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7TH GRADE STUDENTS' MENTAL MODELS ABOUT THE CONCEPT OF 'SUSTAINABLE DEVELOPMENT'

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Abstract:
The purpose of the current study is to elicit the opinions constructed by 7th grade secondary school students about three components of the concept of sustainable development; environment, society and economy. Study group of the implementation consists of 20 students attending a public secondary school in 2014-2015 academic year. The study employed the phenomenological design, one of the qualitative research methods. Drawing method was used to collect the data of the study. Drawings representing the relationship between humans, nature and economy were prepared in line with the drawing method. Participants were asked to express thoughts evoked by these concepts through drawings and then to write under their drawings what they had wanted to express through their drawings. Then, small group works were conducted for students to illustrate the relationship between these concepts so that the relationship between these concepts could be elicited. In light of the findings of this analysis, it is seen that the cognitive connections established by the students on the components of the sustainable development concept are compatible with this concept.

Keywords: education for sustainable development; phenomenology; sustainable development; secondary school

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1. Introduction

Sustainability defines the relationships between environment, human and responsibilities of the current generation for future generations. Because of the increasing destruction of nature and threat to human health and life, the concept of sustainability has gained a greater importance for the protection of nature (Sayhan, 2013). Sustainability entails changing thinking patterns without deteriorating the quality of life. On the basis of this change lies the target of creating societies that are cognizant of environmental management, societal responsibilities and economic solutions (Hart, 1999). Sustainability is the central theme of environmental science, human development and resource utilization. Though sustainability has many intellectual aspects, the principal intellectual aspect is the requirement of using local sources. Natural resources such as wild life and natural beauties should be protected so that future generation can enjoy healthy and happy lives, just as we do now (Jardins, 2006).

Another concept that is as dynamic as sustainability is sustainable development, which can be defined as developing in such a way as not to remove the capability of future generations to meet their needs (Görmez, 2003). The idea of sustainable development first strongly emphasized by the Brundtland Commission (WCED 1987) may be seen as a response to the problems and possibilities presented by a deeply systemic world. Yet ecologically sustainable development requires an integrative perspective that brings together (at least) society, economy and environment and present and future dimensions (Sterling, 2003). Uras and Acar (2008) defined sustainable development as the improvement of living quality in such a way as not to destroy the life supporting capacity of natural systems. Sustainable development is a strategy utilized by societies to protect the quality of the environment and life, while seeking a suitable approach to economic development (TÜBİTAK, 2003; Keleş, 2007).

From an economic perspective, sustainable development is a process in which society can compete in world markets, while basic human needs are properly met and level of welfare increases. From a social perspective, it is a process of promoting justice and equality, supporting disadvantaged groups and increasing the quality of life. From the perspective of environment and natural systems, it is a preventive, protective, rehabilitative process whose individual parts complement each other and which requires the balanced planning and management of environmental resources within-generation and between-generations (Whistler, 2007). For a sustainable development to occur, existing resources should be protected and waste should be kept under control. However, for the concept of sustainable development to solve the problems encountered by humans today, it needs to encompass the elements of equality, justice,

collectivism, democracy, human needs and environmental values (Torunoğlu, 2003). Utilizing nature without using it up is one of the principle requirements of sustainable development (Kışlalıoğlu & Berkes, 2005). The common feature of the definitions of sustainable development is that it is made up of environmental, economic and social components. Although each component has its own contribution to sustainability, if they are considered separately, complete sustainability cannot be achieved. It is argued that the dimensions of sustainable development are related to each other and they cannot be considered separately (Haris, 2000).

Education is a long process and is a pre-requisite for sustainable development. It improves and strengthens the capacity of individuals, groups, communities, organizations and countries in order to make evaluations and preferences in favor of sustainable development. It makes our world more secure, healthier and more prosperous by changing the viewpoints of individuals and enhances the quality of life. Sterling (2001) defines 'sustainable education' as "*a change of educational culture which both develops and embodies the theory and practice of sustainability*".

Education for sustainable development can provide more opportunities for critical thinking, raising awareness and being more qualified so that new visions can be created and new methods and tools can be developed (Keleş, 2007). Education for sustainable development is based on the inculcation of environmental, economic and social information. Education for sustainable development aims to impart information, skills and values required for people to put forth efforts to live in a sustainable manner, to increase their contribution to the democratic society and to support sustainable behaviors (Engin, 2010). Education for sustainable development intends to help people to make conscious decisions, to develop their attitudes, skills and information to achieve what they have decided and to act in compliance with these decisions for both personal and social interests and for the interests of future generations (UNESCO, 2005). Starting from early ages, sustainable development education programs should be incorporated into the educational programs of students so that skills and abilities required sustainable development to occur can be improved.

Education for sustainable development should aim to leave a world of social justice, equality, peace and economic sustainability to future generations for the conservation of nature for future generations (Contini & Pascual, 2010). One claim of education for sustainable development is that the only way for sustainable development is to educate future generations in such a way as to enable them to live in their environments in a sustainable manner (Qablan, 2005). The efficiency of such an education can be improved when sustainable education programs are planned by considering cultural, local, social and economic conditions of the target population. The content of education for sustainable development; unlike the environmental education,

also encompasses economic and social effects as well as environmental effects of the use of natural resources. This approach should be of great interest to everyone who has a stronger sensitivity towards nature and a stronger tendency to benefit from natural resources (Demirbaş, 2011).

The vision of education for sustainable development not only entails changing of values, attitudes and living styles, but also puts emphasis on the development of an inter-disciplinary approach aiming to enhance information and skills needed for a sustainable future. This requires the reorganization of education systems for both youth and adults in order to make decisions and to implement these decisions in a cultural and local manner so as to eliminate the problems posing threats to our common future. In this way, people of any age can be encouraged to create alternative visions for the future and to evaluate and implement these alternative visions in cooperation with others (UNESCO, 2002). Education for sustainable development can promote critical thinking skills (Webster, 2007). Moreover, education for sustainable development is influential on making long-term decisions about nature for a better world and improves thinking, reflection and action skills (Fien, 1993). As education for sustainable development provides opportunities for people to enhance their information, values and skills to participate in decisions about the things to be done to improve the quality of life without causing harm to the earth by individuals and societies at universal and local levels, it is of great importance to design sustainable development education within a program focusing on individual components of sustainable development (Summers, 2000).

An education in harmony with sustainable development can play an important role in creating an educational and environmental awareness and in developing sustainable attitudes and behaviors. Therefore, it is believed that incorporation of sustainable development into formal and informal education will be of great importance to change individuals' anxieties and worries and make their perceptions and understandings more sensitive (UNESCO, 2002). Education of sustainable development is more than the sum of information about education, environment and society. Moreover, it also includes the promotion of skills, viewpoints and values that can guide and motivate the quest for ways of making living more sustainable in a democratic society. Education for sustainable development requires studying both local and global issues. Therefore, five components (information, skills, viewpoints, values, and topics) should be addressed in an education program for sustainable education.

When the relevant literature is reviewed, it is seen that there are different studies focusing on the issue of education for sustainable development. For example; Bögeholz, Böhm, Eggert and Barkmann (2014) examined the German path to Education for Sustainable Development (ESD). Eilks (2015) criticized central ESD educational

justifications and frameworks from the viewpoint of science education. Tanrıverdi (2009) investigated the place of the concept of sustainable development in elementary education by evaluating elementary school programs; Türer (2010) investigated pre-service teachers' awareness of sustainable environment; Walshe (2008) used the concept-map technique to determine the relationships formed by elementary level eighth graders between the three components of sustainable development; McNaughton (2004) looked at the effect of drama method in the field of sustainable development education; Hopkins and McKeown (2002) pointed to the need for providing sustainable development education in informal education as well as formal education; Petersen and Alkış (2009) reported that many students do not know the concept of sustainable development; Yapıcı (2003) found that the education for sustainable development is an area not receiving enough attention.

One of the common findings of these studies is that education for sustainable development is of great importance to have a better life in a sustainable world and to integrate sustainable development to our living patterns. Another common finding of these studies is that sustainable development is usually considered at one dimension and the relationship between the three components is not systematically explored. Sustainable living must be the new pattern for all levels: individuals, communities, nations and the world. To adopt the new pattern will require a significant change in the attitudes and practices of many people. We will need to ensure that education programs reflect the importance of an ethic for living sustainably (IUCN, UNEP, WWF 1991, 5).

Education is critical for promoting sustainable development and improving the capacity of the people to address environmental and developmental issues. It is also critical for attaining environmental and ethical awareness, values and attitudes, skills and behaviors consistent with sustainable development and for effective public participation in the decision-making process (UNCED 1992, Chapter 36).

In Turkey, all curricula are improved and organized by the Head Council of Education and Morality. Therefore, all schools must follow the same curriculum, but some schools, if necessary, may make some changes due to their geographical or local conditions and physical environments. Since newly-structured curricula based on constructivist learning approach have just been released, we can only summarize general environmental education themes embedded within the curricula of different school subjects. Examination of all the curricula of the school subjects in Turkey resulted in identification of nine environmental themes: Becoming a conscious consumer or aware of his/ her responsibility (Theme 1); improving environmental consciousness/ideas/sensitivity (Theme 2); using environmental resources effectively (Theme 3); what environmental problems (the types) are or how they impact their local environments (Theme 4); learning how to protect yourself from natural disasters

(Theme 5); problem-solving for environmental issues (Theme 6); learning how to design one's local environment (Theme 7); understanding interaction between humans and their environment (and/or society), or between living things, or relationships between environment, industry and energy (Theme 8); and becoming aware of our cultural (environmental) heritage and its conservation (Theme 9) (Çalık, 2009). As seen in these themes, the curricula in Turkey implicitly embrace the three dimensions of sustainability: ecological sustainability (Themes 4-7), economic sustainability (Themes 1 and 3), and social justice (Themes 2, 8-9). However, Tanrıverdi (2009) argued that Turkish curricula tend to frequently use the term "environmental education" whilst direct use of "sustainability" is limited. The Council of the European Union (as cited in Tanrıverdi, 2009) has highlighted seven features for sustainable development. However, Turkish curricula have very limited objectives: (a) climate change, (b) social integration, population and immigration, (c) fighting global poverty, (d) public health threats, and (e) sustainable transport. In other words, it can be deduced that Turkish curricula have some pitfalls in emphasizing EE within the three dimensions of sustainability (ecological sustainability, economic sustainability, and social justice) taking into account principles of "sufficiency", "efficiency" and "consistency" (Özdemir, 2007).

In our country in the science education curricula, a great emphasis is put on this statement "Promoting the recognition of the reciprocal interaction between the individual, environment and society and the awareness of sustainable development". One of the sub-fields of the science education curricula is sustainable development and the concept of sustainable development means enabling future generations to meet their needs as a result of the sensible use of natural resources by the present generation. The unit of Living Organisms and Energy Connection/Living Organisms and Life included in the 8th grade science education curricula state some objectives related to the concept of sustainable development for students to develop awareness of sustainable development and living (TTKB, 2013). When the science education curricula of the 3rd-8th grades are examined, it is seen that though the concept of sustainable development is included within only one unit in the 8th grade with two objectives, there are some other objectives (e.g. Recognize the biological diversity in eco-system and know its importance) related to the components of the concept in other parts of the program. However, when the objectives included within the education program are examined, it is seen that they are limited to the dimension of environment. No objectives focusing on the relationship between the three components of sustainable development in a holistic manner are included in the program.

Offering sustainable development education to students by focusing on only one dimension is not recommended. It is of great importance to understand how students

form a relationship between human, economy and nature and to reorganize the content of instructional programs along this line. Mental models can provide an opportunity to look only at the three components of the concept of sustainable development. A mental model, briefly, is "*an internal representation which acts out as a structural analogue of situations or processes. Its role is to account for the individuals' reasoning both when they try to understand discourse and when they try to explain and predict the physical world behavior*".

According to the experts on cognitive psychology, mental model is an internal-scale model representation of an external reality, or person's private representation of an idea or concept (Greca & Moreira, 2000). Mental model can be defined as conceptual model, mental representation, mental image, internal representation, mental process, abstract construction and personal cognitive representation (Chittleborough & Treagust, 2007; Chittleborough & Treagust, 2008). The experts of cognitive psychology often use mental model to obtain information on thinking process, especially during problem solving. Bower and Morrow (Strickland, et. al., 2010) defined the mental model in the following statement: "an individual's mental models are complex knowledge constructs representing the person's experiences regarding a particular phenomenon. The construction of mental models is not limited to tangible objects; the phenomena may be as abstract as the notions of 'right' and 'wrong"'. Therefore, mental model construction is the core of a meaningful learning. People should construct mental model system he/she encounters in his or her mind in order to understand and comprehend how it works. Mental model formation depends heavily on the conceptualizations brought to a task and our views, beliefs, and attitudes concerning: (a) the world, (b) ourselves as learners or teachers, (c) our capabilities and prior experiences, (d) the tasks we undertake, (e) the issues we confront, and (f) the strategies we employ (Norman, 1983; Henderson & Coombs, 2002). There are two reasons why we need mental models and systems while tackling environmental problems:

- To understand the whole complexity of the issues we face, we can no longer rely on the analytical approach, which tries to understand all the details, but we have to take a look at a broader picture.
- Existing mental models - of managers, politicians, consumers, of everybody - influence to a great extent the decisions being made, and therefore, these models are the part of the problems. Unlearning' old models and the provision of new ones are the part of the solution (Rosner, 1995).

The concept of sustainable development is an inter-disciplinary concept. Until reaching 8th grade, when the concept of sustainable development is studied within a specific unit, students' subconsciously experience the environment-society-economy relationship in their ordinary lives. The phenomenon of the current study is the meaning of the concept of sustainable development for 7th graders.

We argue that students' conceptualizations of the sustainable development. In essence, to understand sustainable development issues, students must first conceptualize what the sustainable development is, the phenomena and processes that interact to shape and characterize the sustainable development. Consequently, the purpose of this study was to identify secondary school students' conceptualizations or mental models of the sustainable development. The general purpose of this study is to elicit the opinions constructed by 7th graders in their minds about the three components of sustainable development; environment, society, and economy, through drawings. To this end, answers to the following research questions were sought;

1. How do secondary school 7th graders reflect their opinions about the components of the concept of sustainable development in their drawings?
2. What are the similarities and differences between 7th graders' opinions about the components of the concept of sustainable development expressed through their drawings?

2. Material and Methods

2.1. Research Design

The current study employed the phenomenological approach, one of the qualitative research methods. Phenomenological studies examine human experiences through the descriptions provided by the people involved. These experiences are called lived experiences. The goal of phenomenological studies is to describe the meaning that experiences hold for each subject. This type of research is used to study areas in which there is little knowledge (Donalek, 2004). In phenomenological research, respondents are asked to describe their experiences as they perceive them. They may write about their experiences, but information is generally obtained through interviews.

The purpose of a phenomenographic study is to define different ways employed by people to experience, interpret, comprehend or conceptualize a certain aspect of a phenomenon (Çepni, 2007). Thus, in the current study, phenomenological approach was adopted to delineate different ways employed by the 7th graders in order to understand and conceptualize the components of the concept of sustainable development in their minds. The objective of a phenomenographic study is to qualitatively explain how different phenomena are understood through different ways and to systematically separate different comprehensions on the basis of the emerging categories (Ashworth & Lucas, 1998). The objective of phenomenological approach in educational research is to explore the relationship between the learning and teaching experiences of the teacher and the student. Phenomenographic research intends to understand what students have done while learning and what kind of approaches they

have adopted for learning. By using phenomenographic research, the relationship between the individual and the thing he/she tries to understand or learn is investigated and elicited. If the results of such studies are understood well, then important steps can be taken in terms of the issues related to personal learning (Çepni, 2007); because, if the teacher is aware of students' conceptions of a certain phenomenon, then he/she can take more effective precautions to prevent their misconceptions and can help them to better construct their conceptions (Marton, 1986).

2.2. Study Group

The participants of the current study were selected through criterion sampling, one of the purposive sampling methods. In this approach to selection, the researcher can apply some criteria for the selection of participants, but they can also employ pre-determined criteria (Yıldırım & Şimşek, 2013). Purposive sampling involves the selection of data sources that can provide rich information to conduct an in-depth study. Sources of rich data make it easier for the researcher to obtain important information in line with the research question (Patton, 2002). The criterion adopted in the current study for the selection of the participants is the participants' not having had any courses directly defining the concept of sustainable development. As the objectives of the secondary school 7th grade Science Education course focus on ecosystem, bio-diversity, environmental problems, recycling and reuse, 7th grade students were preferred for the current study. Though the objectives related to the concept of sustainable development are included in the 8th grade science education course, in the current study, 7th graders were preferred to determine the schemata of the students about the dimensions of sustainable development. Study group of the implementation consists of 20 students (10 males, 10 females) attending a public secondary school in 2014-2015 academic year.

2.3. Data Collection Instrument

In order to collect data from the students, student drawings and semi-structured interviews were used.

Students' drawings: All of the students were asked the following four open-ended questions to elicit their feelings and opinions about the components of the concept of sustainable development by means of drawings;

1. What does the concept of nature mean for you? Please, explain your opinions about nature by drawing.
2. What does the concept of money mean for you? Please, explain your opinions about money by drawing.
3. What does the concept of human mean for you? Please, explain your opinions about the concept of human by drawing.

4. Is there a relationship between nature, money, and human? Please, explain the relationships between these three concepts existing in our lives/ you think should exist in our lives by drawing.

In the current study which aims to delineate secondary school students' opinions about the components of sustainable development, drawing method was employed as a data collection tool. Drawing method is one of the qualitative methods used to elicit the images and thoughts constructed by students in their minds (Kearney & Hyle, 2004). Drawing in education is also an instructional strategy employed to evaluate the information possessed by the student and to develop some skills such as writing, reading and oral explanation (Chula, 1998). Drawings are unique tools allowing children to explain how they feel and consider their thoughts from a broader perspective (Zians, 1997).

2.3.1. Semi-structured interviews

After the completion of all the drawings, an interview was made with each student regarding his/her drawings. The students were asked to explain their drawings and in this way, the researchers were prevented from interpreting the drawings on the basis of their own viewpoints. Each interview lasted five minutes and they were recorded in writing. In semi-structured interviewing, a guide is used, with questions and topics that must be covered. The interviewer has some discretion about the order in which questions are asked, but the questions are standardized, and probes may be provided to ensure that the researcher covers the correct material. This kind of interview collects detailed information in a style that is somewhat conversational. Semi-structured interviews are often used when the researcher wants to delve deeply into a topic and to understand thoroughly the answers provided.

2.3.2. The role of the researcher

In the current study, in compliance with the drawing technique, drawings developed by Keleş (2007) representing the relationship between human, nature and economy were used. First, students were given drawings including the pictures of tree representing nature, of money representing economy and of human representing society one by one and the students were asked to display the thoughts evoked by these pictures in their minds by drawing. The students were also asked to explain what they mean through these drawings by writing their own sentences under the drawings. Then, the students were put into groups to discuss and delineate the relationships they constructed between these three concepts in their minds by drawing.

2.4. Data Analysis

Phenomenological analysis was used to analyze the drawings obtained in the current study. In this analysis, the coding scheme proposed by Creswell (2015) for phenomenological research was employed. Preliminary statements, important meaning units (themes), textural delineations and structural delineations were placed in this scheme. In the current study, first of all, an important expressions list was developed on the basis of the students' drawings and their explanations written under the drawings. Then, the themes for the opinions formed in the minds of students about these concepts were constructed. In order to perform the textural delineations of the students' opinions, excerpts from the sentences they wrote under the drawings are presented. After this, structural delineations were carried out by eliciting how the students made sense of the relationship between the three components of sustainable development. Finally, codes constructed under the themes according to the students' important statements were presented by developing mind-maps. Moreover, the students' repetition frequencies related to the codes were indicated on the mind-maps as frequency values. For increased reliability, the drawings and written explanations under the drawings were simultaneously coded by another researcher.

3. Results

In this section, numerical data related to the themes constructed as a result of the analysis of the data collected by using four different data collection tools to determine the students' opinions about the components of sustainable development are presented. The data related to the common themes are presented in the form of mind-maps and supported with student drawings and explanations.

The data related to the first interview question "*What does the concept of nature mean for you? Please, explain your opinions about nature by drawing."* are gathered under the common themes and presented in the form of a mind-map in Figure 1.

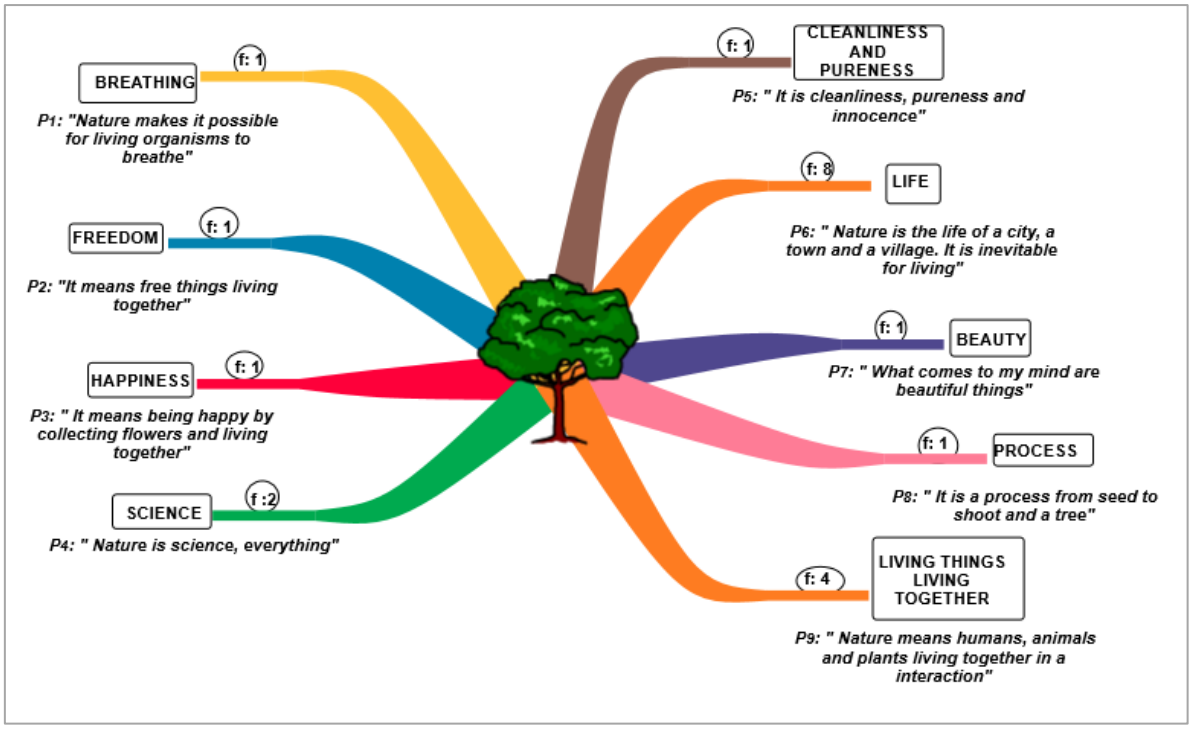

Figure 1: Students' perceptions on: *"What does the concept of nature mean for you? Please, explain your opinions about nature by drawing?"*

The themes having the highest frequency rates among the themes derived from the students' responses to the interview question *"What does the concept of nature mean for you? Please, explain your opinions about nature by drawing?"* are the themes of "Life" (f=8) and "Living organisms living together" (f=4). The themes of 'beauty', 'process', 'cleanliness', 'science', 'freedom', 'happiness', and 'breathing' were only repeated once. The sample drawings of the students having the highest frequency rates are shown below in Figure 2. Students explain their drawing of tree as *"Nature means humans, animals and plants' living together in an interaction"*; *"Tree is life"*; *"Tree is life, it is a source of life"*; *"Nature is life, science and everything"*.

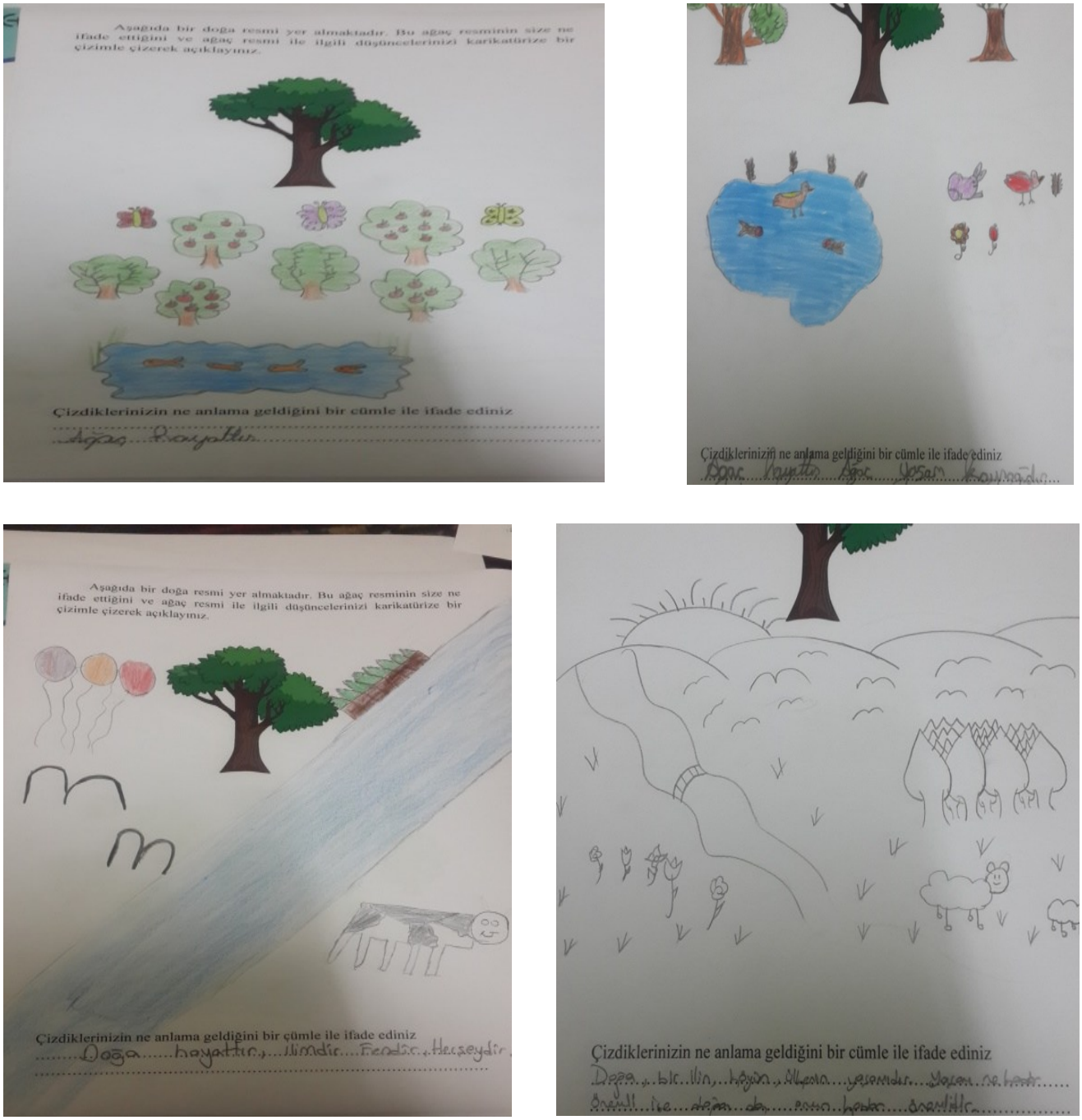

Figure 2: Some samples of the 7th grade students' drawings about the concept of nature

The data related to the second interview question "What does the concept of money mean for you? Please, explain your opinions about money by drawing." are gathered under the common themes depending on similar features and presented in the form of a mind-map in Figure 3.

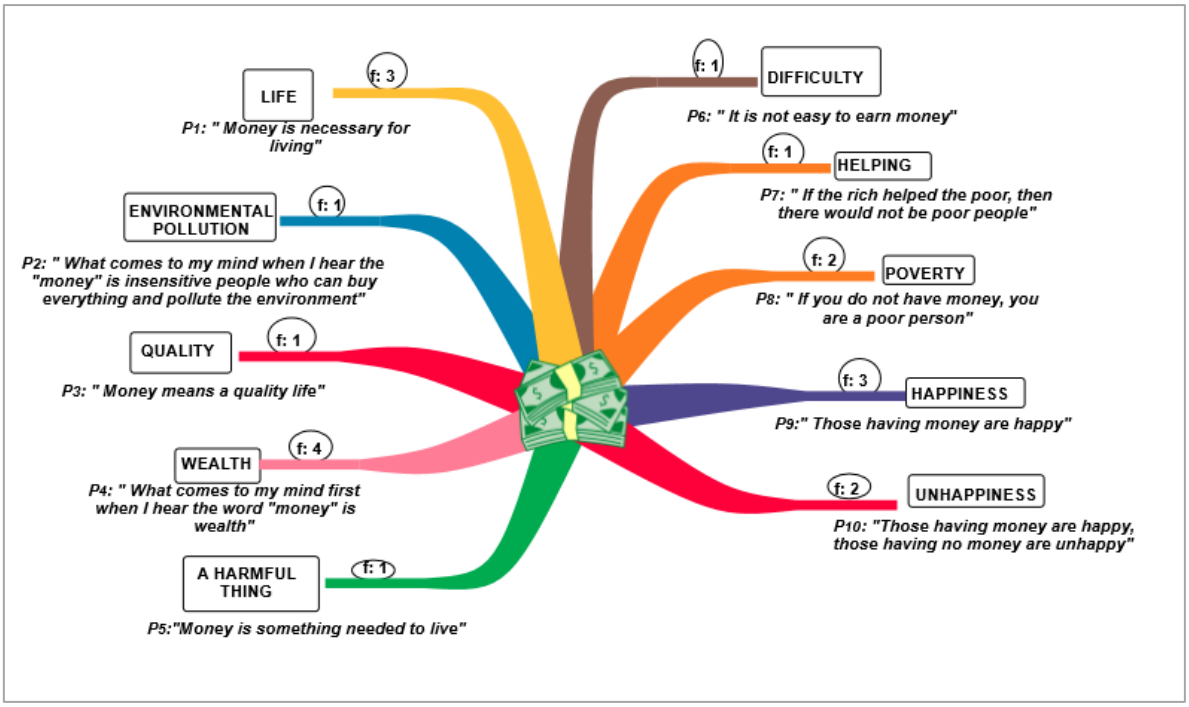

Figure 3: Students' perceptions on: "*What does the concept of money mean for you? Please, explain your opinions about money by drawing*?"

The themes having the highest frequency rates among the themes derived from the students' responses to the interview question "*What does the concept of money mean for you? Please, explain your opinions about money by drawing?*" are the themes of "life" (f=3), "wealth" (f=4), "poverty" (f=2), "happiness" (f=3), "unhappiness" (f=2) and sample drawings from these themes are shown below in Figure 4. Students explain their drawing with this statement "*What comes to my mind first when I hear the word "money" is wealth. But earning money is not easy*"; "*Money sometimes brings happiness and sometimes unhappiness*"; "*If you do not have money you are poor and unhappy, but if you have money you are rich and happy*". The themes of "difficulty", "a harmful thing", "quality", "environmental pollution", and "helping" were only repeated once.

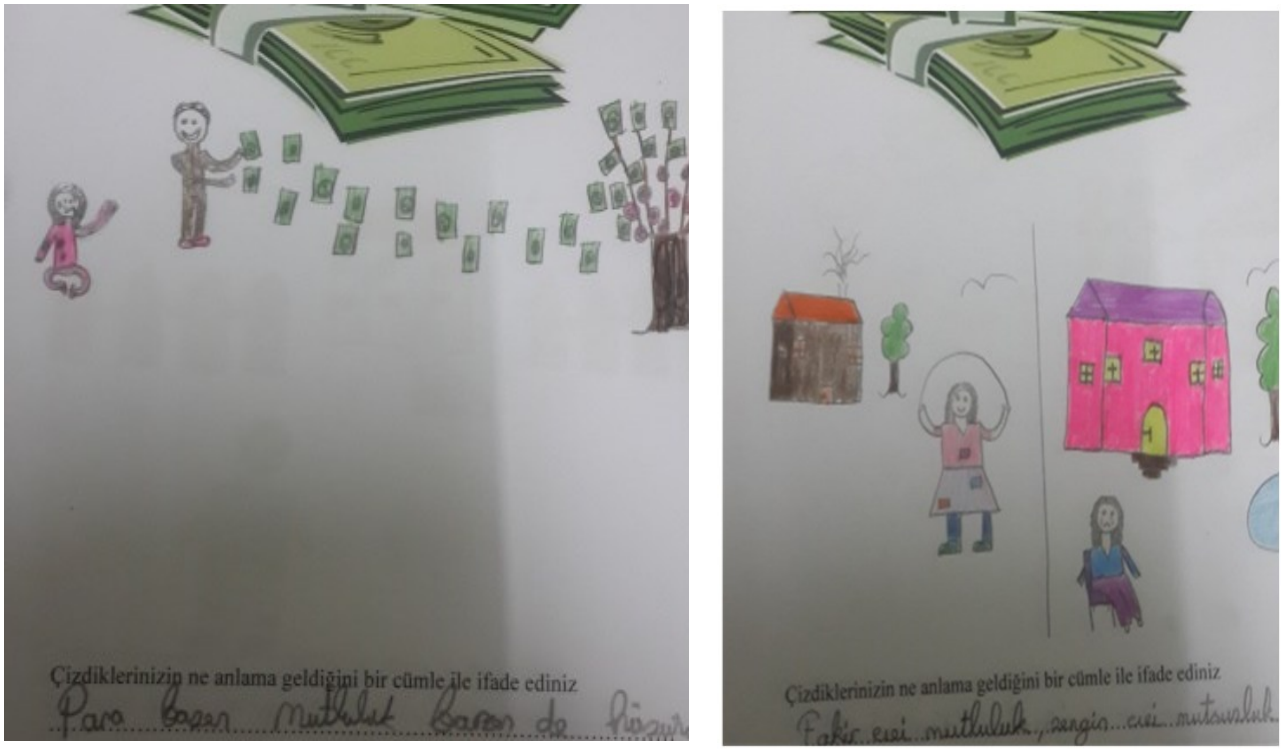

Figure 4: Some samples of the 7th grade students' drawings about the concept of money

The data related to the third interview question are gathered under the common themes and presented in the form of a mind-map in Figure 5.

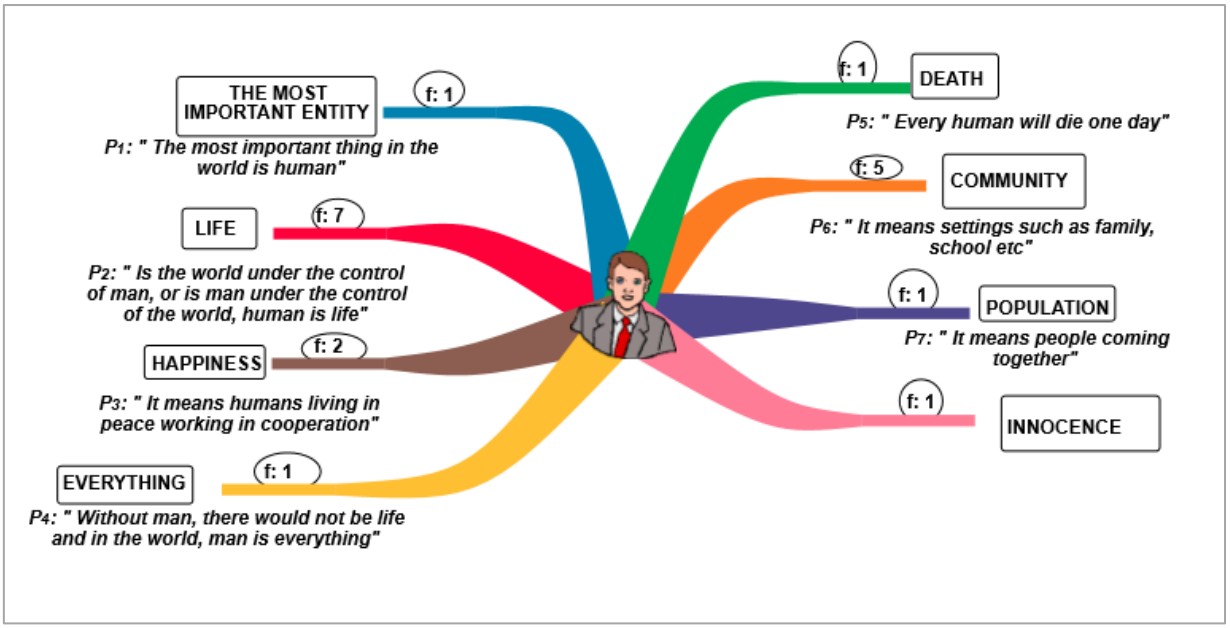

Figure 5: Students' perceptions on: "*What does the concept of human mean for you? Please, explain your opinions about money by drawing?*"

The themes having the highest frequency rates among the themes derived from the students' responses to the interview question "What does the concept of human mean for you? Please, explain your opinions about money by drawing." are the themes of 'life' (f=7), "community" (f=5), "happiness" (f=2), "the most important entity" (f=1) and the sample drawings from these themes are given below in Figure 6. Students explain their drawing with this statement *"Humans means settings such as family, school etc."* ; *"The most important thing in the world is man"*; *"Human is life, human is a community"*. The themes of "innocence", "population", "everything", and "death" were only repeated once.

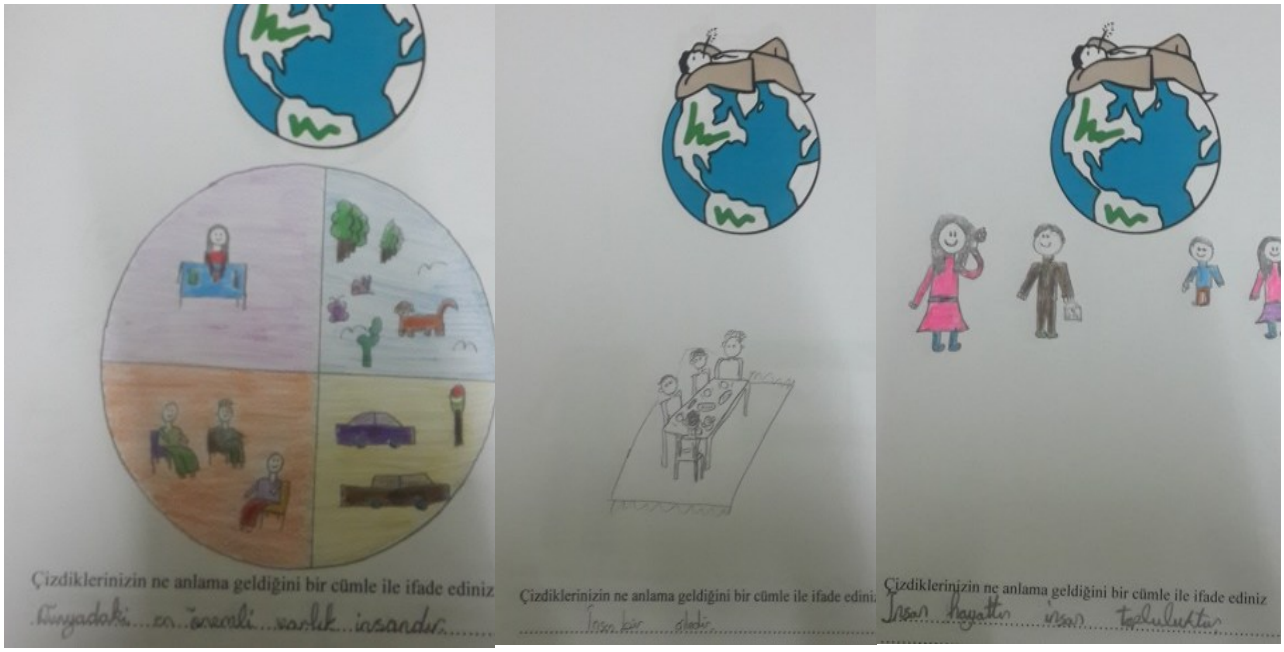

Figure 6: Some samples of the 7th grade students' drawings about the concept of human

The data related to the fourth interview question involving a group work are gathered under the common themes and presented in the form of a mind-map in Figure 7.

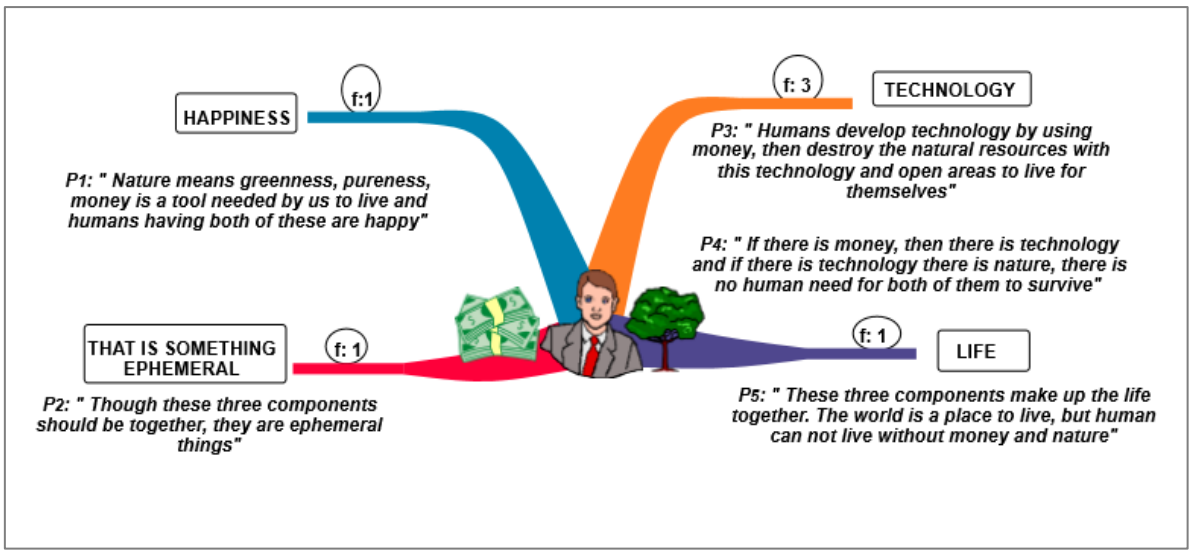

Figure 7: Students' perceptions on: "*Is there a relationship between nature, money, and human? Please, explain the relationships between these three concepts existing in our lives/ you think should exist in our lives by drawing.*"

The theme having the highest frequency rate among the themes derived from the students' responses to the question "*Is there a relationship between nature, money, and human? Please, explain the relationships between these three concepts existing in our lives/ you think should exist in our lives by drawing." is the theme of "technology?"* (f=3).

Sample drawings related to this theme are shown below in Figure 8. Students explain their drawings with this statement "*Human develop technology by using money, then destroy the natural resources with this technology and open areas to live for themselves"*; "*If there is money, then there is technology and if there is technology there is no nature, there is no human, human needs both of them to survive"*. The themes of "happiness", "something ephemeral", and "life" were only repeated once.

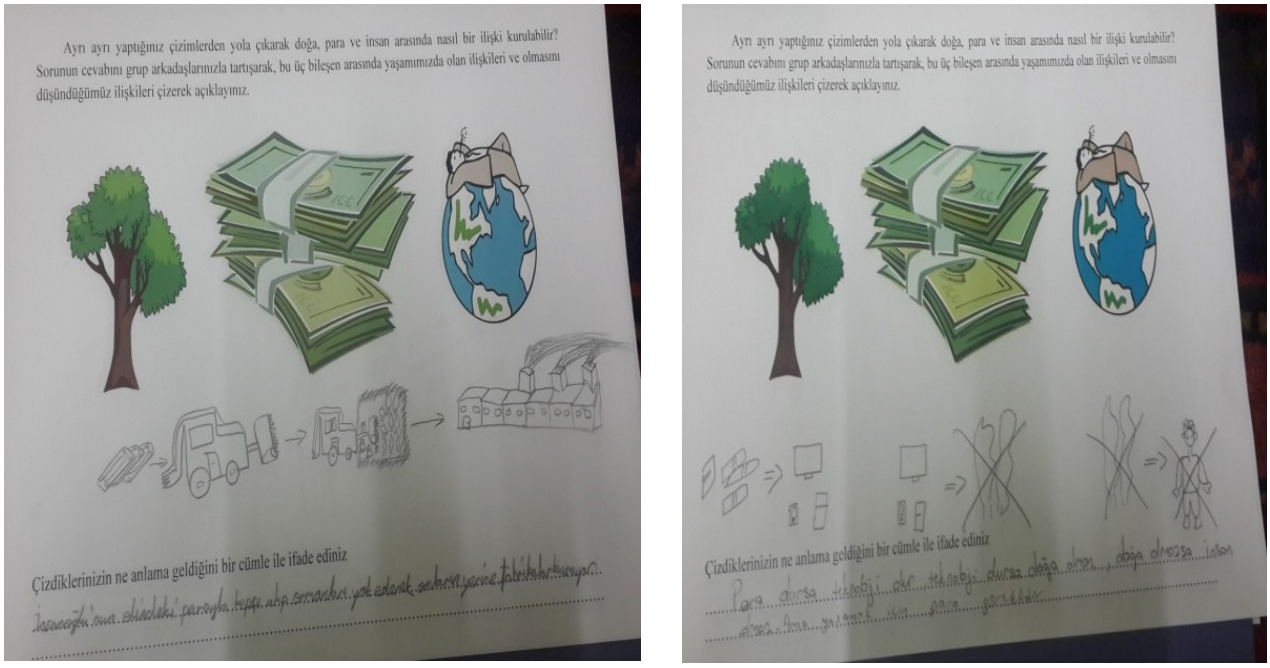

Figure 8: Some samples of the 7th grade students' drawings about the relationship between nature, money, and human

4. Discussion

In the current study, the purpose was to determine the opinions constructed by 7th grade students in their minds about the three components of the concept of sustainable developments "environment, society, and economy". By categorizing the students' drawings and explanations on the basis of their similarities, themes were created and thus the findings of the study were obtained. These common themes were illustrated through the drawing of mind-maps.

First, the students were given the data collection tool including the picture of a tree representing the "Environment" component of sustainable development. Then the students were asked to explain what the picture of a tree in this data collection tool means to them by drawing. When the students' drawings were examined, it was seen that the majority of the students identified the concept of "nature" with the concept of "life". In the literature, the concept of nature is defined as the living area of living things where all their needs are met (Yıldız, Sipahioglu & Yılmaz, 2000). Students used the statement "*humans, animals and plants living together*" to define the concept of nature in the current study. Nature is the unity constituted by the interaction of living and non-living things (Keleş & Hamamcı, 2005). When the reasons behind the parallelism between the students' drawings and the literature are examined, it is seen that in the third grade life-sciences textbooks of the updated education programs, nature is defined as "*a setting where living and non-living things exist in balance*" (Erten, 2014) and the

students' definition is likely affected from this definition. Yardımcı and Bağcı Kılıç (2010) concluded that students perceive the environment as a unity, including the interaction of living and non-living things, plants and animals.

Second, the students were given the data collection tool including the picture of money representing the "Economy" component of sustainable development. Then, the students were asked to explain what the picture of money in this data collection tool means for them by drawing. The students defined economy on the basis of money as needed to live. On the basis of the students' opinions about this component lies the belief that "*Those having money are happy and those not being rich are poor and unhappy*". This indicates that for the students, the concepts of happiness and unhappiness are equal to the concept of money. Harris (2000) stated that at the economy dimension of sustainability, when needs for food, clothes, transportation, health, housing and education are met at the optimum level with the lowest expenditure, then people can attain peace and happiness. Boratav (2002) pointed to the importance of money. The students defined money as a tool needed to continue living and emphasized that today, money is required to meet our needs, to satisfy our desires and to improve our living standards. They also indicated that money is not everything and may not make people always happy and people can be happy with small things.

Third, the students were given the data collection tool including the picture of a human representing the "Society" component of sustainable development. Then, the students were asked to explain what the picture of the human in this data collection tool means for them by drawing. When the common themes emerging from the students' drawings are examined, it is seen that the students defined human as the most important entity in the world, a part of life and individuals making up society. From early ages, students are informed about concepts such as individual, family, friend, society, and nation and the importance of human is emphasized. In their drawings, the students also emphasized the importance of human and society. Tolan (1978) defined the society as "*a community of people made up of individuals and having a unique structure, social relationships and a shared culture*". This definition is parallel to the students' drawings and explanations produced for the picture of human.

Finally, in order to find out what the togetherness of the three components of sustainable development means for the students, the fourth data collection tool including the pictures of tree, money, and human together was given to the groups of students and they were asked to draw a group picture to depict what the togetherness of these three components means for them. When the common themes derived from the students' group drawings are examined, it is seen that the togetherness of these three components means technology for students. As Rosner (1995) stated that technology may allow future generations a fair share again. This does not imply, of course, that

technology will restore the original, undamaged situation. It means only that the ability to fulfill the needs of future generations is still guaranteed - presumably in other ways than those we use now - without forcing them into environmental bankruptcy. The essence is therefore that technology may offer some chance, but it is doubtful whether technology can be adequate on its own to cope with the existing severe problems. Simon (1983) pointed out that technology is rational discipline designed by humans by using science to rule over the nature (as cited in Sarıtaş, 2009). From an abstract and experimental viewpoint, technology can be defined as a small group's dominance over the rest (humans, events, machines etc.) by means of an organized hierarchy (McDermott, 1981). In their drawings, the students defined technology as something that can be created by using money to control and destroy nature and to open up living areas for themselves. They emphasized the systematic togetherness of these three components for the world to exist, for humans to survive, and for them to be happy. Walshe (2008) conducted a study with the participation of 8th graders and found that few students were able to show the relationship between the three components of sustainable development by means of concept-maps. Petersen and Alkış (2009) reported that many students do not know the concept of sustainable development and the ones knowing the concept stated that they participated in applied school activities such as project, club and competition activities. Yapıcı (2003) pointed out that sustainable development education has not drawn enough attention for years and educational organizations have not been very successful in addressing shortcomings in this area, emphasizing that educational programs should be enhanced with applied visual and audio materials. Moreover, Higgs and McMillan (2006) investigated how schools constructed their sustainable education in their organizations and concluded that instead of direct exposure to the information about sustainable education, students should be provided with opportunities to continuously observe sustainable applications at schools so that their learning can be more permanent. Acar (2008) pointed to the need for the renewal of sustainable development education programs, for increasing the rate of schooling, for the elimination of inequality in having access to education, and for increasing the resources allocated for education and particularly to the need for quality enhancement.

The findings of the current study showed that revisions should be done on sustainable education programs in such a way as to include the other two dimensions besides the dimension of environment. Tanrıverdi (2009) and Yapıcı (2003) also reported findings concurring with this result, stating that all three components of sustainable education should be equally focused upon, because future-oriented global environmental education cannot be considered independent of economic and social dimensions.

In light of the findings of the current study, it can be argued that mental relationships constructed by the students between the components of sustainable development are consistent with the concept of sustainable development. Models can only be offered, and the best an author or a teacher can do is to make them as plausible as possible and to attach them to perceptions already present in the audience's mind. In light of the findings of the current study, it can be suggested that similar studies should be repeated with larger samplings from both state and private schools, and then in light of the findings of this research, a systematic revision of sustainable development education can be conducted.

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