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RESEARCH REPORT

Turkish Student Science Teachers' Conceptions of Sustainable Development: A phenomenography

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In creating a society whose citizens have sustainable lifestyles, education for sustainable development (ESD) plays a key role. However, the concept of sustainable development (SD) has developed independently from the input of educators; therefore, ESD presents current teachers with many challenges. At this point, understanding how stakeholders in the education sector (school students, student teachers, and teachers) view SD is of great importance. We selected a sample of 113 Turkish student science teachers from this body of stakeholders and distributed a questionnaire to them that included two separate sections. In the first section, questions regarding personal information such as gender, age, and year group were asked, whereas the meaning of SD was the focus of the second part. A phenomenographic approach was used to analyse student teachers' descriptions of SD. The results showed that student teachers had a variety of ideas about SD that could be collected under headings such as environment, technology, society, economy, politics, energy, and education. In addition, we thought that gender, context-based issues, and informal experiences might be responsible for the variety of the responses.

Keywords: Student teachers; Sustainable development; Education for sustainable development; Phenomenography

Introduction

Conceptions of Sustainable Development

The term sustainable development (SD) has an intriguing historical background relative to other concepts that have equally wide-ranging effects on scientific disciplines such as environmental science, economics, politics, and engineering, among others. This concept was developed at international conferences and via declarations

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(Mckeown, 2002; UNESCO, 2010) rather than evolving by the philosophies associated with the aforementioned disciplines. The concept of SD first appeared on countries' agendas in the late 1980s. The World Commission on Environment and Development promoted the concept of SD at that time. Before then, environment and development tended to be considered two distinct concerns, with the need to promote development on the one hand and the need to protect the environment on the other. At the 1992 Earth Summit in Rio de Janeiro, the environmental side of SD emerged as a main focus. Poverty eradication was viewed as important, but the Rio declaration and Agenda 21, which were the main documents to emerge from the Earth Summit, primarily emphasised the importance of protecting the natural environment. A more fully developed paradigm of SD was endorsed at the highest political levels at the World Summit on Sustainable Development in Johannesburg in 2002. The political declaration states that SD includes social development and environmental protection, both of which must be established at local, national, regional and global levels. The current paradigm of SD establishes linkages between poverty alleviation, human rights, peace and security, cultural diversity, biodiversity, food security, clean water, and sanitation, renewable energy, the preservation of the environment, and the sustainable use of natural resources (UNESCO, 2010).

Today, many authors consider SD to be a complex, contested (Mckeown, 2002; Summers & Childs, 2007; Summers, Corney, & Childs, 2003) and problematic term (Bonnett, 2002), perhaps because of its aforementioned historical background and because it is a concept that is still evolving (Mckeown, 2002). Even though there is still no definition that has achieved a broad consensus among stakeholders, there are five particular trends in defining SD that receive significant attention.

The first trend is represented by a definition of the World Commission on Environment and Development (1987). According to this definition, SD is 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs' (p. 43). Some authors (Gil-perez et al., 2003; Summers & Childs, 2007) believe that a consensus has been reached endorsing this definition, even though the definition does not explain the nature of needs or how they would be met.

The second trend is based on the idea that SD must be conceptualised in terms of three dimensions at the very least. These dimensions are the environmental, economic and social (Corney, 2006; Gough, 2002; Mckeown, 2002; Summers & Childs, 2007; Summers, Childs, & Corney, 2005; Summers, Corney, & Childs, 2004). To the researchers, these three areas are intertwined, and therefore, any definition of SD needs to centre on the inter-relationships between these three dimensions (Petersen & Alkış, 2009).

The third trend places emphasis on rejecting reductionist approaches when defining SD. The authors who support this trend present differing interpretations rather than seeking consensus in terms of the concept of and processes associated with SD (Corney, 2006). Then, unlike the previously discussed trends, the fourth trend

sees the term SD itself as semantically difficult to understand (Bonnett, 2002; Summers et al., 2003). Some writers in this trend have proposed new terminology intended to emphasise their own opinions and concerns (Summers et al., 2003). Bonnett (2002), for example, uses the phrase ‘sustainability as a frame of mind’. In his opinion, this frame of mind does not ‘simply have to do with the issue of peoples’ attitude towards environment but represents a perspective on the set of the most fundamental ethical, epistemological and metaphysical considerations which describe human being’ (Bonnett, 2002, p. 14). In another example, Gough (2002) suggests that to conceive of SD as ‘a destination of any kind’ (p. 70) is a mistake. SD is, rather, ‘a way of travelling’ (p. 70). According to this analogy, people cannot hope to learn definitively where they are going or how to get there. They can, however, learn how to maintain more rather than have less control over the journey.

The final trend encompasses several attempts to describe the term SD using categories or parameters. Dawe, Jucker, and Martin (2005), for example, use nine different categories pertaining to SD: diversity, needs and rights of future generations, uncertainty and precautions, social justice, interdependence, citizenship and stewardship, acceptance of limits, deceleration and the idea that small is beautiful. Bonnett (2002) uses three parameters—semantic, ethical and epistemological—in defining SD. Sauve (1996), in contrast, makes use of an analytical tool including a typology of conceptions of SD. In this typology, the categories are continuous development owing to technological innovation and free trade, development as dependent on the world order and production modes, alternative development, and autonomous development (indigenous development).

Education for SD

As the concept of SD was discussed and formulated, it became apparent that education is the key to sustainability (Mckeown, 2002). Since the late 1980s, when the term SD was first introduced, the concept of education for SD (ESD) has also evolved and been discussed and negotiated at different international meetings. As a result, a great deal of relevant declarations (D) and agreements have been signed: the Stockholm D, the Tallories D, the Halifax D, Chapter 36 of Agenda 21 in the Rio D, the Swansee D, the CRE-Copernicus Charter, the D of Barbados, the Earth Charter, the Thessaloniki D, the Lüneburg D, the D of UBUNTU, and the UN Decade of ESD (Segalas, Ferrer-Bales, & Mulder, 2008). Of these, Chapter 36 of the Agenda 21 and the UN Decade of ESD have a special place in the conceptual development process of ESD. Initial thoughts concerning ESD were captured in Chapter 36 of Agenda 21. This chapter identified four major thrusts for beginning the work of ESD: improving basic education, reorienting existing education to address SD, developing public understanding, and training (Mckeown, 2002). Additionally, the 57th session of the UN General Assembly in 2002 adopted a resolution proclaiming the UN Decade of ESD from 1 January 2005 to 31 December 2014. Governments around the world are now working on measures to implement

the Decade of ESD, fine-tuning their respective educational strategies and action plans and taking into account the international implementation scheme (UNESCO, 2010).

As with SD, defining ESD is difficult. In a straightforward sense, ESD is a way of linking education and SD (Corney & Reid, 2007). According to Dawe et al. (2005), ESD enables people to develop the knowledge, values and skills necessary for them to participate in decisions (both locally and globally) that will improve the quality of their lifestyles without damaging the planet or its future. ESD is a visionary approach to education that seeks to help people better understand the world in which they live and face the future with hope and confidence, knowing that they can play a role in addressing the complex and interdependent problems that threaten their future: poverty, wasteful consumption, environmental degradation, urban decay, population growth, gender inequality, health issues and the violation of human rights (UNESCO, 2010).

Addressing the contribution of education to SD, Bonnett (2002) points out two ways in which this can occur. First, education can be a vehicle for actively promoting positive attitudes and proenvironmental behaviours that are requirements for SD. Secondly, developing students' critical abilities and understanding of sustainability issues can help because it can allow them to make informed decisions. Mckeown (2002) stresses that education can directly affect sustainability plans in three areas: implementation, quality of life and decision-making. In terms of implementation, Mckeown believes that an educated citizenry is vital to implementing sustainability projects. In addition, Mckeown points out that nations with high illiteracy levels and an unskilled workforce have fewer development options because they are forced to buy energy and manufactured materials on the international market with hard currency. In terms of quality of life, education raises the economic status of people, lowers infant mortality and improves living conditions. When it comes to decision-making, Mckeown stresses that making good community-based decisions that will facilitate social, environmental and economic welfare depends on having educated citizens.

Even though ESD promises a positive brand of future citizenship, it entails many challenges for current educational practices. On a theoretical level, unlike most education movements, ESD evolved in political and economical forums. In many countries, the concepts and content associated with ESD have been developed by ministries and then given to educators to deliver. This ill-conceived form of development independent of educators' input is considered a significant challenge (Mckeown, 2002; UNESCO, 2010). Another challenge stems from the conceptual structure of ESD. There are no boundaries or even indicators related to ESD yet. This leaves teachers with a fuzzy picture of what ESD is about, what they are supposed to teach and what teaching strategies they should use (Chatzifotiou, 2006). Additionally, because this education involves new educational approaches and the introduction of complex subjects, the issue of whether teachers have enough knowledge about these approaches and subjects is another problem. Cross (1998), for example, reports that teachers are unfamiliar with literature dealing with the concepts of SD. According to him, teachers are not facilitating understanding grounded in theory; their efforts appear to lack clarity

and may send confused messages to students. The final challenge may be the multifaceted nature of ESD. Some teachers see the topic of SD as a new, 'separate' subject to be integrated into an already overcrowded curriculum (Summers et al., 2003). On the contrary, it is an interdisciplinary construct and covers controversial, value-laden, and complex issues (Corney, 2006; Winter & Firth, 2007). Therefore, in addition to transmitting knowledge, ESD should also include lessons on critical thinking, complexity, values, and ethics (Segalas et al., 2008).

Previous Research

The research on conceptions of SD has focused on school (pre-college) students, undergraduates and teachers. In some studies, researchers have used an open-ended item that asked participants to define the concept of SD, whereas in others, closed-ended items were used to probe whether participants had any knowledge of SD or exhibited behaviours that are compatible with sustainable lifestyles.

School students generally seem to be unaware of the concept of SD (Petersen & Alkış, 2009). Even though the majority of these students do not have a clear understanding of the complex issues of SD (Petersen & Alkış, 2009), some use three main concepts—environmental, social and economic sustainability—when defining SD (Walshe, 2008). In addition, Walshe (2008) notes that the concepts of 'preservation', 'improvement', 'timescale', and 'future' are important arguments to school students. Evaluating the reasons why school students do not fully grasp SD, some authors (Petersen & Alkış, 2009; Siegel, 2006) have stressed that most teaching related to SD at the primary and secondary level focused on environmental issues and noted that vital issues such as sustainable lifestyles, employment patterns, values, stewardship, worldviews, and political actions received little attention.

The literature about knowledge of SD at the undergraduate level emphasises the realm of engineering and teacher training (Dawe et al., 2005). With regard to engineering, Azapagic, Perdan, and Shallcross (2005) report that although some students believed that SD was more important for future generations than for them, they exhibited knowledge gaps about topics such as components of SD, approaches to SD, precautionary principles, and stakeholder participation. According to the researchers, these knowledge gaps occur because engineering students perceived sustainability issues as 'soft' science in comparison to 'hard' engineering courses and thus, were not interested in the former. Segalas et al. (2008) asked engineering students to draw conceptual maps before and after taking a course about SD. The categories included in their analysis were environmental aspects, resource scarcity, social impact, cultural and value aspects, future generations, imbalance, technology, economic aspects, educational aspects and actors, and stakeholders. Before the course, students considered sustainability significantly related to the environment and technology categories; after the course, these categories were still viewed as the most relevant. Carew and Mitchell (2006) strove to identify the metaphors that engineering academics use in understanding the concept of sustainability. The researchers identified four different metaphors: sustainability as weaving (cohesion and flexibility),

sustainability as guarding (resource conservation), sustainability as trading (cost–benefit analyses), and sustainability as observing limits (availability of limits).

Regarding student teachers, Tuncer, Tekkaya, and Sungur (2006) report that Turkish student teachers were conscious of the concept of sustainability, as noted in their responses to a questionnaire based mainly on environmental aspects of sustainability. These students believed in the importance of conserving resources for future generations, prioritised environmental issues over economic growth, and expressed an intention to take on individual roles in solving environmental problems. In another study conducted in the same university on a different group of student teachers, it was found that student teachers did not have a background in regarding issues of SD (Tuncer, 2008). However, as in the former study, participants were willing to protect natural resources and make changes in their lifestyles. Based on another sample in the UK, Summers and Childs (2007) note that a large majority of student science teachers were able to identify valid features of SD: notably the centralisation of the environment (72%) and economic (53%) and social (31%) factors. About 15% highlighted all three of these factors, while 60% mentioned at least two of them. In addition, Summers et al. (2005) studied the mentors of student teachers in Post-Graduate Certificate of Education courses in the UK and reported that, like student teachers in the former study, a large number of mentors recognised the centrality of the environment (69%) as a focus for SD; awareness of economic factors (49%) and social aspects (20%) were the second and third most prevalent factors mentioned.

When it comes to teachers, there is a consensus that current educators lack a proper understanding of sustainability issues (Cross, 1998; Gil-perez et al., 2003; Spiropoulou, Antonakaki, Kontaxaki, & Bouras, 2007). Spiropoulou et al. (2007), for example, report that teachers exhibited misunderstandings and misconceptions regarding the conceptual meaning of sustainability and renewable energy. In addition, Cross (1998) reports that teachers demonstrated a lack of understanding grounded in theory and associates this state of affairs with their limited knowledge and resources related to issues of sustainability. Despite this negative picture, some studies showed that teachers were aware of the importance of human action in sustainable lifestyles and their role in moulding a conscious new generation (Elshof, 2005; Summers et al., 2003).

Problem

Through our investigation of the existing literature, we determined some main issues on which we can base this research. First, as mentioned above, the term SD has not completely evolved its meaning yet. This makes it a difficult concept to teach properly. Despite this complexity of SD, policy-makers in many countries strive to develop the concept independent from educators. At this stage, we thought that it was essential to understand the perspective of stakeholders in the education sector (school students, student teachers, teachers, academics) on SD.

We chose student teachers as our sample. Many scholars agree that teacher education is a key strategy for achieving a sustainable society (e.g., Ferreira, Ryan, & Tilbury, 2007; Firth & Winter, 2007). This education provides unique opportunities

for developing a society's concept of SD. Additionally, in the process of developing ESD, we consider student teachers as the leading actors. Because most current teachers did not take any courses related to SD during their schooling and because issues of sustainability were not discussed via the popular media during their training (Huisingh, 2006), it seems that current student teachers might have developed various pre-conceptions about SD that are intriguing to study. In addition, we are aware that these pre-conceptions can be resistant to change (Corney, 2000), and this fact indicates that teacher candidates can use these pre-conceptions in their future teaching practices.

Another issue was that of independent variables related to conceptions of SD in the existing literature. We foresaw that among student teachers, gender might have an influence on how well understood the concept of SD was. Even though there is a relatively large body of research on the effects of gender on psychometric variables such as knowledge (Makki, Abd-El Khalick, & Boujaoude, 2003), attitudes (Bord & O'Connor, 1997), values (Dietz, Kalof, & Stern, 2002), and risk perceptions (Davidson & Freudenburg, 1996) related to environmental issues, we found only a few studies (Azapagic et al., 2005; Tuncer, 2008; Tuncer et al., 2006) that had tried to investigate differences in males' and females' perceptions of SD. Azapagic et al. (2005), for example, note that gender does not have an influence on understanding of SD and the related issues. On the other hand, Tuncer et al. (2006) conclude that females are more conscious about SD than males. They associate this result with the fact that females express greater concern than males in environmental issues. Finally, Tuncer (2008) argues that females are more sensitive towards SD compared to males. Like in the former study, Tuncer (2008) explains these differences by using the arguments in the existing literature about attitudes towards environment.

The final issue for us was the context of the research in the existing literature. At first glance, we could see that the literature related to conceptions of SD was dominated by British, American and Australian studies. Because these are all developed countries, we expected that people's understanding of SD in these countries would be different from that of individuals living in the developing countries. We believed that Turkey, as a developing country with a population of almost 70 million, would serve as an intriguing sample. All in all, this study aimed to answer two questions:

- (1) What are Turkish student science teachers' conceptions of SD?
- (2) Does gender have any effect on Turkish student science teachers' conceptions of SD?

Methods

Phenomenography as a Research Approach

In the present study, we utilised phenomenography as a research approach. In the late 1970s, a group of Swedish researchers developed this qualitative approach (Barnard, McCosker, & Gerber, 1999). Phenomenography is a research method of mapping qualitatively distinct ways in which people perceive, conceptualise, understand and

experience various dimensions of and phenomena in the world around them (Marton, 2001; Sjöström, & Dahlgren, 2002). In other words, it is concerned with the relations between human beings and the world around them.

Phenomenographers categorise the descriptions provided by their subjects as the primary outcome of phenomenographic research. At this point, the goal of phenomenography is to ascertain the structural framework within which various categories of understanding exist. Such structures (categories of description) should prove useful to understanding other people's understanding of a subject (Barnard et al., 1999; Marton, 2001). Toward this end, the researchers use open-ended questions to let the participants choose what dimensions of each question they wish to address. Therefore, semi-structured interviews and questionnaires including open-ended items are the main sources of data in phenomenographic research (Örnek, 2008; Stamouli & Huggard, 2007).

The first phase of the data analysis process is a selection procedure based on criteria of relevance. The statements considered to be related to the main phenomenon are selected and marked. After that, each statement is interpreted in relation to the context from which it is selected. The result is a set of categories of statements that are formed according to their similarities (Barnard et al., 1999; Marton, 2001; Örnek, 2008).

Phenomenography has continued to emerge in education research as a new approach to qualitative research since its invention (Barnard et al., 1999). These studies probe how students understand and construct new knowledge (Örnek, 2008). Another benefit of this research is the fact that students become aware of discrepancies in their understanding and learn to be open to different ideas (Marton, 1986). In environmental education literature, this method was used for determining conceptions of environment (Demirkaya, 2009; Loughland, Reid, & Petocz, 2002; Sauve, 1996), understanding of hazardous household items and waste (Malandrakis, 2008), and perceptions of sustainability (Reid & Petocz, 2006).

Design of the Questionnaire

The questionnaire consisted of an open-ended item asking student teachers what they understood of the concept of SD preceded by a cover sheet that asked participants to record their year group in school, age and gender. Following this item, a blank area was left so that student teachers could write what they knew about this concept.

Sample

A total of 113 student science teachers enrolled at Ahi Evran University in Turkey made up the sample. The distribution across the various year groups was as follows: 28% were in year 2; 53% in year 3; and 19% in year 4. Forty four (39%) of the respondents were males, whereas 69 (61%) were females. The average age of the participants was 22.4.

The teaching science programme in Turkey covers 4-year education. First 3 years include many theoretical and lab-based courses, whereas last year includes especially teaching practices in local elementary schools. Through this education, student teachers take some courses regarding environmental subjects, such as General Biology, Specific Issues in Biology, Environmental Awareness (elective), and Environmental Sciences. For the former two courses, the emphasis is placed on food chains, population dynamics, and ecosystems. For the latter two, especially the reasons, mechanisms, results and cure methods of environmental pollution are taught. In addition, SD is included in the programme of Environmental Sciences course as a separated unit.

Administration of the Questionnaire

Questionnaires were completed during normal classroom lessons in the presence of the usual lecturers and one of the researchers. The questionnaires were completed individually under 'examination conditions', although no time limit was imposed. In addition, student teachers were assured that their responses would be anonymous.

Analyses of Data

After collection of the completed compositions, the responses were typed into Excel and then printed out. The transcripts of these responses were exposed to phenomenographic analysis using 'mind maps' by the authors. In this analysis, we adopted the approach of Dahlgren and Fallsberg (1991). The first stage was that of *familiarisation*. At this stage, the transcriptions were read and listed. The second stage entailed the *compilation* of all respondents' answers to the main open-ended question (What is the meaning of SD?). The main task here was to show the most significant elements of each participant's answer. The third stage was the *condensation* of the answers as intended to locate the central parts of the longer answers. At this stage, a preliminary classification of descriptions was developed. The fifth stage was a preliminary *comparison* of the categories of descriptions. Some revisions to the categories were made at this stage. The final stage was the *naming* of the categories of descriptions.

Once the analysis was completed, the mind maps showing different group of descriptions and their linkages with the main theme (SD) were prepared by the two authors independently. Afterwards, the authors discussed the categories, and then overlapping categories were determined. As a result of these discussions, minor changes were made to some categories. In addition, these mind maps were explained to two experts in the educational sciences, who were asked to place each description into a suitable position on the mind maps. According to these placements, we slightly changed the original maps and attained final versions.

In Figure 1, we present an example of how we developed a mind map based on a related answer by a participant. The boxes display the main descriptions and themes, whereas the lines show conceptual linkages. We placed the figures on the lines. Because a participant might have different descriptions in the same composition, we used these figures to indicate the number of descriptions rather than the number of participants.

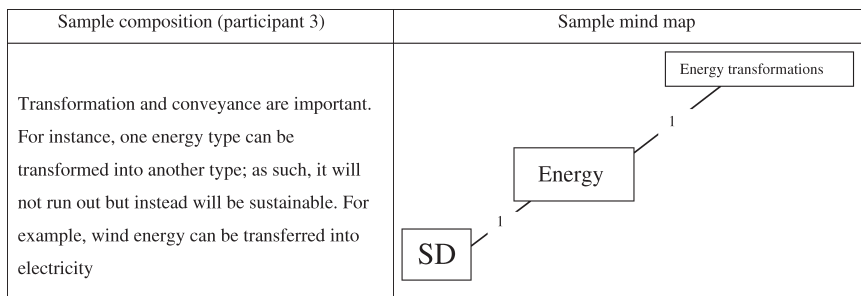


Figure 1. A sample of the phenomenographic analysis conducted in the present study

Results

Conceptions of SD

As seen in Figure 2, the participants' main conceptions of SD fell into seven categories: 'environment', 'energy', 'society', 'education', 'economy', 'technology', and 'politics'. Of these categories, 'environment' was the most popular according to the responses of the participants. Fifty participants (36%) described SD as related to 'environmental' considerations. Of those 50, 23 participants thought that SD meant 'sustaining the natural balance'. These participants had the idea that nature preserved a balance and that human activities usually destroyed this balance. They therefore thought that any development, like human activity, should be compatible with the natural equilibrium. Some participants in this group drew attention to the balance between humans and nature and acknowledged that people should protect this balance if they wish to leave something for future generations. Additionally, some pointed out that recycling was an important way to sustain the natural balance because it restricts humanity's effect on nature. Also, one participant expressed that protecting natural resources by cultivating technologies such as renewable energies would be influential in sustaining the natural balance, whereas another said that protecting biodiversity is crucial to sustaining the natural balance. Again out of 50, 17 individuals stressed that the meaning of this concept was 'development without damaging the environment'. These participants were aware that some developmental actions, such as building new factories and dams, had damaged the environment in the past. Three participants in this group expressed the idea that creating environmental awareness was a necessary condition for this sort of development. Using renewable energy would lead to this development according to another three. An additional three believed that the fundamental consequence of this harmless development would be that more natural resources would be left to the next generation. Of 50, 9 participants defined SD as 'finding permanent solutions, not temporary ones'. According to these participants, policymakers had implemented temporary solutions to current environmental problems, giving much more importance to the economic aspects of the solutions than to questions of their effectiveness and sustainability. Some participants in this group felt that building a conscientious society and strong cooperation between the public and the government would be essential to finding

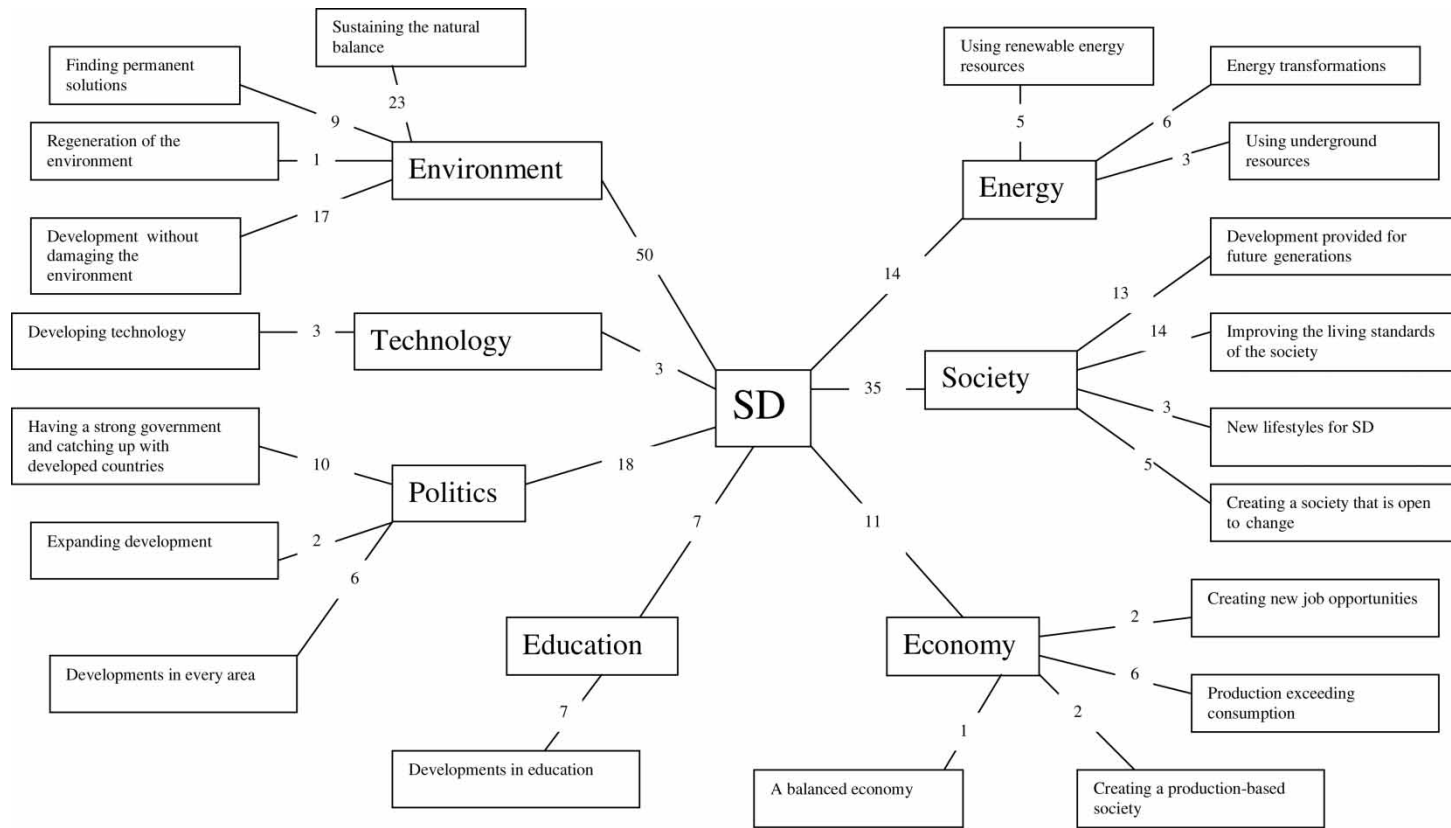


Figure 2. The distribution of the number of descriptions in accordance with the conceptual linkages

permanent solutions. In practical terms, a few participants gave some examples—such as recycling, protecting biodiversity and planting trees—as possible permanent solutions. Finally, of the 50 individuals, 1 participant described SD as the ‘regeneration of the environment’. According to him, the environment had the capacity to regenerate itself even if humans destroyed nature.

Thirty-five participants (25%) described SD in ‘social’ terms. Of the 35, 14 stressed that SD was ‘improving the living standards of society’, perhaps because they were aware that there were some people who live in poverty in Turkey. According to these participants, resolving health problems such as pandemic cases, facilitating the education system financially and taking new precautions with regard to environmental problems was likely to be influential in improving the living standards of the public. A few, on the other hand, commented on the 5-year development plans and the Southeastern Anatolia Project (SAP). These participants felt that these kinds of plans or projects addressed new job opportunities and government support for the people who live in rural places. Of the 35, 13 participants described SD as ‘development provided for future generations’. These participants thought that current developments would affect the next generation and that people should therefore consider the rights of that generation. An important point for most participants in this group was the ‘human factor’. In other words, they believed that governments were temporary organisations and that every human should know his or her responsibilities to future generations. In addition, a few thought that strong public awareness was an essential condition for achieving this kind of development. Again out of the 35, 5 defined SD as ‘creating a society that is open to change’. These participants emphasised that changing the public’s perceptions about their lives should be the first step. They considered current societies to be ignorant and conservative, so that the main obstacle was combating prejudices and creating transparency about ‘change’. Three participants out of the 35 expressed that SD had to do with ‘new lifestyles’. In their opinion, current lifestyles relied on over-consumption and selfish feelings; thus, adopting behaviours related to sustainable living and helping to create a well-informed public would result in SD.

Eighteen participants (13%) made use of ‘political’ arguments in describing SD. Of the 18, 10 participants reported that SD was ‘having a strong government and catching up with developed countries’, perhaps because they considered Turkey to be a developing country. In addition, economic frustrations in Turkey might make these participants pessimistic about Turkey’s development, causing them to view this term (SD) in terms of financial crises in recent decades. Catching up with developed countries, on the other hand, is a slogan that was first mentioned by Kemal Ataturk, founder of the Turkish Republic, in 1933. This statement is visible on some textbooks’ coversheets and in the foyers of some schools in Turkey. Therefore, these participants might associate this statement with SD because both address the idea of a strong and developed country. Some expressed that to achieve this goal, Turkey should reduce its dependence on other countries; they gave examples such as that of seeds imported from Israel. Some participants, on the other hand, believed that today’s Turks should learn from their roots in Ottoman Empire, which lasted for about 600 years.

A few suggested that large-scale projects such as the SAP, which entail different solutions, might shorten the transition to development for the nation. Another 6 out of the 18 defined SD as ‘development in every area’. These participants stressed that development should occur simultaneously in different disciplines such as education, environment, economy, technology, and energy. According to them, these disciplines could not be independent of each other, and any changes or problems in a particular area will lead to a domino effect and cause new problems in the other areas. They believed that only governments with strong policies encompassing all areas and stakeholders would accomplish SD. Finally, again out of the 18 individuals, 2 defined SD as ‘expanding development’. These participants felt that SD entailed a long process and therefore it required long-term policies such as 5-year development plans in Turkey. The difference between the former definition and this one is that these participants highlighted some priorities in the development process, a process that would expand so as to cover all areas eventually.

Fourteen participants (10%) highlighted concepts related to ‘energy’ in defining SD. Of those 14, 6 suggested that ‘energy transformations’ would be necessary to achieve SD. These participants gave examples that were based on thermodynamic laws and stressed that energy did not disappear but rather just transformed into different types. An interesting point that these participants made use of was the argument about recycling as an element of SD; perhaps they thought that recycling was a kind of energy transformation and that it caused the materials involved not to disappear. Of the 14, 5 described SD as ‘using renewable energy resources’. These participants saw energy as an essential condition for development, so that any country would need unlimited or renewable resources. In addition, they were aware that this energy was environmentally friendly and transferrable to future generations. Also of these 14, 3 described SD as ‘using underground resources’. They thought that if the governments that have rich underground resources such as Turkey used these resources productively, this would result in SD.

Eleven participants (8%) defined SD in an ‘economic’ sense. Of these 11, 6 considered SD to be a matter of ‘production exceeding consumption’. According to them, a country should be powerful in a financial sense, and policy-makers could achieve this power only if production exceeded consumption. Tourism, agriculture, and technology were the examples that the participants gave of tools that countries with SD use. Two more of the 11 defined SD as ‘creating new job opportunities’. These participants pointed out that Turkey had a large unemployed population and that the best solution to that problem was SD. Again of the 11, 2 expressed that ‘creating a production-based society’ was a fundamental condition for SD. Both used a Chinese proverb—give a man a *fish*, and he will eat for a day; *teach* a man to *fish*, and he will eat for a lifetime—in their descriptions. According to them, a society based only on consumption was a big barrier to SD. Finally, of the 11, 1 participant considered SD to mean ‘a balanced economy’. According to her, any country that enjoyed production that was on an equal level with its consumption would have SD. In addition, she used a Turkish proverb—cook it with its own oil—to address the balanced nature of SD.

Seven participants (5%) used 'educational' terms in defining SD. In their opinion, 'developments in education' would automatically lead to SD. They believed that if educated citizens could be trained, these people would be successful in disciplines such as economics, health, and technology. A few in this group criticised the Turkish education system because this system is based mainly on memorisation (according to them). They recommended a system based on a constructivist approach, perhaps because they had newly learned this approach in their courses at the university. Finally, three participants (2%) associated SD with 'technology'. They believed that Turkey was using new technologies developed by some European countries. According to them, if any country wants to enjoy SD, it should develop its own technologies and these developments should be sustainable.

We also investigated whether the participants used different categories we determined in describing SD. Accordingly, 5 participants used both 'environmental' and 'social' arguments in their descriptions. They considered that people need to convey the natural resources without polluting them to the next generations and that the emphasis should be placed on consuming the resources carefully in improving the living standards of society. In addition, 3 participants utilised both 'social' and 'political' terms in defining SD. These participants stressed that the successful policies were required to create a society adopting sustainable lifestyles.

Gender and Conceptions of SD

We did not create a sample including equal numbers of females and males, and we noticed that 83 definitions came from females, whereas 58 definitions came from males. We, therefore, calculated the percentages of the descriptions for each gender and Figure 3 shows these percentages. According to this figure, more males than females preferred 'environmental' definitions. Under this category, 'sustaining the natural balance' and 'development without damaging the environment' were the most popular definitions used by both genders. On the other hand, many more females than males used 'social' arguments in describing SD. 'Development provided for future generations' and 'improving the living standards of society' were favoured by many females. In addition, in the same category, the definition of 'new lifestyles for SD' was preferred only by females. Regarding 'politics', we can say that more females than males used political arguments. Most of the females in this group defined SD as 'having a strong government and catching up with developed countries'.

With regard to 'energy', 'using renewable resources' and 'underground resources' were chosen by males in particular, whereas most females preferred the definitions related to 'energy transformations'. On the other hand, more males than females used terms related to the 'economy' in describing SD. Males in particular preferred 'production exceeding consumption' as a definition. On the other hand, females in particular felt that SD had to do with development in the realm of 'education'. Finally, only females pointed out that 'technological' developments meant SD.

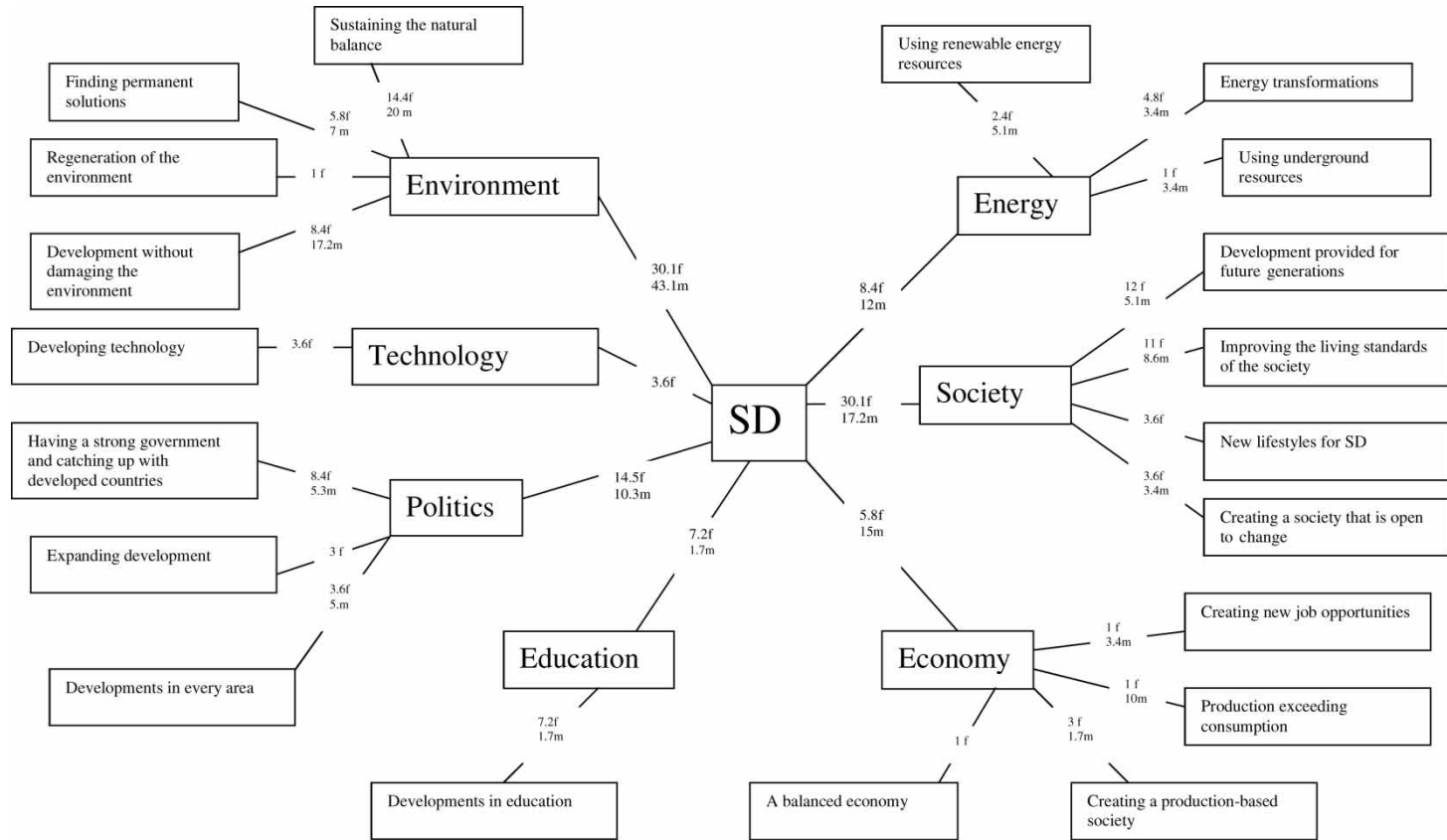


Figure 3. The distribution of the percentages for each gender in accordance with the conceptual linkages (f: female [83 definitions], m: male [58 definitions])

Discussion

In the present study, we strived to show Turkish student science teachers' conceptions of SD by asking them to define the term. As can be seen from the findings, seven main conceptual areas were raised: 'environment', 'economy', 'society', 'politics', 'energy', 'technology', and 'education'. Like some other researchers (e.g. Corney, 2000), we do not find this variety to be a problem in defining SD; on the contrary, we see it as an element of richness. In addition, this picture showed that SD was not understood exclusively in terms of the 'environment' or the three popular pillars (the environment, society, and the economy). On the other hand, even though some research assumes that people do not take 'politics' into account in thinking about SD (e.g. Gil-perez et al., 2003), this study displayed that student teachers used many political arguments in defining SD. At this stage, the important questions to ask are what the sources of this variety are, how to put to advantage this variety and what implications for ESD can be suggested.

If we begin with the former question, we can say that both formal (schools, universities) and informal (TV, internet, newspapers) education may be responsible for this variety. In terms of formal education, we must note that Turkish student science teachers did not undergo a systematic programme of education about SD during their primary and secondary school years. Except in a few units of biology and geography at the secondary level, current Turkish school curricula unfortunately do not include ESD yet. At the undergraduate level, Turkish student science teachers take two courses called 'Environmental Awareness' and 'Environmental Sciences'. However, we can say that both of these courses at the undergraduate level and the courses in biology and geography at the secondary level are based mainly on biophysical and ecological aspects of environment, so this situation perhaps explains why the majority of student science teachers defined SD in terms of the environment. On the other hand, in terms of informal ESD, we can argue that news or documentaries about 5-year development plans, the SAP and environmental degradation may lead to awareness among student science teachers. The articles included in the eighth (2001–2005) and ninth (2007–2013) development plans as well as the long-term development plan (2001–2023) have received attention in fora like political discussions in the Turkish popular media. In addition, some student teachers gave SAP as an example of SD. SAP is a multi-sectoral project and integrates regional SD projects in SAP in which many Turkish NGOs are involved. Its basic aim is to eliminate regional development disparities by raising people's income levels and living standards and to contribute to such national development targets as social stability and economic growth by enhancing the productive and employment-generating capacity of the rural sector (Kiziroğlu, 2007). We can argue that these kinds of excellent examples covering all aspects of SD can be used in ESD in teacher education programmes.

When it comes to the results related to gender, we can note that gender affected student teachers' conceptions of SD. Although we accept that the present results regarding gender may not be generalisable due to the relatively low sample size, we believe that some intriguing findings about gender deserve attention. According to

the results, we can infer that females mostly have ‘environmental’, ‘social’, ‘political’, and ‘educational’ orientations and males have ‘environmental’, ‘economical’, and ‘energy-related’ orientations. ‘Environmental’ and ‘social’ dimensions were the major categories addressed by females equally. Even though females are more sensitive than males to issues of the environment and environmental protection (Burger et al., 2000; Davidson & Freudenburg, 1996; Gardos & Dodd, 1995; Tikka, Kuitunen, & Tynys, 2000; Yilmaz, Boone, & Andersen, 2004), the results display that males might more frequently bridge the connections between the environment and SD. In terms of the ‘social’ aspect, as expected, we see that females commonly preferred this dimension in describing SD. They particularly used the descriptions such as ‘development provided for future generations’ and ‘improving the living standards of society’. Studies have described females as more nurturing, concerned with health and well being, and interested in the fate of society as a whole (Cutter, Tiefenbacher, & Solecki, 1992; Dietz et al., 2002; Freudenburg & Davidson, 2007; Gustafson, 1998). In other words, they are seen as the ones considering the needs and interests of others (Johnsson-Latham, 2007; Sener & Hazer, 2008). The socialisation of females and their reproductive nature may explain why they preferred to refer to social dimensions. In terms of ‘political’ descriptions, even though large international organisations such as UNESCO and the UN accept that female participation in the decision-making process of many countries is very low (United Nations Development Fund for Women, 2010), Turkish female student teachers in the present study more commonly chose ‘political’ arguments related to SD than did to their male counterparts. This situation may be understood as a reaction of ‘educated’ females against gender inequalities in policy-making processes. In other words, ‘educated’ females may much more often consider political issues than do ‘educated’ males because they are aware that male-dominated policies can cause problems in the development of a country. Regarding ‘education’, we note that females generally believe that education could be a crucial solution to significant problems such as climate change (Kılınc, Boyes, & Stanisstreet, 2011). On the other hand, we believe that Turkish female student teachers are familiar with the gender gap in the Turkish education system. In 2005, for example, one in three high school-aged girls did not attend school compared to only about 1 in 10 boys in Turkey (World Bank, 2005). This situation might make females sensitive about educational issues as related to SD. Regarding the ‘economic’ dimension, traditional roles and socialisation for males emphasise engagement in the market (Davidson & Freudenburg, 1996; Dietz et al., 2002) and breadwinner position. As a result, we can say that males are more likely than females to be concerned about economic issues (Davidson & Freudenburg, 1996). On the other hand, energy-related descriptions were favoured by males perhaps because they show a higher level of support for energy-related developments due to their economic concerns (Davidson & Freudenburg, 1996) or because males have a managerial role in the energy sector and energy policies (Dankelman, 2002).

Another point we noticed is that reasons specific to the Turkish context might be responsible for this variety. The descriptions ‘having a strong government and

catching up with developed countries', 'finding permanent solutions', 'developments in education', 'developing technology', 'using underground resources', 'improving the living standards of society', and 'creating new job opportunities' displayed that Turkish student teachers were aware of the current problems in their developing country (Turkey). We can thus say that 'context-based' variables affect people's conceptions of SD. The citizens of a country that has completed the development process, for example, may focus on different dimensions of SD, such as quality of life, rather than on developing new technologies. This state of affairs has some implications for ESD. Curriculum-makers around the world can take into account 'context-based' issues because different countries feature different contextual structures in terms of development. This means that the ESD curricula in countries at different stages of development may have different goals and focus on different subjects.

We consider that conceptions of SD may lead to teaching practices with different orientations for these student teachers in the near future. In choosing subjects and educational materials, technology-oriented teachers, for example, may focus heavily on this aspect in teaching ESD, whereas politics-oriented teachers may make especial use of political arguments. Similarly, Summers et al. (2003) stress criteria such as interest and personal confidence with the subject-matter as being of importance to student teachers in choosing the subjects to be taught during ESD. In addition, teaching about SD involves engagement with controversial issues (Winter & Firth, 2007). Corney and Reid (2007) argue that teachers choose different stances in accordance with their own views or pre-conceptions, such as devil's advocate, a neutral role, a balanced role, and a role reflecting stated commitment, in teaching these controversial issues. Looking to the results of this study, we can infer that student teachers' conceptions of SD may lead to different stances in their future teaching practices.

At this stage, we suggest three important implications for ESD in teacher training. First, we believe that an initial phase should be providing student teachers with opportunities to become more aware of their individual preconceptions about SD and the reasons for them. After that, some practical discussions that put together student teachers with different preconceptions or orientations may be useful, helping them to begin to think more critically about their existing ideas (Corney, 2000; Corney & Reid, 2007) and combine the conceptions of their peers into their conceptual framework for understanding SD. During this process, the main aim should be to create awareness about the variety of conceptions of SD, not to try to change existing orientations. Another implication may have to do with the competences targeted in the programmes of ESD in teacher training. Understanding the complex and contested nature of SD, appreciation of differing interpretations of the SD, developing competence in approaches to teaching about controversial issues, being aware of differing teaching roles (neutrality, balance, commitment) rather than adopting only a biased stance (Corney, 2006) might be influential competences in achieving a successful ESD in teacher training. Final implication may be about the curricula for ESD in teacher education. A programme grounded in these conceptions that displays the interrelationships among these different aspects of SD may be successful. In addition,

the science curricula that are being taught in primary or secondary schools should also be compatible with these orientations. In preparing the school curriculum, SD should not be considered a separate subject; it should be embedded in different courses or subjects. If this is the case, student teachers will have opportunities to reflect on this variety of orientations rather than using merely environmental arguments in teaching ESD in the future.

Consequently, if we desire to create effective ESD in teacher training, one of our first steps should be understanding the conceptions of student teachers about SD. As displayed in the present study, student teachers had a range of conceptions of SD even though they did not have a strong educational background associated with this issue. We consider context-based issues, informal experiences, and gender to be influential factors in creating this variety. We accept that there may be other factors that affect student teachers' conceptions of SD, and future studies may be planned based on this assumption. For instance, we addressed the student teachers in the present study as one group though they were at different stages of their education. Another research focusing on the comparisons among different stages of teacher training in terms of exposing courses regarding SD and Environmental Sciences seems very intriguing. Finally, curriculum planners and policy-makers who study ESD in teacher training may shape their programmes based on these pre-conceptions and strive to develop educational practices targeting the interrelationships among these different descriptions.

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