to simulations, it is possible to learn abstract concepts that are difficult for students to visualize in their minds. It is possible to perform dangerous and costly experiments safely and economically, to experience situations and phenomena that occur in different geographies, and to revive events that can be observed as a result of long periods of time. In the light of these results, a more effective and productive training process can be achieved by including simulation applications in different fields and different age groups. Teachers should be encouraged to use simulations in learning environments.

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