Start for Sustainable Development: Ecological Footprint

Hamdi KARAKAŞ

1. Introduction

The recognition of environmental problems on a global scale and the adoption of international measures took place in 1972 with the Human and Environmental Conference held in Stockholm. After that, UNESCO issued an "International Environmental Education Program" on 22 October 1975 and published a declaration called the Charter of Belgrade. In 1977, the "Intergovernmental Environmental Education Conference" was held in Tbilisi and the Tbilisi Declaration 1977 was published. The sentence, *"Environmental Education should contribute to the awareness of the economic and ecological interdependence of the modern world in order to create a spirit of international responsibility and solidarity"* was used in the final declaration of the conference in Tbilisi (Tbilisi Declaration 1977, p. 2). As a result of these three conferences, it was emphasized that defending and improving the environment is an inevitable task for humanity and that environmental education is a must for the generations currently living and will continue to live on earth. The Rio Summit in 1992 made significant contributions to Environmental Education. In this meeting, it was emphasized that environment and development could not be considered separately and that any development should be sustainable development (Misar 2000).

It has become inevitable that efforts to raise environmental awareness and environmental problems in a global sense should be made available at all levels of education levels starting from pre-school period through environmental education programs (Yücel and Özkan 2013). With environmental education, the aim is to help individuals develop positive attitudes towards the environment, thus leading them to sustainability by shaping their lifestyles with environmentally conscious behavior (Meyer 2004). This is because sustainability envisages increasing the biologically productive areas, ensuring their self-renewal and the maintenance of renewal capacities (Yıldız and Selvi 2015). Sustainability includes environmental–economic trade-offs from choices that affect social-ecological systems today and in the future, and it reflects a dilemma for us (Chapin et al. 2011). Therefore, sustainable development has become a necessity for a livable world. Sustainable development means

continuing without harming the economy (Taylor et al. 2007). While sustainable development is evaluated from an economic point of view, it aims not to ignore the environmental dimension and to use resources in a balanced and sparing manner by considering the next generations (Harris 2000). In the development policies to be implemented, it is important to protect ecological processes, sustainable use of resources and the conservation of genetic diversity (Soussan 1992). From this point of view, the aim of environmental education should be to provide awareness that will ensure sustainable development. International Union for Conservation of Nature (IUCN) emphasizes that individuals' attitudes towards sustainable environment should be replaced by education programs (IUCN 1991); The Rio Summit agenda 21 report (United Nations Conference on Environment and Development (UNCED)) states that the environmental value, attitude, skills, behavior and ethical awareness necessary for sustainable development are acquired through education (UNCED 1992). The 17th United Nations Sustainable Development Goals (SDGs) was published in 2015 as a framework program for the necessity of integrate the environment in all aspects of sustainable development (SDGs 2015). Among these goals, SDG 4 has been identified as "Quality Education" and emphasized that the education to be provided to the students in schools from an early age is a powerful tool for creating sustainable and flexible societies. Within the framework of the same objective, Quality Education is critical for promoting sustainable development, addressing environmental and development issues of the people and countries and increasing their capacity to create green sectors. Thus, with the sustainable development, the interests of future generations will be protected, the interests of today's people will be ensured, and a balance will be established (Collin 2011).

A modern understanding of environmental education should be considered, which addresses environmental elements with a holistic and sociocultural approach, emphasizes sustainability, and encourages individuals to act (Sauvé 2005). Pooley and O'Connor (2000) emphasized the necessity of activities to help students develop positive attitudes towards the environment as well as providing theoretical knowledge to the students, determined that the use of different methods and techniques is important in creating lasting behavior. The concept of "Ecological Footprint" for students in terms of environmental education and sustainability and awareness about this concept is one of the prominent activities. According to Wackernagel and Rees (1996), ecological footprint can be used as a method in games and school projects to enable sustainable lifestyle activities to realize concrete local practices such as mathematics, biology and physics taught

simultaneously. The concept of ecological footprint can be combined with in-school and out-of-school educational activities.

Based on this point, it was deemed important by the researcher to measure the relationship between sustainable use of resources and ecological footprint and the aim was to work with students at elementary level (primary school 1st, 2nd, 3rd and 4th grade; secondary school 5th, 6th, 7th and 8th grade) that form the basis of the educational process. The students in the elementary education process receive the information about Life Science, Science and Social Studies courses and the theoretical information about environmental education directly in this process, and they can implicitly perform activities for environmental education through other courses (MoNE (2017a, 2017b, 2017c)). When the related studies are examined, the lack of a study examining the concept of ecological footprint and student attitudes towards sustainable development together makes this research valuable. At the same time, this study is important in terms of measuring the ecological footprints of this group of students who will use the resources in the future and to determine their attitudes towards sustainable development and to determine the level of these students in order to provide a prediction for the teachers who are the practitioners of the educational process. Thus, the results of this study can contribute to the development of ecological footprint awareness in educational environments and increase the number of studies in this field. From this point of view, in this study, it was aimed to investigate the relationship between primary school students' ecological footprint average scores and their attitudes towards sustainable development.

2. Theoretical Part

2.1. Destruction of Natural Resources

Human beings obtain many elements that will help them continue their lives from the environment and the natural resources offered by the environment. When these natural resources are used in reasonable amounts, the world can renew itself and the natural cycle can be re-formed. While the changes that people made on natural life did not pose a threat to the ecosystem until the industrial revolution, unconscious interventions with nature led to the disruption of the natural balance in the ecosystem and ecological problems on a global scale (Özbuğutu et al. 2014). Very important reasons, such as scientific and technological developments in the last century, overpopulation, the desire to use and consume more, urbanization played an active role in this issue, natural resources rapidly depleted, the interaction between living and non-living beings was disrupted and natural life changed. This change and careless use of resources brought about some

complications, also called "environmental problems" such as global climate change, perforation of ozone layer, destruction of forests, erosion, air, soil, water pollution, reduction of biological diversity, radioactive pollution and acid rain (Borden 1985; Sam et al. 2010). Developing countries with a relatively poor and vulnerable population are primarily affected by the consequences of such environmental changes (Rudolpha and Figge 2017). While these environmental problems are felt in small dimensions and at local levels in the middle of the last century, they are now increasingly being addressed globally (Özdemir et al. 2004). However, the point that should be kept in mind is that the threat posed by the problems will not only be the problem of the present day, it will also cause the needs of the next generation to be borrowed, and what they will need will be used up.

With the improvements in technology, people strive to dominate nature and strive to make their lives easier. On the other hand, governments aim to progress in every field so that they can provide a better life for the citizens and they use all natural resources as a prominent input. Thus, rapid economic growth and development is seen as the basic requirement for all states. Humankind has been thinking that everything can be taken and consumed, forests as a supply of paper and timber; seas as a source of fish and energy; plants and animals as sources of food and space as an endless source of resources to be conquered (Aydın and Aykaç 2016). However, the survival of human beings can only be ensured by the resources of the world, which have been greatly changed by humans themselves (Reece et al. 2013). Unfortunately, these resources are being used extensively today, and serious environmental disasters such as air, soil, water pollution, hunger, drought and the destruction of forests are threatening human life. However, humans giving up excessive consumption habits and gaining positive behaviors towards the environment will ensure that resources are not used more than necessary. Thus, the amount of pollution and waste in our world can decrease, environmental balance can be maintained, global climate change can slow down and the pressure on biodiversity can be reduced (EPA (1999)).

2.2. Ecological Footprint

Mathis Wackernagel and William Rees first introduced the concept of ecological footprint. Their goal was to find out how long the humankind could continue by taking away from the nature and leaving only waste and how long the resources in the world could withstand this situation (Wackernagel and Rees 1996). Ecological footprint is a method created to calculate the burden of a certain population for the nature in which they are located (Huiqin and Linchun 2011). The concept of ecological footprint means the biologically fertile soil and water area needed to re-produce

the resources consumed by an individual, community, or activity with existing technology and resource management and to eliminate the waste it creates. Thus, the ecological footprint measures how quickly human activities are consuming the resources of nature and often presents us with biological capacity and the renewal capacity of nature (Bastianoni et al. 2012; Peng et al. 2018). In its simplest form, the formula *"Ecological footprint = Consumption x Required production area"* is used to make ecological footprint calculations. According to the ecological footprint estimates, it is reported that it is used as a way to estimate the effects of human beings on nature and that approximately 2 hectares of land is needed per person (Reece et al. 2013; Cunningham and Cunningham 2018). Ecological Footprint is calculated according to six different components: carbon footprint, agricultural land footprint, forest footprint, grassland footprint, built area footprint, fishing area footprint and is expressed with the phrase "global hectare" (gha) (WWF (2012)). These components are, briefly:

- *Carbon Retention Footprint:* Calculation of the forest area required to capture emissions from fossil fuel consumption, land use changes and chemical processes, as well as CO2 emissions retained by the oceans.
- *Agricultural Footprint:* Calculation of the area used for food and fiber, animal feed, oil crops and rubber production for human consumption.
- *Forest Footprint:* Calculation of the forest area required to cover the amount of timber, pulp, wood products and firewood consumed.
- *Grassland Footprint:* Calculation of the area of livestock for meat, milk, leather and wool products.
- *Built Area Footprint:* Calculation of the area covered by infrastructure and superstructure for meeting human needs including housing, transportation, industrial buildings and power plants.
- *Fishing Area Footprint:* Calculation of the marine and freshwater area required to supply consumed fish and seafood (WWF 2012).

The ecological footprint has been developed to measure the impact of human activities on ecosystems. With the ecological footprint calculation, it is possible to measure the land and sea area needed to regenerate the natural resources consumed by a human being. To explain this with a simpler example, a person who consumes one bread (300 g) a day, the calculations aim to ascertain how much area should be cultivated for 120 kilograms of bread for that person to eat per year, how much area should be planted for the cotton in that person's clothes, how big of an area is the water that that person drinks is supplied from, etc. (Coşkun and Sarıkaya 2014). Thus,

ecological footprint measurements are made to obtain nutrients, produce resources, generate energy, eliminate waste and reduce the amount of carbon dioxide increased by photosynthesis through the use of fossil fuels (Keleş et al. 2008). According to the WWF (2018) report, the ecological footprint of the US citizen was determined to be equal to the footprints of 43 African citizens. Moreover, UAE, Qatar, Denmark, USA, Canada, Kuwait and Estonia are among the top 10 countries with the largest ecological footprint. It can be estimated that there is a relationship between ecological footprint and economic development and that ecological footprints of consumption in developed countries have increased. The most important reasons for this situation are the unsustainable consumption behaviors, high resource wastage and carbon emission increases caused by industrialization (Koru 2012).

The growth of the ecological footprint determined by the provision in productive ecosystems such as food, housing area, transportation and amount of waste consumed by the society and/or individual results in the destruction of biological resources (Akıllı et al. 2008). From this perspective, the ecological footprint refers to the sustainability relationship between the rate of human consumption of Earth's resources and the degree of healthy or unhealthy ecosystems. At the same time, it is a concept that brings up questions such as what is the share of people in environmental problems and "what can I do?" (Kaypak 2013). Since the ecological footprint reveals the relationship between natural resource supply and demand, it provides a scientific basis for recognizing imbalances and generating solutions (Günal 2018). The ecological footprint focuses more on consumption and gives clues about the damage that people create in nature. In this respect, it is considered that the calculation of ecological footprint reveals the dimensions of the pressure on ecosystem and has an important role in the development of ecological awareness and ecological consciousness. With the awareness of the ecological footprint, the pressure exerted by the consumer society on the planet can be reduced and the growing ecological footprint can be scaled down.

3. Aim of the Study

The aim of this study is to investigate the relationship between elementary school students' mean ecological footprint scores and their attitudes towards sustainable development. For this purpose, the following sub-objectives were sought:

1. What are the mean ecological footprints of elementary school students?

1.1. Do the ecological footprint mean scores of elementary school students differ significantly according to gender, location and type of school?

2. What are the mean attitude scores of elementary school students towards sustainable development?

2.1. Do the mean scores of sustainable development attitude of elementary school students differ significantly according to gender, place of residence and type of school?

3. Is there a relationship between the mean scores of ecological footprints of elementary school students and the mean scores of attitude towards sustainable development?

4. Materials and Methods

4.1. Relational Survey Model

In this research, the relational survey model, a quantitative research method, is used. An existing situation or phenomenon in the survey model is the approach that is tried to be described as it is. When conducting survey research, the researcher takes a sample from the population he wants to work with and asks survey subjects one or more questions about attitudes, perceptions, or behaviors (Stockemer 2019). In relational screening, the aim is to learn the change of more than one variable together and how it occurs, if there is any change. Starting from the most probable solution, these relationships are tested (Yıldırım and Şimşek 2013). In this context, the relationship between the ecological footprint mean scores of elementary school students and their attitudes towards sustainable development was described and interpreted.

4.2. Study Group

Elementary school students (primary school 1st, 2nd, 3rd and 4th grade; secondary school 5th, 6th, 7th and 8th grade) participated in this study. Primary school students are between aged 6–9; middle school students are aged 10–13. Maximum diversity sampling method, one of the purposeful sampling methods, was used to determine the study group. With maximum diversity sampling, a relatively smaller study group is created, and it is aimed that this study group reflects the diversity of individuals who may be part of the problem to the maximum extent (Yıldırım and Şimşek 2013). Thus, it is ensured that the sample group reflects the universe well. In this process, the researcher tried to select the sample group that could best reflect the elementary school student population and the data were collected in the second semester of the 2018–2019 academic year. The researcher contacted different elementary schools from three different regions of the country

(east, middle and west) and made appointment in advance to apply the data collection tools. The researcher went to the schools that accepted the appointment, informed the students on how the data collection tools would be answered and gave the students 20 minutes to answer the scale questions. As a result of data collection, 210 elementary school students from three different regions of the country (east, middle and west) were reached directly. Regarding the 210 students, the fact that they live in different parts of the country, reside in different settlements and study in different grade is thought to have a structure that can reflect the elementary student profile in the country (Table 1). Thus, maximum diversity was achieved.

Table 1. Characteristics of elementary school students participating in the research.

Features of The Working Group		f	%
• **Gender**			
Female		114	54.3
Male		96	45.7
	Total	**210**	**100**
• **Location**			
City Centre		111	52.9
Countryside (District, Town, Village)		99	47.1
	Total	**210**	**100**
• **Type of School**			
Primary School [1] (2nd–3rd–4th grade)		76	36.2
Secondary School (5th–6th–7th–8th grade)		134	63.8
	Total	**210**	**100.0**

[1] 1st grade is not included in the sample group because the literacy level is not sufficient.

4.3. Data Collection Tool

In this study, "Turkey Specific Ecological Footprint Calculator" developed by Keleş and Özsoy (2010) and "Scale of Attitudes Towards Sustainable Development" developed by Kaya (2013) are used together.

"Turkey Specific Ecological Footprint Calculator" was developed by Keleş and Özsoy (2010) as part of a project. The ecological footprint calculation tool consists of 16 questions in total with 5 questions in the food category, 3 questions in the goods category, 4 questions in the shelter category and 4 questions in the transportation category. The questions are about what foods elementary school students are fed

with and how often, monthly consumption costs, the size of the house they live in and their expenses, energy consumption options and public transportation preferences and durations. Elementary school students were asked to answer the questions in the ecological footprint calculation tool individually. The ecological footprint calculation tool expresses the number of planets needed in the universe individually by the numerical values of the means taken by elementary school students.

"Attitude Scale for Sustainable Development" was developed by Kaya (2013). The scale has been prepared in a way to reflect the sustainable development attitudes of secondary school students and scale items have been shaped by social, environmental and economic sustainability dimensions of secondary school students. The validity and reliability studies of the scale were conducted by the scale preparer. The 5-point Likert scale consists of 21 items and 3 factors with social, environmental and economic sustainability dimensions. The ratings of these three dimensions are "completely disagree (1)", "disagree (2)", "slightly agree (3)", "agree (4)" and "fully agree (5)." It was suggested that this scale could be applied to different student groups (Kaya 2013). The researcher primarily piloted and tested whether the scale could be applied to elementary school students. This scale pilot was applied to 97 elementary school students who were not included in the research and after the analysis for the pilot application, the main application was started.

4.4. Data Analysis

The data collection tool was applied face to face to the elementary school students after the informed by the researcher in compliance with the principle of volunteering and without the name of the student on the forms. All data were randomly ordered and SPSS software was used for statistical analysis of the data. In this research, the data collection tool was applied twice as pilot application and actual application. The purpose of piloting is to test whether the Attitude Scale for Sustainable Development is a reliable data collection tool for elementary school students.

The pilot study was applied to 96 elementary school students who were not included in the sample group, and the obtained data were analyzed and Cronbach's Alpha reliability coefficient was calculated as 0.92. The reliability coefficient of 0.80 and above indicates that the questionnaire is highly reliable (Büyüköztürk et al. 2012). In this context, it was decided that the scale could be applied to elementary school students, no changes were made on the data collection tool and the actual implementation was started.

In actual practice, this scale was applied to 210 elementary school students. The Cashier Meyer Olkin (KMO) value of the scale was 0.73 and the Bartlett Sphericity Test results (x^2: 3494.115; sd:210; $p < 0.05$) were determined to be significant. This result shows that the data about the scale is suitable for factor analysis. In the actual application, the Cronbach's Alpha reliability coefficient for the whole scale and the reliability results for its sub-dimensions was calculated.

The reliability results of the sub-dimensions of the scale were high and the Cronbach's Alpha reliability coefficient for the whole test was calculated as 0.92 (Table 2) and the scale was considered to be highly reliable (Büyüköztürk et al. 2012).

Table 2. Reliability analysis of sub-dimensions of the scale.

Dimension	Number of Items	Cronbach's Alpha	Reliability
Social Dimension	8	0.86	Extremely Reliable
Environmental Dimension	6	0.75	Highly Reliable
Economic Sustainability Dimension	7	0.79	Highly Reliable
The Whole of the Scale	**21**	**0.92**	**Extremely Reliable**

Kolmogorov–Smirnov and Shapiro–Wilk tests were performed for the normality of data sets applied to elementary school students. Looking at the results obtained from the tests, it was determined that the data were suitable for normal distribution ($p > 0.05$) and the skewness and kurtosis coefficients were in the range of +2 to −2. At the same time, Levene test was performed for each variable to evaluate the equality of variances and since the data showed normal distribution ($p > 0.05$), a decision was made to use parametric tests in the analysis of the measurements. Percentage, frequency and arithmetic mean were used in the analysis of the mean scores of the ecological footprint and attitude towards sustainable development of elementary school students. In the comparison of these mean scores according to gender, location and type of school, independent groups were analyzed by t-test and the effect size (eta square [$\acute{\eta}^2$]) was calculated. *Cohen's d* formula, which is put forward by Cohen in effect size calculation is taken as a basis. According to Cohen, if the value of *Cohen's d* is less than 0.2, the effect size is small; if it is 0.5, medium and if it is higher than 0.8, the effect size is large (Kılıç 2014). The difference between the mean scores of the subscales of the Sustainable Development Attitude Scale was analyzed by ANOVA test.

The correlation between the ecological footprint mean scores of the elementary school students and the sustainable development attitude mean scores was calculated by correlation analysis and "Pearson Correlation" coefficient was used. The correlation coefficient (r) has a value between −1 and +1, which means a positive increasing

relationship as it approaches +1, a negative increasing relationship as it approaches −1, and a neutral relation as it approaches 0 and with Sig. (2-tailed) value a significant relationship is interpreted. At the same time, |r|< 0.30 is interpreted as a relationship with weak force, 0.30 < |r|< 0.70 is interpreted as medium–strong relationship and |r| > 0.70 is interpreted as a strong relationship (Büyüköztürk et al. 2012).

5. Results

In this study, it was aimed to investigate the relationship between primary school students' ecological footprint average scores and their attitudes towards sustainable development. The findings related to the sub-objectives formed in line with the aims investigated are given below.

5.1. Findings on the Ecological Footprint Mean of Elementary School Students

The answers of the elementary school students to the questions in the ecological footprint calculation tool were analyzed and the mean scores of the ecological footprints of elementary school students are calculated.

The mean ecological footprint scores of elementary school students are calculated as 2.11 gha (Table 3). This value indicates that more than two worlds will be needed to meet the needs of elementary school students. Mean ecological footprint scores of elementary school students were compared with independent groups *t*-test according to gender, location and type of school and the results.

Table 3. Ecological footprint mean scores of elementary school students.

	N	Min.	Max.	Std.	$\bar{X}$
Mean Ecological Footprint	210	1.38	4.13	0.54	2.11

The difference between the mean scores of ecological footprints of elementary school students was not statistically significant according to gender and location variable ($p > 0.05$), but according to the type of school variable it is statistically significant ($p < 0.05$) (Table 4). The effect size of the difference between the school type variable scores ($\acute{\eta}^2$) was calculated as 0.42 and this value was determined to be a moderate effect since it was 0.2 < *Cohen's d* < 0.8. The mean scores of ecological footprints of the students in the secondary school education process are lower than the students in the primary education process which was the previous education level. This situation can be interpreted as the education process reducing the mean scores of students' ecological footprint with a moderate effect.

Table 4. Comparison of mean ecological footprint scores with independent groups *t*-test.

Ecological Footprint Mean Scores		N	X̄	Std.	sd	*t*	*p*
Gender	Female	114	2.10	0.58	208	−0.621	0.193
	Male	96	2.14	0.50			
Location	County	99	2.07	0.54	208	−1.152	0.339
	City Centre	111	2.16	0.55			
Type of School	Primary School	76	2.28	0.76	208	3.249	0.001 [1]
	Secondary School	134	2.03	0.35			

[1] $t(208) = 3.249$; $p = 0.001$; $\acute{\eta}^2 = 0.42$.

5.2. The Findings Regarding Elementary School Students' Attitudes Towards Sustainable Development

The answers of the elementary school students to the questions in the "Attitude Scale for Sustainable Development" were analyzed and the percentages and frequency calculations of the answers were made.

When the answers of elementary school students towards their attitudes towards sustainable development are examined (Appendix A), it is observed that many questions are concentrated in "strongly agree" and "agree" options. However, when some items were examined, it was seen that some items did not reflect the attitudes expected from elementary school students. When the answers to items S.4, S.5, S.7, and S.8, and the social dimension of sustainable development were examined, it was observed that most elementary school students held their interests ahead of society's interests (strongly disagree, disagree, and undecided rates total N:117, 55.7%); they could not have empathy while evaluating behavior (strongly disagree, disagree, and undecided rates total N:112, 53.2%); they could not be neutral in evaluating the events (strongly disagree, disagree and undecided rates total N:133, 63.4%) and that they could say things that would hurt the person they are talking to (absolutely disagree, disagree and undecided rates total N: 119, 56.6%). When the answers to items C.2, C.5, and the environmental dimensions of sustainable development were examined, it was observed that most elementary school students do not prefer public transportation (strongly disagree, disagree and undecided rates total N:131, 62.4%) and do not prefer nature-friendly products instead of plastic products (strongly disagree, disagree and undecided rates total N:132, 62.8%). In Article E.3, which is the Economic Dimension of Sustainable Development, it is seen that most elementary school students do not pay attention to buying surplus products (strongly

disagree, disagree and undecided rates total N:116, 55.3%). It can be said by looking at the answers given to these items, that elementary school students may have problems in achieving the expected behaviors through the MoNE (2017a, 2017b, 2017c).

The mean scores of attitude towards sustainable development of elementary school students were calculated together with their sub-dimensions. When the scale mean scores are calculated, elementary school students score between 1 and 5, which means positive attitude as the mean of the scores approaches five.

The mean score of attitude towards sustainable development of elementary school students was calculated as 3.62 (Table 5), since this value is in the range of $3.41 < X < 4.20$ it covers the "agree" range of points (Kaya 2013). However, the low mean score may indicate that elementary school students do not exhibit the expected sustainable development attitude. The mean scores of elementary school students regarding the subscales of Sustainable Development Attitude Scale were calculated and the difference between the subscales mean scores was analyzed by ANOVA test.

Table 5. Sustainable development attitude mean scores.

	N	Min.	Max.	Std.	$\bar{X}$
Attitude Towards Sustainable Development Mean Score	210	2.00	4.61	0.72	3.62

It is concluded that the mean scores of attitude towards social dimension of sustainable development of elementary school students are lower than the other dimensions and mean scores of economic dimension are higher (Table 6). However, the difference between the mean subscale mean scores was not statistically significant ($p > 0.05$). Sustainable development attitude mean scores of elementary school students were compared with independent groups *t*-test according to gender, location and type of school.

Table 6. Comparison of sustainable development attitude sub-dimensions between mean scores.

Sub-Dimension	$\bar{X}$	Std.	Assumption Source	Sum of Squares	sd	Mean of Squares	F	*p*
Social Dimension	3.58	0.059	Inter-group	0.927	1	0.464	0.742	0.477 [1]
Environmental Dimension	3.61	0.050	Intra-group	391.738	208	0.625		
Economic Dimension	3.67	0.053	Total	392.665	209	1.089		

[1] $F(1,208) = 0.742$; $p = 0.477$.

The difference between the mean scores of sustainable development attitude of elementary school students is not statistically significant according to the location variable ($p > 0.05$) and according to the gender- and school-type variable it is statistically significant ($p < 0.05$) (Table 7). The effect size of the difference between gender-variable scores ($\acute{\eta}^2$) 0.46; the effect size of the difference between school type scores ($\acute{\eta}^2$) was calculated as 0.40 and these values were determined to be a moderate effect since they were $0.2 <$ *Cohen's d* < 0.8. Female students have higher attitudes towards sustainable development than male students. This can be interpreted as the lower mean scores of the ecological footprints of female students than male students (Table 4) and they feel more responsible for using environmental resources more effectively. Sustainable development attitude mean scores of the students in the secondary school education process are higher than the students in the primary education process which is the previous education level. This situation can be interpreted as the education process increasing the students' sustainable development attitude mean scores with moderate effect, just like the mean ecological footprint scores.

Table 7. Comparison of sustainable development attitude mean scores with independent groups *t*-test.

Sustainable Development Attitude Mean Scores		N	X̄	Std.	sd	*t*	*p*
Gender	Female	114	3.77	0.72	208	3.343	0.001 [1]
	Male	96	3.44	0.70			
Location	County	99	3.52	0.66	208	−1.882	0.061
	City Centre	111	3.71	0.77			
Type of School	Primary School	76	3.43	0.87	208	−2.831	0.005 [2]
	Secondary School	134	3.73	0.61			

[1] $t(208) = 3.343$; $p = 0.001$; $\acute{\eta}^2 = 0.46$ [2] $t(208) = -2.831$; $p = 0.005$; $\acute{\eta}^2 = 0.40$.

5.3. The Findings on the Relationship Between the Mean Scores of Ecological Footprints of Elementary School Students and the Mean Scores of Attitude Towards Sustainable Development

The relationship between the mean scores of ecological footprints of elementary school students and the mean scores of sustainable development attitudes was revealed. In order to reveal this relationship, "Pearson Correlation Coefficient" was based on by performed correlation analysis.

A negative correlation was determined between the mean scores of ecological footprint of elementary school students and the mean scores of sustainable development attitude ($0.30 < |r| < 0.70$) and this relationship was determined to be significant ($p < 0.01$) (Table 8). This result shows an inverse relationship between ecological footprint and sustainable development for elementary school students. The low ecological footprint mean scores of elementary school students may be related to the increase in sustainable development attitudes or the high ecological footprint mean scores may be related to the low mean sustainable development attitude scores.

Table 8. Correlation between the ecological footprint mean scores and sustainable development attitude mean scores.

		Ecological Footprint Mean Scores	Sustainable Development Attitude Mean Scores
Ecological Footprint Mean Scores	Pearson Correlation	1	−0.348
	Sig. (2-tailed)		0.000 [1]
	N	210	210
Sustainable Development Attitude Mean Scores	Pearson Correlation	−0.348	1
	Sig. (2-tailed)	0.000 [1]	
	N	210	210

[1] $p < 0.01$.

6. Discussion

In this study, the relationship between elementary school students' ecological footprint mean scores and their attitudes towards sustainable development was investigated. As a result of the research, the mean ecological footprint scores of elementary school students were calculated as 2.11 gha. Elementary students' ecological footprint has been determined to be lower than Turkey mean (2.7 gha), but higher than the world mean (1.8 gha) (WWF 2012). At the same time, in a study conducted with consumers in Turkey, the ecological footprint mean rate was determined to be low with 2.26 gha and the ecological footprints of individuals have been demonstrated to be on an inadequate level (Özgen and Aksoy 2017). In their study based on the calculation of ecological footprint, Akıllı et al. (2008) emphasized that the amount of ecological footprint per person should be no more than 1.8 gha and that this value should not be exceeded in terms of sustainability. Even if it is a developed or developing country, it should make significant improvements in resource utilization efficiency (reducing waste, turning to sustainable resources, systematically separating economic activity from environmental impacts, etc.) and

try to reduce material consumption levels by balancing (Farmer and Cook 2013). This effect should start with students from an early age. According to Grigoryeva (2010), using the ecological footprint in ecology education serves as an effective tool in planning students' environmental behaviors. By using ecological footprint training practices, students' attitudes, awareness and behaviors towards environmental problems can be changed (Çetin 2015). Making ecological footprint calculations of students at all levels of education can be considered as a starting point in recognizing their consumption habits and raising awareness of a sustainable world. This is because, with ecological footprint calculations, students pay attention to how their consumption can destroy natural resources and how global environmental problems can occur.

The difference between the ecological footprint mean scores of elementary school students was determined to be statistically significant according to the type of school variable and the effect size of this difference was determined to be moderate. The mean ecological footprint scores of the students in the secondary school education process were lower than the students in the primary school education process, which was interpreted as reducing the mean ecological footprint scores of the students with moderate impact. Students involved in the education process learn about many concepts such as environment, ecology, consumption, environmental awareness, etc., and that information changes their attitudes and behaviors towards the environment. Keleş (2011) concluded that the information and activities transferred to the students during the course of the study were effective at all grade levels and caused a decrease in the ecological footprint scores of the students. According to Kiziroğlu (2001), as individuals learn positive and negative effects on the continuity of ecosystem, they act more responsibly in matters related to the environment. Since most human activities strongly affect ecosystems, the awareness of responsibility required for the individual should be raised for the care and protection of nature (Chapin et al. 2011). When evaluated from this perspective, presenting the concept of ecological footprint to the students from early classes, and arranging in-class and out-of-class applications that highlight this concept may be effective in creating the desired awareness and decreasing the mean of ecological footprint. When some studies in the literature are examined (Meyer 2004; Weinberg and Quesenberry 2010; Benzer and Şahin 2012; Özgen and Aksoy 2017), it can be seen that active participation practices are effective in creating ecological footprint awareness and creating sustainable environmental awareness.

The mean score of attitude towards sustainable development of elementary school students was calculated ($\bar{X}$ = 3.62), and the low mean score showed that

elementary school students did not exhibit the expected sustainable development attitude. When the answers they gave to the scale items were examined, it was determined that most of the elementary school students could not provide sufficient answers in some social, environmental and economic items. Most of the decisions that adversely affect the ecosystems were taken with the need to maintain certain socioeconomic benefits, rather than being intentionally misused (Chapin et al. 2011). With regards to sustainable development, the environmental dimension indicates the protection of natural environment and biological diversity in which human activities take place (Koçak and Balcı 2010), the economic dimension indicates the use of natural resources in production process (Goodland 1995), the social dimension indicates inter-communal equality (poverty reduction) and protection of cultural diversity (Moffatt 1996). When these three dimensions are considered as a system, it becomes clear that sufficient consumption of resources and environmental behavior should be established to ensure an environmentally sustainable development. Environmental education issues integrated with curricula should take place at all levels and levels of education, as they have a facet that covers all segments of society. In their studies, McMillan et al. (2004) evaluated the environmental values of the classes that carry out studies at university level and take courses. They emphasized that the ecological footprint test applied to university students and the video they watched had a major impact on developing value judgments towards the environment.

It was determined that the difference between the average scores of sustainable development attitude of elementary school students is statistically significant according to the gender and school type variable and the effect size of this difference is medium. Female students' attitudes towards sustainable development were determined to be higher than male students. Özdemir et al. (2004) and Şama (2003) determined that female students had more knowledge about the environment than boys and they paid more attention to environmental issues. In this study, the mean ecological footprint scores of female students are lower than male students and it can be interpreted that the sustainable development attitude mean may be higher because they feel more responsible for using environmental resources more effectively. The sustainable development attitude mean scores of the students in the secondary education process are higher than the students in the primary education process, which is the previous education level. This situation can be interpreted as the education process increasing the students' sustainable development attitude mean scores with moderate effect, just like the mean ecological footprint scores. According to Simon (2009), education plays a key role in the development of sustainability. As the

education level increases, individuals' perception, attitude and behavior towards sustainability will develop.

A negative correlation was determined between the mean scores of ecological footprints of elementary school students and the mean scores of sustainable development attitude and it was concluded that this relationship was significant. This result shows an inverse relationship between ecological footprint and sustainable development for elementary school students. Therefore, when elementary school students are able to keep their ecological footprint mean scores lower, it will help them to increase their attitude towards sustainable development. Weinberg and Quesenberry (2010), in their study, gave students the key concepts of global, local sustainability theme and gave them ecological footprint education. As a result of the research, they found out that the students see how individual and national ecological footprints are structured and understand the importance of sustainable life. Meyer (2004) concluded that the ecological footprint analysis and activities used as an environment education tool increased the awareness of the individuals participating in the research in a positive way, developed their attitudes in a moderate positive way and were effective in acquiring responsible behaviors towards sustainable living. van Vuuren and Smeets (2000) stated that the concept of ecological footprint is an interesting tool affecting consumption preferences. Hart (2003) suggests that teachers should engage in practical activities in their classrooms in the form of theory, activity and community building in order to achieve the goal of environmental education. Therefore, ecological footprint can be used theoretically and practically in educational processes as an educational tool in changing consumption habits and ensuring sustainable development.

Individuals' attitude towards an event or fact constitutes a general design of his behavior type for that object. There are cognitive, emotional and behavioral elements in the formation of this attitude. Attitudes and behavioral patterns consists of action, target for action, content for action and time elements. A general or specific pattern of these four elements is provided with attitudes towards action (Ajzen and Fishbein 1977). The first step to create this attitude starts with creating awareness. In order to ensure sustainability, this awareness will be created first, and then individual responsibility, behavior change, development will continue and sustainable development will be ensured (Lourdel et al. 2006). Thus, this process will be completed. Therefore, creating ecological footprint awareness in students will be a beginning for sustainable awareness and will prepare the ground for transformation into behavior change by taking responsibility. Negev et al. (2008) found a strong relationship between the nature of children and their attitudes and behaviors and

stated that it would be effective in developing awareness, attitudes and behaviors that would occur in children.

7. Conclusions

Achieving sustainable development is primarily possible by changing the consumption habits of individuals. Children, who are the guarantee of the future, should play a critical role in the success of this change. One of the most important ways to contribute to this process is to train them in the best way. This is because when children interact with society, they will both socialize and also affect the development of society (Lucerne Declaration 2007). Starting environmental education with the concept of ecological footprint contributes to the awareness of students' own consumption habits, the development of the expected features, and thus the development of sustainable development by using natural resources more effectively. The results of this study will provide an insight to readers and education practitioners to demonstrate the relationship between ecological footprint and sustainable development. In this way, it will increase the studies on ecological footprint awareness and, by creating awareness, it will be possible to develop an attitude towards the environment and create environmental behavior. This training process will be an important step in achieving sustainable development. Thus, a step may be taken in reaching the "Quality Education" targets expected from SDG's goal 4.

Conflicts of Interest: The author declares no conflict of interest. There were no founding sponsors who had a role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

Appendix A

Distribution of elementary school students' attitudes towards sustainable development.

Environment-Knowledge Level		N %	SD *	D *	U *	A *	SA *
Social Dimension of Sustainable Development (S)	S-1. I believe that transferring cultural heritage to future generations is important	N	31	30	5	61	83
		%	14.8	14.3	2.4	29.0	39.5
	S.2. I respect different opinions and ideas	N	19	15	29	84	63
		%	9.0	7.1	13.8	40.0	30.0
	S.3. Social rules are important to me	N	13	22	12	77	86
		%	6.2	10.5	5.7	36.7	41.0
	S.4. Society's interests come first	N	20	14	83	53	40
		%	9.5	6.7	39.5	25.2	19.0
	S.5. I empathize when evaluating a behavior	N	10	26	76	30	68
		%	4.7	12.3	36.2	14.2	32.6
	S.6. I accept individuals as they are	N	12	22	44	82	50
		%	5.7	10.5	21.0	39.0	23.8
	S.7. I am unbiased when evaluating events	N	9	52	72	31	46
		%	4.3	24.8	34.3	14.8	21.9
	S.8. When I speak, I take care not to say anything that will hurt the people in front of me	N	12	28	79	40	51
		%	5.7	13.3	37.6	19.0	24.3
Environmental Dimension of Sustainable Development (C)	C.1. Damages to the environment make me sad	N	10	16	43	66	75
		%	4.8	7.6	20.5	31.4	35.7
	C.2. I prefer public transport because I think about the environment	N	31	34	66	48	31
		%	14.8	16.2	31.4	22.9	14.8
	C.3. I act economical when consuming natural resources (water, fuel, energy, etc.)	N	7	17	61	45	80
		%	3.3	8.1	29.0	21.4	38.1
	C.4. I take care not to damage natural habitats	N	3	22	48	58	52
		%	1.4	10.5	22.9	40.5	24.8
	C.5. I prefer environmentally friendly products instead of plastic products that take a long time to decompose in nature	N	5	37	90	56	22
		%	2.4	17.6	42.8	26.6	10.5
	C.6. I take care to throw the trash into the trash can	N	5	23	45	53	84
		%	2.4	11.0	21.4	25.2	40.0

Environment-Knowledge Level		N %	SD *	D *	U *	A *	SA *
Economic Dimension of Sustainable Development (E)	E.1. I do not keep the refrigerator door open for a long time	N	9	10	52	76	63
		%	4.3	4.8	24.8	36.2	30.0
	E.2. I don't leave the computer on after I'm done using it	N	16	29	38	66	61
		%	7.6	13.8	18.1	31.4	29.0
	E.3. I take care not to get any surplus when shopping	N	26	17	73	50	44
		%	12.4	8.1	34.8	23.8	21.0
	E.4. I prefer to buy quality long lasting products instead of cheap products	N	3	22	56	67	62
		%	1.4	10.5	26.7	31.9	29.5
	E.5. I take care not to waste bread	N	12	26	40	76	56
		%	5.7	12.4	19.0	36.2	26.7
	E.6. I try to be economical in paper consumption	N	24	22	39	76	49
		%	11.4	10.5	18.6	36.2	23.3
	E.7. I prefer to use towels instead of disposable handkerchiefs to dry hands and face	N	8	10	46	42	104
		%	3.8	4.8	21.9	20.0	49.5

* **SD:** Strongly Disagree **D:** Disagree **U:** Undecided **A:** Agree **SA:** Strongly Agree

References

Ajzen, Icek, and Martin Fishbein. 1977. Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin* 84: 888–918. [CrossRef]

Akıllı, Hüsniye, Funda Kemahlı, Kadriye Okudan, and Ferihan Polat. 2008. The content of ecological footprint concept and calculatıon of individual ecological footprint in the Akdeniz Universty Economics and Administrative Sciences Faculty. *Akdeniz University Journal of Economics & Administrative Sciences* 15: 1–25.

Aydın, Özge, and Necdet Aykaç. 2016. The effect of the education ımplemented by the creative drama method on the environmental awareness of pre-school students. *Creative Drama Journal* 11: 1–16.

Bastianoni, Simone, Valentina Niccolucci, Riccardo M. Pulselli, and Nadia Marchettini. 2012. Indicator and indicandum: "Sustainable way" vs. "prevailing conditions" in the ecological footprint. *Ecological Indicators* 16: 47–50. [CrossRef]

Benzer, Elif, and Fatma Şahin. 2012. Evaluation of preservice science teachers' environmental literacy by using case studies throughout project based learning. *Marmara University Journal of Educational Sciences* 35: 55–83.

Borden, Richard J. 1985. *Personality and Ecolojical Concerns. Ecolojical Beliefes and Behaviour*. Greenwood: Westport.

Büyüköztürk, Şener, Ebru K. Çakmak, Özcan E. Akgün, Karadeniz Şirin, and Funda Demirel. 2012. *Scientific Research Methods*, 12th ed. Ankara: Pegem Akademi Publishing.

Çetin, Fahriye A. 2015. The Effect of Ecological Footprint Education on 8th Grade Students' Attitude, Awareness and Behavior Towards Sustainable Life. Master's thesis, Gazi University Graduate School of Educational Sciences, Ankara, Turkey.

Chapin, F. Stuart, III, Pamela A. Matson, and Peter M. Vitousek. 2011. *Principles of Terrestrial Ecosystem Ecology*. Berlin: Springer Science & Business Media.

Collin, Peter H. 2011. *Dictionary of Environment & Ecology*, 5th ed. London: Bloomsbury Publishing.

Coşkun, Işıl Ç., and Rabia Sarıkaya. 2014. Investigation of ecological foot print levels of classrom teacher candidates. *Turkish Studies* 9: 1761–87.

Cunningham, Wm, and Mary A. Cunningham. 2018. *Environmental Science: A Global Concern*, 14th ed. New York: McGraw-Hill Education.

EPA. 1999. *Recycling Works*. Washington: EPA.

Farmer, G. Thomas, and John Cook. 2013. *Climate Change Science: A Modern Synthesis: Volume 1-The Physical Climate*. Berlin: Springer Science & Business Media.

Goodland, Robert. 1995. The concept of environmental sustainability. *Annual Review of Ecology and Systematics* 26: 1–24. [CrossRef]

Grigoryeva, Victoria V. 2010. Research of Parameters of a Personal Ecological Footprint as an Effective Tool of Education for Sustainable Development. Paper presented at the Footprint Forum, Italy, June 9–10.

Günal, Nazlı. 2018. Evaluation of University Students' Trends in Reducing Ecological Footprint. Master's thesis, Gazi University Graduate School of Natural and Applied Sciences, Ankara, Turkey.

Harris, Jonathan M. 2000. Basic principles of sustainable development. In *Dimensions of Sustainable Development*. Edited by K. S. Bawa and R. Seidler. Oxford: EOLSS Publisher/UNESCO, pp. 21–41.

Hart, Paul. 2003. *Teachers' Thinking in Environmental Education: Consciousness and Responsibility*. New York: Peter Lang Publishing.

Huiqin, Li, and Hou Linchun. 2011. Evaluation on sustainable development of scenic zone based on tourism ecological footprint: Case study of yellow crane tower in Hubei Province, China. *Energy Procedia* 5: 145–51. [CrossRef]

IUCN. 1991. *Caring for the Earth: A Strategy for Sustainable Living*. Switzerland: The World Conservation Union.

Kaya, Mehmet F. 2013. A scale development study on the attitudes of sustainable development. *lnternational Journal of Geography and Geography Education* 28: 175–93.

Kaypak, Şafak. 2013. Looking at the environmental peace in the ecological footprint. *Turkish Journal of Sientific Reviews* 6: 154–159.

Keleş, Özgül. 2011. The effect of learning cycle model on students' reducing ecological footprints. *Gaziantep University Journal of Social Sciences* 10: 1143–60.

Keleş, Özgül, and Sibel Özsoy. 2010. *Turkey Specific Ecological Footprint Calculator*. Global Footprint Network.

Keleş, Özgül, Naim Uzun, and Sibel Özsoy. 2008. Measuring and evaluating pre-service teachers' ecological footprints. *Ege Journal of Education* 9: 1–14.

Kılıç, Selim. 2014. Effect size. *Journal of Mood Disorders* 4: 44–60. [CrossRef]

Kiziroğlu, İlhami. 2001. *Ecological Potpourri*. Ankara: Takav Publishing.

Koçak, Funda, and Velittin Balcı. 2010. The environmental sustainability in the sporting events in nature. *Ankara University Journal of Environmental Sciences* 2: 213–22.

Koru, Ayça T. 2012. Consumption footprint: A look to the world. *The Journal of Economics and Society* 24: 13–19.

Lourdel, Nathalie, Jan Martin, and Olivier Bérerd. 2006. Overcoming Obstacles to Understanding Sustainable Development–An Approach Based on Personal Experiences. Paper presented at Engineering Education in Sustainable Development Conference, France, October 4–6.

Lucerne Declaration. 2007. Lucerne Declaration on Geographical Education for Sustainable Development. Paper presented at Lucerne-Symposium, Switzerland, July 29–31.

McMillan, Emily E., Tarah Wright, and Beazley Karen. 2004. Impact of a university–level environmental studies class of students' values. *The Journal of Environmental Education* 35: 19–27. [CrossRef]

Meyer, Verena. 2004. The Ecological Footprints as an Environmental Education Tool for Knowledge, Attitude and Behavior Changes Towards Sustainable Living. Master's thesis, University of South Africa, Unisa.

Misar, R. 2000. *Environmental Education*. Ankara: Ankara University Faculty of Educational Sciences Alumni Association Publications.

Moffatt, Ian. 1996. *Sustainable Development: Principles, Analysis and Policies*. London: The Parthenon Publishing.

MoNE. 2017a. *Elementary Schools Science (3, 4, 5, 6, 7 And 8th Grades) Curriculum*. Ankara: Board of Education and Training.

MoNE. 2017b. *Primary School Life Science (3rd, 4th, 5th, 6th, 7th and 8th Grades) Curriculum*. Ankara: Board of Education and Training.

MoNE. 2017c. *Elementary Social Studies (3rd, 4th, 5th, 6th, 7th and 8th Grades) Curriculum*. Ankara: Board of Education and Training.

Negev, Maya, Gonen Sagy, Yaakov Garb, Alan Salzberg, and Alon Tal. 2008. Evaluating the environmental literacy of Israeli elementary and high school students. *The Journal of Environmental Education* 39: 3–20. [CrossRef]

Özbuğutu, Emrah, Serdar Karahan, and Çetin Tan. 2014. Environmental education and its alternative methods—A literature review. *Mustafa Kemal University Journal of Graduate School of Social Sciences* 11: 393–408.

Özdemir, Oya, Ayşe Yıldız, Esin Ocaktan, and Özlem Sarışen. 2004. Awareness and sensibility levels of medical students. *Journal of Ankara Medical School* 57: 117–27.

Özgen, Uğur, and Aybala D. Aksoy. 2017. Ecological footprint awareness levels of consumers (sample of Ankara province). *Third Sector Social Economic Review* 52: 46–65.

Peng, Wenjun, Xiaoming Wang, Xiaokang Li, and Chenchen He. 2018. Sustainability evaluation based on the emergy ecological footprint method: A case study of Qingdao, China, from 2004 to 2014. *Ecological Indicators* 85: 1249–61. [CrossRef]

Pooley, Julia A., and Moria O'Connor. 2000. Environmental education and attitudes: Emotions and beliefs are what is needed. *Environment and Behavior* 32: 711–23. [CrossRef]

Reece, Jane B., Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, and Robert B. Jackson. 2013. *Campbell Biology*. Ankara: Palme Publishing.

Rudolpha, Alexandra, and Lukas Figge. 2017. Determinants of ecological footprints: What is the role of globalization? *Ecological Indicators* 81: 348–61. [CrossRef]

Sam, Neslihan, Sevda Gürsakal, and Rıza Sam. 2010. Assessing environmental risk perceptions and environmental attitudes of university students. *Akademik Bakış Dergisi* 20: 1–16.

Şama, Erdoğan. 2003. Teacher candidates' attitudes toward environmental problems. *Journal of Gazi Education Faculty* 23: 99–110.

Sauvé, Lucie. 2005. Una cartografía de corrientes en educación ambiental (A map of currents in environmental education). In *A Pesquisa em Educação Ambiental: Cartografias de uma Identidade Narrativa em Formação*. Edited by M. Sato and I. Porto. Alegre: Artmed.

SDGs. 2015. *17th United Nation Sustainable Development Goals*. Washington: United Nations Environment Program.

Simon, Szabolcs. 2009. Environmental education for sustainability. *Practice and Theory in Systems of Education* 4: 10–14.

Soussan, J. G. 1992. Sustainable development. In *Environmental Issues in the 1990's*. Edited by M. Mannion and S. R. Bowlby. New York: John Wiley & Sons, pp. 21–35.

Stockemer, Daniel. 2019. *Quantitative Methods for the Social Sciences: A Practical Introduction with Examples in SPSS and Stata*. New York: Springer International Publishing.

Taylor, Neil, Tamar Doff, Kathy Jenkins, and Julie Kenne. 2007. Environmental knowledge and attitudes among a cohort of pre-service primary school teachers in Fiji. *International Research in Geographical and Environmental* 16: 367–79. [CrossRef]

Tbilisi Declaration. 1977. Available online: https://www.gdrc.org/uem/ee/tbilisi.html (accessed on 15 August 2019).

UNCED. 1992. *The Global Partnership for Environment and Development: A Guide to Agenda 21*. Geneva: United Nations Commission on Environment Development.

van Vuuren, Detlef P., and Edward M. W. Smeets. 2000. Ecological footprints of Benin, Bhutan, Costa Rica and the Netherlands. *Ecological Economics* 34: 115–30. [CrossRef]

Wackernagel, Mathis, and William Rees. 1996. *Our Ecological Footprint Reducing Human Impact on The Earth*. Canada: New Society Publishers.

Weinberg, Randy, and Jeria Quesenberry. 2010. Introducing the Footprint in Information Systems Education. Paper presented at the Footprint Forum, Italy, June 9–10.

WWF. 2012. *Living Planet Report 2012, Biodiversity, Biocapacity And Better Choices*. Washington: World Wildlife Fund.

WWF. 2018. *The Human Footprint*. Washington: World Wildlife Fund.

Yıldırım, Ali, and Hasan Şimşek. 2013. *Qualitative Research Methods in Social Sciences*, 9th ed. Ankara: Seçkin Publishing.

Yıldız, Emre, and Mahmut Selvi. 2015. The ecological footprints and the views on ways to reduce the ecological footprint of pre-service science teachers. *Gazi University Journal of Gazi Educational Faculty* 35: 457–87.

Yücel, Elif Ö., and Muhlis Özkan. 2013. Comparison of 2013 science education curriculum with the 2005 science and technology curriculum in terms of environmental topics. *Journal of Uludağ University Faculty of Education* 26: 237–65.