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Determining the opinions of science teachers on the concept of sustainable development through educational games

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Abstract

Since the concept of sustainability is linked to the problems of daily life, educational games are an important tool to teach this concept and to reveal perceptions about this concept. This study aims to determine science teachers' views on the concept of sustainable development through educational games. This study is a phenomenological study. The study group of this study consists of 37 science teachers. In the research, five semi-structured interview questions prepared by the researchers were used as data collection tool. When the results obtained from the research were examined, it was found that teachers associated the concept of sustainable development less with the words environment and next generation rather than other words. Teachers explained the main idea of the game around the themes of society, environment and economy. In addition, teachers stated that the game process affects them in terms of knowledge, attitudes and values, behavior about sustainable resources. Most of the teachers stated that they will play the game differently after they learn what the cards and resources in the game mean. Teachers mostly explained that they would try not to consume resources and would protect non-renewable resources. Finally, after the game, the teachers classified the countries in today's world into three categories as developed countries, developing countries and underdeveloped countries.

Keywords: Sustainable development; educational games; teacher

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1. Introduction

After When humans started to populate the earth, they began exploiting the nature to meet rudimentary needs such as food, shelter and security. In those days, despite human beings exploiting nature, nature was able to replenish what it lost to human appetite and renew itself one way or another. However, that is no longer the case today. Unfortunately, nature can no longer find the opportunity to recover due to rapid population growth, increasing needs of humanity, and excessive consumption (Önder &

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Güven Yıldırım, 2021). Due to the ever-increasing world population, over-consumption of natural resources, reckless environmental pollution, and people's consumption-oriented lifestyles, the power of science and technology will not be enough to prevent the irreparable damage to the environment, and the hunger and poverty that threatens much of the world. It can be assumed that the developed countries play a major role large in this trend. This is because industrialized countries consume not only their own resources but also the resources of developing and underdeveloped countries to amass more wealth. The fact that almost all societies, especially industrialized countries, have become so consumer-oriented threatens natural habitats and the lives of beings that inhabit those habitats (Keleş, 2007). However, nature will still be around to accommodate future generations, as it did past generations hundreds of years ago. And that is where the concept of sustainable development enters the picture. The term sustainable development has been used since the 1970s to express the desired balance between the economy, society, and the environment (Keleş & Hamamcı, 2005). Sustainable development means meeting the current needs of humanity without jeopardising the ability of future generations to meet their own needs (United Nations General Assembly, 1987). In other words, the concept of sustainable development rests on two pillars, meeting the needs of present and future generations, taking into account the basic needs and the capacity of nature to restore itself (Conca & Geoffrey, 2004). Sustainable development posits the urgency of protecting natural resources so that future generations can live as healthily and happy as we do (Jardins, 2006). The basic tenet of sustainable development is to protect natural resources and to give nature the time it needs for self-renewal (Ergün & Çobanoğlu, 2012). Stimulating growth, improving the quality of growth, ensuring sustainable population levels, protecting and expanding resources, reorienting technology and managing risk, combining the natural world and the economy in decision making are cited as the main objectives of sustainable development (Keleş, Metin & Sancak, 2005). Sustainable development has three dimensions: environmental, economic and social (Strange & Bayley, 2008).

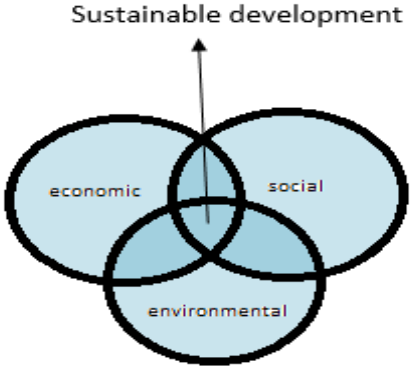

Figure 1. Dimensions of sustainable development

As shown in Figure 1, the environmental dimension of sustainable development refers to the careful and conscious use of natural resources, the use of renewable energy resources, the preservation of biodiversity and the balance of the ecosystem, and recycling. Its economic dimension refers to the realization of production and consumption

in harmony with nature, the development of eco-design technologies compatible with nature and the environment, the introduction of a green economy, the development of regional and local markets. Finally, its social dimension refers to gender equality, social justice, welfare, health, education, participation in policy and decision-making processes, respecting future generations (Holmberg & Sandbrook, 1992; Strange & Bayley, 2008). The success of sustainable development is achieved by conflating the environmental, economic and social dimensions. By putting these three dimensions together, the goal is to enhance quality of life, achieving human equity, intergenerational equity, social welfare, self-sufficiency, protection and enhancement of natural systems, and compliance with carrying capacities (UNESCO, 2005). The concept of sustainable development is a very important approach because it treats economy, society and environment as inseparable parts of a whole and protects ethical values that put the environment at the center (Wolbring & Burke, 2013).

Since environmental problems are common problems that affect everyone, it is argued that sustainable development cannot be attributed to any discipline alone, but that different disciplines can contribute to sustainable development to varying extents. (McKeown, 2002). Education is one of these disciplines. School-based education has an important role in cultivating people's knowledge, awareness, and behavior related to the environment and sustainability (Brause & Wood, 1993). Many methods and techniques are used in the context of teaching about the environment and sustainability at schools. One of these techniques is educational games. Games are indispensable activities that occupy an important place in the lives of people as well as children and even all living things on earth, used for various purposes at all ages and making essential contributions to learning and development. (Malta, 2010). Educational games provide individuals with opportunities to learn various skills and ideas, as well as acquiring skills such as problem solving. When individuals add scientific skills and themes to a game, they make what they learn meaningful with their own imagination and positive emotions (Yawker, 1999). The learning process becomes more fun and enjoyable (Coşkun, 2012; Demir, 2012; Karamustafaoğlu & Kaya, 2013). Educational games can be used to measure how well an individual is doing in terms of mental capacity, emotional growth and skill learning (Altunay, 2004). In addition, games help individuals overcome issues in their daily lives (Shaftel, Pass & Schnabel, 2005). Since the concept of sustainability is linked to the problems of daily life, educational games are an important tool to teach this concept and to reveal perceptions about this concept. Because regardless of their status, people continue to live their lives with mounting environmental problems to face. Therefore, every individual should have the awareness of sustainable development. And it is teachers who educate people in educational institutions. Teachers have an important role in cultivating people's knowledge, awareness, and behavior related to the environment and sustainability. For teachers to successfully fulfill this role, they also should develop their own perceptions of sustainability. In this context, this study aims to determine science teachers' views on the concept of sustainable development through educational games. Accordingly, the problem statement of the study is "How do science teachers relate to the concept of sustainable development?".

2. Method

2.1. Research design

This study, which aims to determine science teachers' views on the concept of sustainable development through educational games, is a phenomenological study. Phenomenology is a qualitative research method that allows people to reveal their feelings, sensibilities, perceptions, and perspectives about a particular concept or phenomenon and determine how they experience that phenomenon (Rose, Beeby & Parker, 1995). In other words, the purpose of phenomenology is to understand the human experience (Van Manen, 2007). Understanding human experience is achieved by revealing the underlying meanings of existing perspectives through a common phenomenon. This research is about revealing teachers' perceptions, perspectives, and ideas of the phenomenon of sustainable development via pedagogical games.

2.2. Working group

Purposive sampling was used to identify who should take part in the study. Purposive sampling involves selecting individuals who can serve the purposes of the research study (Cohen, Monion & Morrison, 2007). It is also beneficial because it allows for in-depth study of cases that promise vast information (Yıldırım & Şimşek, 2008). The study group of this study consists of 37 science teachers working in different secondary schools in Ankara as of the fall semester of the academic year 2019-2020. 27 of the teachers are female and 20 are male. Their professional experience ranges from 2 to 10 years.

2.3. Data collection tool

The semi-structured interview form, developed by the researchers themselves, was the data collection tool for the study. The sustainable development interview form consists of five questions. One of these questions was applied as a word association test.

The interview questions are as follows.

1. Write the first 10 words that come to your mind when you think of sustainable development.
2. According to you, what is the main import of the game that you are playing with regards to the concept of sustainable development?
3. How did the gaming process affect you in terms of international trade and sustainable resources?
4. How would you play the game if you knew before what the cards and resources in this game meant?
5. Considering the game you are playing, discuss the situation of countries in today's world and their relations with each other.

The interview questions prepared by the researchers were presented to four faculty members in the areas of science education, biology education, and measurement and

evaluation, and necessary arrangements were made according to the suggestions. All data obtained from the interviews were recorded with a voice recorder to convert them into written text in a computer environment, after obtaining the consent of the participants. Since the teachers' own sentences are given directly in the results, each teacher was given code names such as T1, T2, T3....

2.4. Data collection process

The research was carried out with 37 science teachers working in Ankara. For the purposes of the study, the "Trade Game (Sustainable Development Variable)" was played with the teachers. The trading game was originally developed by a British charity called Christian Aid, and updated by Keleş (2007). In the research, first of all, the students were informed about educational games before playing the games. The trade game was intended to show that trade, division of labor, and competition increase production, money plays a role as a medium of exchange in this process, resources are distributed disproportionately, and organizational and entrepreneurial skills of individuals can influence the outcome of the game or the success of the individual/group. The detailed description of the game is given below.

2.4.1. Materials

7 pencils, 6 pens, 4 scissors, 3 rulers, 2 miters, 2 protractors, 7 green cardboards, 10 red paper crafts, 10 blue paper crafts, 10 green paper crafts, 3 pieces of glue, printed fake banknotes worth 5000 TL.

2.4.2. Preliminary preparations

Before the game, 4 large envelopes were taken with the necessary materials placed inside these envelopes and delivered to the groups during the game, as described below.

1. Envelope: All materials were put inside this envelope in abundance. This envelope contained 2 pencils, 2 pens, 1 scissor, 1 ruler, 1 miter, 1 protractor, 2 green cardboards, 3 red paper crafts, 3 blue paper crafts, 3 green paper crafts, 1 piece of glue, printed fake banknotes worth 1500 TL.
2. Envelope: This envelope contained fewer materials than the first one. This envelope contained 1 pencil, 1 pen, 1 scissor, 1 green cardboard, 2 red paper crafts, 2 blue paper crafts, 2 green paper crafts, printed fake banknotes worth 750 TL.
3. Envelope: This was the envelope containing the least amount of materials. This envelope contained 1 pencil, 1 pen, 1 green cardboard, 1 red paper craft, 1 blue paper craft, 1 green paper craft, printed fake banknotes worth 250 TL.
4. Envelope: This is the envelope to represent the world bank. This envelope contained all materials in abundance. This envelope contained 3 pencils, 3 pens, 2 scissors, 2 rulers, 1 miter, 1 protractor, 3 green cardboards, 4 red paper crafts, 4 blue paper crafts, 4 green paper crafts, 2 pieces of glue, printed fake banknotes worth 2500 TL.

2.4.3. Game process

Before starting the game, the teachers were divided into 3 groups, as heterogeneously as possible. Besides the teachers in the groups, one teacher was selected and assigned to represent the World Bank. Then, the first 3 envelopes were randomly distributed to the groups, one for each group. 4. The envelope was given to the student representing the World Bank. This student was told that the products made by the groups could be bought at the price he/she wanted; that he/she might choose not to buy the products he/she did not like; that he/she could buy the products that did not meet the requirements for a much cheaper price through bargaining; and he/she could change the prices for the products whenever he/she wanted. He/she was also told that he/she could sell the materials to the groups at any price he/she wanted.

After the envelopes were distributed to the teachers and each group saw the materials that came out of the envelope in their hands, shapes were drawn on the board without any directions and the teachers were asked to remake the shapes on the board using the materials that they had. A rectangle, a circle, a triangle and a parallelogram were drawn on the board. The teachers were told that the short side length of the rectangles should be 4 cm; the long side length should be 6 cm; the diameter of the circles should be 4 cm, all side lengths of the triangles should be 4 cm, and all side lengths of the parallelogram should be 5 cm. It was emphasized that the shapes should correspond to the desired dimensions. No questions were accepted from the groups and it was stated that the game time was 45 minutes long. The game was started by reminding teachers that each group should draw their own path. While the groups were discussing among themselves, commercial activities were started by putting a price on the board for each shape. The groups were allowed to interact with one another and the World Bank. The groups that didn't know what to do at first started communicating with each other and with the other groups after a while. The unequal distribution of resources among groups began all commercial activities. As game progressed, commercial activities between the groups and with the World Bank became more intense. The images for the game process are given in Figure 2. The prices of the figures on the board were increased by drawing the attention of the teachers aware to the board 5 minutes before the end of the game.

Figure 2. Pictures showing the game process

After playtime was over, all groups were reminded that playtime was over and asked to write down the materials they had left and how much money they had. Afterwards, the teachers were asked how the game and the price negotiations went, what they thought about other groups and the World Bank; and the groups were made to hold discussions with one another considering the materials and the money they had.

After the discussions ended, the teachers were told what the materials they had and the shapes they made represented. The table below (Table 1) illustrates what the materials and the shapes represent.

Table 1. What the materials and shapes in the game represent

Material/shape	**What they represent**
Green cardboard	All environmental resources
Red paper craft	Renewable energy sources
Blue paper craft	Water resources
Green paper craft	Non-renewable energy sources
Rectangle	Vehicles and machinery
Circle	Energy
Triangle	Food
Parallelogram	Culture and knowledge

Finally, after the teachers learned what the materials they had and the shapes they made represented, a discussion was started and after this stage, semi-structured interviews were held with the teachers.

2.5. Data analysis

Content analysis, one of the qualitative analysis techniques, was used to analyze the data. In the analysis of the qualitative data obtained from the research, the stages specified by Miles and Huberman (1994) and Yıldırım and Şimşek (2008) were followed. First of all, a coding key was created for the data in the form of written documents, and the expressions containing the codes were grouped according to their similarities and differences and turned into themes. After the themes were obtained, tables were created showing the themes, codes and how often students uttered codes.

3. Results

In this study, teachers were given a word association test and 4 semi-structured interview questions about the concept of sustainable development after playing the sustainable development trading game. The data pertaining to the answers given by the teachers to the word association test and semi-structured interview questions are presented in the tables below.

Firstly, a word association test was given to the teachers asking them to "write the first 10 words that come to their mind when it comes to sustainable development". The frequencies of the words produced by the teachers regarding the concept of sustainable development are given in Table 2.

Table 2. The frequencies of the words produced regarding the concept of sustainable development

Word	**Frequency (f)**
Energy	29
Energy	24
Education	24
Economy	23
Food	20
Technology	19
Society	17
Money	16
Environment	15
Future generation	12

When Table 2 is examined, it is seen that energy (f=29) is the most repeated word among the first 10 words that come to the mind of teachers when it comes to sustainable development. The teachers used the words resource (f=24) and education (f=24) similar number of times. It is also seen that teachers frequently repeated the words economy (f=23) and food (f=20). These words were followed by technology (f=19), society (f=17) and money (f=16). It is noteworthy that among the first 10 words, the words least associated with the concept of sustainable development were environment (f=15) and next generation (f=12). In addition, it was found that words such as trade, raw materials, competition, development, consumption, production, water, continuity, recycling, which are not included in the first 10 words and have a lower frequency, are also associated with the concept of sustainable development by teachers.

After the word association test, semi-structured interviews were conducted with the teachers and firstly, they were asked “According to you, what is the main import of the game that you are playing with regards to the concept of sustainable development?” The codes and themes obtained from the answers given by the teachers are given in Table 3.

Table 3. The main import of the game with regards to the concept of sustainable development as understood by teachers

Theme	**Code**	**Frequency (f)**
Society	Understanding the relations between countries	8
	Recognizing the competition between countries	7
	Social development concept	5
	Understanding the importance of solidarity between countries	5
	Cultural differences	4
	Understanding the causes of crises and war	2
Environment	Efficient use of environmental resources	14
	Importance of non-renewable energy sources	10
	Importance of renewable energy sources	10
	Irresponsible consumption of water and food resources	5
	Understanding that environmental resources are more valuable than money	4
	Recognizing the geopolitical capabilities of countries	3
	Transfer of resources to future generations	2
Economy	Importance of the concept of economic development	9
	The necessity of converting raw materials into products	9
	Using technology to make money	9
	Money-hungry policies of countries	8
	Using environmental resources to make money	5
	Marketing resources with appropriate strategies	5
	Correct planning of production activities	4
	The necessity of increasing production and exporting products	3

When Table 3 is examined, it is seen that the answers given to the question can be categorized under three themes. The teachers explained the main idea of the sustainable development game they played around the themes of society, environment and economy. Under the theme of society, teachers mostly cited relations between countries (f=8) and competition between countries (f=7) as the main idea of the game they played. Another main idea of the game, according to the majority of teachers, was the need to use environmental resources efficiently (f=14), under the environment theme. Under this theme, teachers again talked about the importance of non-renewable (f=10) and renewable energy sources (f=10). Regarding the final theme of economy, teachers talked about the importance of economic development (f=9), the need to transform raw materials into products (f=9), and the use of technological to make money (f=9), as the main idea of the game. Direct quotations from the teachers' responses to the question are given below:

> *T7:* "I think the main idea of this game is to use available resources wisely, make the resources available for sale, sell the production items, communicate with all the countries for the missing resources and produce more and earn more."
>
> *T10:* "…The main idea of the game is the competition between countries and the irresponsible and uncontrolled use of resources."

T23: " In my opinion, the main idea of the game is to understand the importance of non-renewable and renewable energy sources and water. *Also, to market these resources in the right way.* And to use raw materials effectively and efficiently."

Following the first question, the teachers were asked, 'How did the gaming process affect you in terms of international trade and sustainable resources?' The codes and themes obtained from the answers given by the teachers are given in Table 4.

Table 4. How the gaming process affected teachers in terms of international trade and sustainable resources

Theme	**Code**	**Frequency (f)**
Knowledge	Acquiring awareness of sustainability	11
	Noticing the circulation of money around the world	7
	Understanding social and business relationships	7
Attitude and Value	Valuing resources	8
	Being disturbed by the greed of countries	7
	Feeling sorry for underdeveloped countries	5
	Feeling the importance of sustainability	3
	Willingness to reduce consumption	2
	Feeling discomfort when relationships are based on money	2
	Regretting that resources are not protected	2
	Worrying about future generations	1
Behavior	Selling resources for money	6
	Spending money recklessly	5
	Fighting for resources	2
	Calling for cooperation	2
Not affected		7

Looking at the codes and themes that emerged in relation to teachers' responses to this question, we find that they are grouped under three themes: Knowledge, Attitudes and Values, and Behavior. Teachers indicated that the game they played had an impact on their knowledge of international trade and sustainable resources. It can be seen the focus was primarily on raising awareness of sustainability (f=11). Secondly, it is noteworthy that the game had an effect on teachers' attitudes and values. It was seen that the most emphasized codes by the teachers were valuing resources (f=8) and being disturbed by the greed of countries (f=7). Finally, it is seen that the educational game played by the teachers had an effect on their behavior. The codes that teachers emphasized the most in this theme were selling resources for money (f=6) and spending money recklessly (f=5). Direct quotations from the teachers' responses to the question are given below:

T1: "...it really got to me. 1. While developed countries were using their resources comfortably, 3rd world countries tried to produce and sell with limited means, with the sole ambition of making money. They did not care whether their resources were depleted or did not appreciate the value of what they produced. All of the groups only contacted the bank. This enabled the bank to call the shots, getting its way in

the handling of the economy when the groups could have collaborated with one another."

T13: "...it was sad to see that I was wasting resources without thinking, even though that meant extra revenues for my own group *"*

T19: "It got to me. As seen in this game, international trade has turned into a big game of money. Unfortunately no one is doing anything to protect our resources*."*

Then, the teachers were asked, "How would you play the game if you knew before what the cards and resources in this game meant?" The codes and themes obtained from the answers given by the teachers are given in Table 5.

Table 5. How teachers would play the game if they knew before what the cards and resources in this game meant

Theme	Code	Frequency (f)
No change in behavior	Continue with selling the resources	13
	Continuing with commercial activities	9
	Continuing to compete with other countries	1
	Continuing to make money	3
	Continuing to sell renewable energy	5
Behaving differently	Trying not to consume resources	12
	Protecting non-renewable resources	12
	Investing appropriately	7
	Conservation of food and water	7
	Bypassing the World Bank	5
	Leveraging possession of water resources	5
	Making new and different products	5
	Producing products that will make more money	5
	Trying to get resources from other countries	3
	Trying to share resources	2
	Transferring resources to future generations	1

When the codes and themes that emerged regarding the answers given by the teachers to this question were examined, two themes emerged: behaving the same way and behaving differently. Some of the teachers stated that they would behave in exactly the same way even if they knew what the cards in the game meant. In particular, there were many teachers who stated that they would still sell the resources they had (f=13). On the other hand, most of the teachers stated that they would behave differently if they knew what the cards meant. Trying not to consume resources (f=12) and protecting non-renewable resources (f=12) were the behaviors the teachers emphasize the most. Direct quotations from the teachers' responses to the question are given below:

T6: "…As a rich country, I would try to share all resources equally with other countries. So there would be no need for banks."

T14: "…I would use resources accordingly. I would market non-renewable energy using it more efficiently, but I would *not waste my water resources, but rather keep them as a leverage against other countries."*
T21: "…If I had known, I would make products that could make more money.*"*
*T33: "*I would behave in the same way, focusing on earning money.*"*

Finally, teachers were asked, "Considering the game you are playing, discuss the situation of countries in today's world and their relations with each other." The codes and themes obtained from the answers given by the teachers are given in Table 6.

Table 6. What teachers think of countries in today's world and their relations with each other.

Theme	**Code**	**Frequency (f)**
Developed countries	Investing in technology	12
	Looking for ways to make more money	11
	Making their economy stronger	10
	Trying to increase competition	8
	Using other countries' resources	8
	Focusing on production	8
Developing countries	Not producing enough	5
	Not exploiting the available resources	5
	Not analyzing resources correctly	4
	Continuing to depend on foreign resources	3
Underdeveloped countries	Irresponsible production and consumption activities	12
	Failure to allocate resources for economic development	7
	Using illegal means to earn money	7
	Focusing only on the issue of hunger	3

When the codes and themes related to the answers given by the teachers to this question were examined, it was seen that teachers classify countries into three categories, developed countries, developing countries and underdeveloped countries. What teachers emphasized the most about developed countries were their investments in technology (f=12) and their being driven to make more money (f=11). Regarding developing countries, teachers mostly focus on the inability of these countries to produce adequately (f=5) and their inability to utilize existing resources (f=5). Finally, the fact that underdeveloped countries mostly engage in irresponsible production and consumption activities (f=12) was the point most emphasized by teachers concerning underdeveloped countries. Direct quotations from the teachers' responses to the question are given below:

T2: "…First world countries have all kinds of means to focus fully on production, and while doing this, they draw up strategies by keeping an eye on other countries. *Second world countries have means to a certain extent, but are mostly stuck in between, not being fully able to devote themselves to production or anything else.* While third world countries only try to feed themselves.*"*

*T12: "…*Countries that are strong in terms of technology and economy lean towards different projects. *These different projects can set an example for other countries.* When countries that are weak in terms of technology and economy cannot produce enough to feed themselves, they try to manage the situation illegally by purchasing vehicles and waste that other countries consider as garbage.*"*

*T35: "…*Countries that have all the means are working to develop new technologies, and not to make more money because they don't need anything. *Which makes them even more developed. Developed countries are making poor countries dependent on them. Countries with medium-sized economies want to develop themselves while trying to earn some money. However, they are also dependent on developed countries. Third world countries, on the other hand, focus only on making money and try to turn whatever they have into cash. They're trying to make quick money.* Indeed, they are completely dependent on other countries.*"*

4. Discussion

In this study, in which teachers' views on the concept of sustainable development were determined through an educational game, the results of the study were obtained by analyzing teachers' responses to the word association test and semi-structured interview questions.

Firstly, the word association test was applied to the teachers and it was found that the first word that came to the teachers' mind when talking about sustainable development was energy. After energy, the most repeated words were resource, education, economy, food, technology, society, and money, respectively. Almost all of these words are related to sustainable development and sustainability of resources. In this context, it is assumed that teachers have a certain level of knowledge about sustainable development. A review of the literature reveals that the studies on the subject support this result. For example, a study conducted by Wright (2010) found that most participants were familiar with the concept of sustainable development, but fewer were familiar with the concept of sustainable university.

Again, a study by Şahin et al. (2009) with university students found that most students were familiar with the concept of sustainable development. A study conducted by Maidou, Plakitsi, and Polatoglou (2019) with trainee teachers found that most teacher candidates training were aware of environmental issues, but did not view social and economic issues as elements of sustainable development education. As the results of the study's word association tests were showed, surprisingly, teachers associated the concept of sustainable development much less with the word 'environment' than with other words. A study by Alkış and Öztürk (2007) have similarly concluded that teacher candidates have awareness of environmental issues, but that there is a large knowledge gap about sustainable development among these candidates. Again, in many sources (Brundtland Report, 1987; OECD, 2001; Erdem & Ökmen, 2008), the concept of "next generation" encapsulated within the definition of the concept of sustainable development is the word most associated with sustainable development by teacher candidates. Based

on the findings of a study conducted by Nas and Çoruhlu (2017), science teacher candidates do not have sufficient knowledge of the concept of sustainable development and very few of them approach the concept of sustainable development with a holistic approach, defining it as "handing over natural resources to future generations" However, in contrast to these studies, a study conducted by Selvi, Selvi, Güven Yıldırım, and Köklükaya (2018) has shown that teacher candidates associate sustainable development with preserving the nature for future generations; are aware of the importance of maintaining the balance between the humanity and nature, and the necessity of preserving non-renewable energy resources, and using natural resources responsibly for future generations.

After the word association test, teachers were asked about the main idea of the game they played, concerning the concept of sustainable development. The teachers explained the main idea of the game around the themes of society, environment and economy. These themes are entirely similar to the three important dimensions of the concept of sustainable development widely accepted in the literature (environment, economy, society). (Holmberg & Sandbrook, 1992; Harris, 2000; Herremans & Reid, 2002; Soubbotina, 2004; Erdem & Ökmen, 2008; Akpınar, 2011; Öztürk Demirbaş, 2015). Again, an examination of the results shows that the theme most emphasized by the teachers was environment. This finding is comparable to results reported by other studies in the field. For example, the study by Selvi, Selvi, Güven Yıldırım, and Köklükaya (2018) has shown that the ecological perspective on sustainable development is the most widely accepted perspective among all teacher candidates. However, the study has also shown that teacher candidates refrained from referring to other dimensions of sustainability such as economy, society, or politics. Also, a study by Gökmen, Solak, and Ekici (2017) has found that teacher candidates can highly relate to the scale of matching sustainable development indicators at an ecological level while relating to the social and economic dimensions of the scale only to a certain level. Similarly, Olsson, Gericke, and Rundgren (2016) examined the environmental, economic, and social dimensions of sustainable development in terms of students' awareness of, attitudes towards, and behaviors in relation to sustainability. The study has shown that among the dimensions of sustainable development, the environmental dimension contributed the most to students' awareness. Birdsall (2014) has also shown in his study that teacher candidates have a simplistic understanding that only focuses on the environmental dimension of sustainability. There are other studies reporting similar results (Cotton et al., 2007; Summers et al., 2005; Summers & Childs, 2007; Pepper & Wildy, 2008; Yavetz, Goldman, & Pe'er, 2013).

The question "How did the gaming process affect you in terms of international trade and sustainable resources?" was asked to teachers and teachers provided responses to this question that could be categorized into three themes: Knowledge, Attitudes and Values, and Behavior. The literature clearly emphasizes that with effective education for sustainable development, individuals acquire valuable sets of knowledge, use that knowledge in their lives, and change their values, behaviors, and attitudes in accordance with their new perception of sustainable development (Warburton, 2003; Wals, 2011). Examination of responses to the question revealed that teachers had the most awareness

of sustainability in relation to knowledge, international trade, and sustainable resources. According to a study by Olsson, Gericke and Rundgren (2016), the sustainability awareness of students at schools teaching sustainable development is higher when compared to students from other schools. Changes in teachers' attitudes and values took place after the game. At this stage, teachers mainly talked about values such as valuing resources and discomfort with countries' ambitions. This situation aligns very much the view that education for sustainable development highlights the importance of values. Values such as respect for other societies, cultures, and future generations, as well as respect for the world's natural resources, which are part of the values established by UNESCO (2013), largely overlap with values which teachers say they have come to embrace after being a part of this study (as cited in Kaya & Tomal from Linder, 2011). Finally, it was found that the game had an effect on the behavior of teachers. With this theme, teachers emphasized that the game mostly affected the behaviors for selling resources for money and spending money recklessly. According to Tanrıverdi (2009), learning environments have an important role in understanding, interpreting and implementing the goals of sustainable development as they can create significant changes in behavior. In this respect, a study by Keleş (2007) found that teacher candidates' awareness, attitude, and behavior scores for sustainable living increased after using the ecological footprint as an environmental education tool.

Besides, the teachers were asked, "How would you play the game if you knew before what the cards and resources in this game meant?" Examining the responses to this question, it was found that some of the teachers indicated that they would still play the game the same way even though they had known what the cards in the game meant. In answering the question, a significant portion of teachers indicated that they would sell their resources and continue commercial activities anyway to make money. This might be due to teachers not fully understanding what holistic approach means. In particular, the results of a research study conducted using the ecological paradigm scale show that adults mostly adopt a human-centered approach to the environment and may place their own priorities ahead of environmental values. (Corral Verdugo & Armendariz, 2000; Gökmen, 2014; Borg et al., 2014; Selvi, Selvi, Güven Yıldırım, & Köklükaya, 2018). On the other hand, it was remarkable that most teachers stated that they would play the game differently. Teachers mostly answered that they would try not to deplete resources, and protect non-renewable resources. Literature shows that sustainable development awareness requires reducing the consumption of non-renewable resources, preserving the quality of air, water, and other natural elements, and maintaining the overall integrity and continuity of the ecosystem (Turkish Foundation for Environmental Problems, 1991). A study by Ergün and Çobanoğlu (2012) has also concluded that the fundamentals of natural life should be safeguarded in the long term and the consumption of resources should be checked in this context; the consumption of renewable resources should be preferred, and the regenerative capacity of nature should be respected.

Finally, teachers were asked, "Considering the game you are playing, discuss the situation of countries in today's world and their relations with each other." considering the dynamics of the game. In answering this question, teachers classified countries into three categories, developed countries, developing countries and underdeveloped

countries. Looking at the answers to this question in general, the need for all countries of the world contributing to sustainable development becomes apparent. Because, as Whistler (2007) states, sustainable development encompasses all processes that are economically competitive with world markets; that meet the basic needs of people; that are socially equitable and inclusive of disadvantaged groups, and that enhance quality of life, as well as preventing, protecting, curing, and supporting the natural world and natural systems to prevent further damage (as cited in Keleş, 2007). The concept of sustainable development plays a key role in raising the sustainable consumption and production patterns of all countries (UNESCO, 2002).

5. Conclusion

Sustainable development does not happen with decisions taken at international meetings. However, it is possible to make a difference by examining how individuals perceive this concept and how they reflect it in their lives. In order for sustainable development activities to serve their purpose and become a way of life for people, it is necessary to raise individuals with an awareness of sustainable development who live their lives according to the principles of sustainable development (Tanrıverdi, 2009; Aydoğan, 2010). Teachers are the ones who raise individuals with an awareness of sustainable development, regardless of what academic level they are teaching at. In this respect, science teachers were chosen as the study group for this study. Other studies must be conducted to reveal the knowledge, awareness and attitudes of teachers, teaching different branches, towards sustainable development. However, it is extremely important to integrate courses on sustainable development into the teacher training programs of the faculties of education. Thanks to these courses, teacher candidates can acquire knowledge, awareness and attitudes about sustainable development and exhibit a whole new set of behaviors that align with their newly gained awareness.

References

Akpınar, P. (2011). *Sürdürülebilir kalkınma için eğitim konusunda ilköğretim okulu yöneticilerinin görüşleri.* (The opinions of primary school principals on education for sustainable development) (Master's Thesis). Hacettepe University, Ankara, Turkey.

Alkış, S., & Öztürk, M. (2007). Sustainable development in opinions of primary student teachers and pre-service teacher education in Turkey. (Ed. Reinfried, Schleicher, Rempfler). IGU Geographical Views on Education for Sustainable Development, *Proceedings of Lucerne-Symposium, Switzerland.*

Altunay, D. (2004). *Oyunla desteklenmiş matematik öğretiminin öğrenci erişisine ve kalıcılığa etkisi.* (*The effect of mathematics teaching which is supported with games on the students' success and the permanence of the knowledge learned)*, (Master's Thesis). Gazi University, Ankara, Turkey.

Aydoğan, A. (2010). *Sosyal bilgiler öğretmenlerinin sürdürülebilir kalkınma konusuyla ilgili kazanımların öğretimine ilişkin görüşleri (The ideas of social studies teachers on teaching about the improvements of sustainable development issues).* (Master's Thesis). Niğde University, Niğde, Turkey.

Birdsall, S. (2014). Measuring student teachers' understandings and self-awareness of sustainability. *Environmental Education Research, 20*(6), 814-835. **https://doi.org/10.1080/13504622.2013.833594**

Borg, C., Gericke, N., Höglund, H.O., & Bergman, E. (2014) Subject and experience-bound differences in teachers' conceptual understanding of sustainable development. *Environmental Education Research, 20*(4), 526-551. **https://doi.org/10.1080/13504622.2013.833584**

Brause, J. A. & Wood, D. (1993). *Environmental education in the school: Creating a program that works!* Washington, DC: North American Association for Environmental Education.

Brundtland Report (1987). *Sustainable development*. Retrieved from: http://www.un-documents.net/wcedocf.htm [30.10.2021].

Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education*. (6th edition). London: Routledge Falmer.

Conca, K. & Geoffrey, D. D. (2004). *Green planet blues, environmental politics from Stockholm to Johannesburg*. Colorada: Westview Pres.

Corral Verdugo V., & Armendariz, L. I. (2000). The new environmental paradigm in a Mexican community. *Journal of Environmental Education, 31*(3), 25-31. **https://doi.org/10.1080/00958960009598642**

Coşkun, H. (2012). *Bilimsel öyküler içeren eğitsel oyunlar ile fen öğretiminin öğrencilerin akademik başarısına etkisi.* (*The effects of educational games based on science stories on students? academic achievements in science education*). (Master's Thesis). Erciyes University, Kayseri, Turkey.

Cotton, D. R. E., Warren, M. F., Maiboroda, O., & Bailey, I. (2007). Sustainable development, higher education and pedagogy: a study of lectures' beliefs and attitudes. *Environmental Education Research, 13*(5), 579–597. **https://doi.org/10.1080/13504620701659061**

Demir, M. (2012). 7. Sınıf vücudumuzdaki sistemler ünitesinin oyun tabanlı öğrenme yaklaşımı ile işlenmesinin öğrencilerin akademik başarılarına ve fen teknoloji dersine karşı tutumlarına etkisi. *X. National Science and Mathematics Education Congress,* Niğde University, Niğde, Turkey.

Erdem, H., & Ökmen, F. (2008, 8-9 May). Kalkınma ve sürdürülebilir kalkınma. (Development and sustainable development) *11th Students' Conference on Economics,* Ege University, İzmir, Turkey.

Ergün, T., & Çobanoğlu, N. (2012), Sürdürülebilir kalkınma ve çevre etiği (Sustainable development and environmental ethics). *Ankara University Journal of Social Sciences, 3*(1), 97-123. **https://doi.org/10.1501/sbeder_0000000041**

Gökmen, A. (2014). *Sürdürülebilir kalkınma için eğitim: öğretmen adaylarının tutumları ile ilişkili olan faktörler (Gazi Eğitim Fakültesi örneği).* (*Education for sustainable development: The factors in relation to pre-service teachers' attitudes; the case of Gazi Faculty of Education*). (Doctoral dissertation). Gazi University, Ankara, Turkey.

Gökmen, A., Solak, K., & Ekici., G. (2017). Sürdürülebilir kalkınma için eğitim: öğretmen adaylarının tutumları ile ilişkili olan faktörler (Educaiıon for sustainable development: the factors in relation to preservice teachers' attitudes). *The Journal of Kesit Academy, 3*(12), 462-480.

Harris, J. M. (2000). Basic principles of sustainable development, Global Development and Environment Institute, Working Paper. Retrieved from: http://ase.tufts.edu/gdae/publications/working_papers/Sustainable%20Development. [28.10.2021].

Herremans, I. M., & Reid, R. E. (2002). Developing awareness of the sustainability concept. *The Journal of Environmental Education, 1*(34), 16-20. **https://doi.org/10.1080/00958960209603477**

Holmberg, J., & Sandbrook, R. (1992). *Sustainable development: What is to be done? making development sustainable: redefining institutions, policy, and economics*. (Ed. J. Holmberg). International Institute for Environment and Development. Washington, D. C: Island Press.

Jardins, D. J. (2006). *Çevre etiği çevre felsefesine giriş.* (R. Keleş, Çev.) Ankara: İmge Kitabevi.

Karamustafaoğlu, O. & Kaya, M. (2013). Eğitsel oyunlarla 'yansıma ve aynalar' konusunun öğretimi: yansımalı koşu örneği (Teaching the Subject of 'Reflection and Mirrors' with Educational Games: A Case of Reflective Race). *The Journal of Inquiry Based Activities (JIBA), 3*(2), 41-49.

Kaya, M. F., & Tomal, N. (2011). Sosyal bilgiler dersi öğretim programının sürdürülebilir kalkınma eğitimi açısından incelenmesi (Examination of the Social Sciences Education Program in the Context of Sustainable Development Training). *Journal of Educational Sciences Research 1*(2), 49–65.

Keleş, İ., Metin, H., & Sancak, H. Ö. (2005). *Çevre kalkınma ve etik*. Ankara: Birlik Matbaacılık.

Keleş, Ö. (2007). *Sürdürülebilir yaşama yönelik çevre eğitimi aracı olarak ekolojik ayak izinin uygulanması ve değerlendirilmesi (Application and evaluation of ecological footprint as an environmental education tool towards sustainable life).* (Doctoral dissertation). Gazi University, Ankara, Turkey.

Keleş, R. & Hamamcı, C. (2005). *Çevre politikası*. Ankara: İmge Kitabevi.

Linder, W. (2007). *Bildung für nachhaltige entwicklung, ansichten und aussichten.* Wien: Bundesministerium für Unterricht, Kunst und Kultur.

Maidou, A., Plakitsi, K., & Polatoglou, H. M. (2019). Knowledge, perceptions and attitudes on education for sustainable development of pre-service early childhood teachers in Greece. *World Journal of Education, 9*(5), 1-15. **https://doi.org/10.5430/wje.v9n5p1**

Malta, S. E. (2010). *İlköğretimde kullanılan eğitsel bilgisayar oyunlarının öğrencilerin akademik başarılarına etkisi. (The effects of educational computer games that used in elementary education on academic achievement). (*Master's Thesis). Sakarya, Turkey.

McKeown, R. (2002). Education for Sustainable Development Toolkit. Retrieved from: http://www.esdtoolkit.org/esd_toolkit_v2.pdf [17.01.2019]

Miles, M. B. & Huberman, M. A. (1994). *An expanded sourcebook qualitative data analysis*. London: Sage Publication.

Nas, E. R., & Çoruhlu, T. Ş. (2017). Fen bilgisi öğretmen adaylarının perspektifinden sürdürülebilir kalkınma kavramı (The Concept of Sustainable Development from the

Perspective of Preservice Science Teachers) *YYU Journal of Education Faculty, 14*(1), 562-580. **http://dx.doi.org/10.23891/efdyyu.2017.22**

OECD. (2001). *Strategies for sustainable development- Practical guidance for development*. Paris: OECD.

Olsson, D., Gericke, N., & Chang-Rundgren, S. (2016). The effect of implemetation of education for sustainable development in swedish compulsory schools - assessing pupils' sustainability consciousness. *Journal Environmental Education Research, 22*(2), 176-202. **https://doi.org/10.1080/13504622.2015.1005057**

Önder, A. N. & Güven Yıldırım, E. (2021). Environmental Problems. In: Erten, S. (Ed.), *Different perspectives on environmental* (pp.306-338). Isres Publishing. Cohen, A. D. (2010). Focus on the language learner: Styles, strategies and motivation. In Norbert Schmitt (Ed.), *An introduction to applied linguistics* (pp. 161-178). London: Hodder Education.

Öztürk Demirbaş, Ç. (2015). Öğretmen adaylarının sürdürülebilir kalkınma farkındalık düzeyleri (Sustainable Development Awareness Levels of Teachers Pre-Service). *lnternational Journal of Geography and Geography Education, 31*, 300-316. **https://doi.org/10.14781/mcd.09811**

Pepper, C., & Wildy, H. (2008). Leading for sustainability: Is surface understanding enough? *Journal of Educational Administration, 46*(5), 613–629. **https://doi.org/ 10.1108/09578230810895528**

Rose, P., Beeby, J., & Parker, D. (1995). Academic rigour in the lived experience of researchers using phenomenological methods in nursing in nursing. *Journal of Advanced Nursing*, *21*(6), 1123-1129. **https://doi.org/10.1046/j.1365-2648.1995.21061123.x**

Selvi, M., Selvi, M., Güven-Yıldırım, E., & Köklükaya, A. N. (2018). Analysis of teacher candidates' views on sustainable development. *Journal of Research in Education and Society, 5*(2), 87-104.

Shaftel, J., Pass, L., & Schnabel S. (2005). Math games for adolescents. *Teaching Exceptional Children, 37*(3), 25-30.

Soubbotina, P. (2004). *Beyond economic growth an introduction to sustainable development*. Washington: The World Bank Washington.

Strange, T. & Bayley, A. (2008). *Sustainable development: Linking economy, society, environment*. Paris: OECD.

Summers, M., & Childs, A. (2007). Student science teachers' conceptions of sustainable development: An empirical study of three postgraduate training cohorts. *Research in Science & Technological Education, 25*(3), 307–327. https://doi.org/10.1080/02635140701535067

Summers, M., Childs, A., & Corney, G. (2005). Education for sustainable development in initial teacher training: issues for interdisciplinary collaboration. *Environmental Education Research, 11*(5), 623–647. **https://doi.org/10.1080/13504620500169841**

Şahin, E., Ertepınar, H., & Teksöz, G. (2009). Implications for a green curriculum application toward sustainabe development. *Hacettepe University Journal of Education, 37*, 123-135.

Tanrıverdi, B. (2009). Sürdürülebilir çevre eğitimi açısından ilköğretim programlarının değerlendirilmesi (Analyzing Primary School Curriculum in Terms of Sustainable Environmental Education). *Education and Science, 151*(34), 91-92.

Türkiye Çevre Sorunları Vakfı, (1991). *Ortak Geleceğimiz, dünya çevre ve kalkınma komisyonu, 1987.* İstanbul: Önder Matbaa.

UNESCO, (2002). Education for sustainability from Rio to Johannesburg: Lessons learnt from a decade of commitment. Retrieved from: http://unesdoc.unesco.org/images/0012/001271/127100e.pdf [15.10.2021].

UNESCO, (2005). Guidelines and recommendations for reorienting teacher education to address sustainability. UNITWIN/UNESCO Chair for Reorienting Teacher Education to Address Sustainability, York University, Toronto and the International Network of Teacher-Education Institutions.

UNESCO, (2013). Education for sustainable development (Esd): A sound invesment to accelerate African development. Retrieved from: https://en.unesco.org/events/education-sustainabledevelopmentesd-sound-investment-accelerate-african-development [15.10.2021].

United Nations General Assembly. (1987). Report of the world commission on environment and development: our common future. Oslo, Norway: United Nations General Assembly, Development and International Co-operation: Environment. Retrieved from: http://www.un-documents.net/our-common-future.pdf [31.10.2021].

Van Manen, M. (2007). Phenomenology of practice. *Phenomenology & Practice*, 1(1), 11–30.

Wals, A. E. J. (2011). Learning our way to sustainability. *Journal of Education for Sustainable Development, 5*(2), 177-186. https://doi.org/10.1177/097340821100500208

Warburton, K. (2003). Deep learning and education for sustainability. *International Journal of Sustainability in Higher Education, 4*(1), 44-56.

Whistler K. (2007). *Sürdürülebilir kalkınma eğitim programı*. Kültür ve Turizm Bakanlığı Strateji Geliştirme Başkanlığı Toplantı Katılımı Bilgi Notu. Ankara.

Wolbring, G. & Burke, B. (2013). Reflecting on education for sustainable development through two lenses: Ability studies and disability studies. *Sustainability, 5*(6), 2327-2342. **https://doi.org/10.3390/su5062327**

Wright, T. (2010). University presidents' conceptualizations of sustainability in higher education. *International Journal of Sustainability in Higher Education, 11*(1), 61-73. **https://doi.org/10.1108/14676371011010057**

Yavetz, B., Goldman, D., & Pe'er, S. (2013). How do preservice teachers perceive 'environment' and its relevance to their area of teaching? *Environmental Education Research, 20*(3), 354-371. **https://doi.org/10.1080/13504622.2013.803038**

Yawker, D. T. (1999). *Play and early childhood development*. USA: Longman.

Yıldırım A. & Şimşek, H. (2008). *Sosyal bilimlerde nitel araştırma yöntemleri*, Ankara: Seçkin Yayıncılık.

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