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Ecological Footprint Awareness of Generation Z: A Case Study of Selçuk University Faculty of Science

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Abstract − Achieving a sustainable ecosystem requires a harmonious relationship between biological capacity and ecological footprint. However, in today's rapidly industrializing world, population growth and lack of awareness about ecological footprints negatively impact biological capacity. Consequently, global ecological limits have been exceeded, straining the planet's carrying capacity. Human dominance over nature drives biodiversity loss and contributes to climate change, disrupting ecosystem balance, overconsuming natural resources, and causing environmental degradation. Industrialization and rapid urbanization have significantly increased resource consumption, leading to a sharp rise in greenhouse gas emissions—central to the carbon footprint and primary causes of climate change—that critically affect air quality, ecosystem stability, and biodiversity protection. Environmental factors directly influence human well-being, economic activities, and the health of all living organisms while reshaping the ecological order. This study aims to provide a fresh perspective on ecological awareness and inspire actionable steps in terms of building a sustainable ecosystem through a survey assessing the ecological literacy of Selcuk University Faculty of Science (SUFS) students. The survey reveals students' environmental awareness levels while examining its impact on their ecological behaviors. The general evaluation shows that SUFS students exhibit high awareness levels in the Ecological Footprint Awareness scale; however, scores related to recycling and transportation are lower than other dimensions. This indicates that targeted training for recycling and transportation is necessary to enhance overall awareness levels regarding ecological footprints. The findings will serve as a valuable resource for identifying strategies to improve environmental consciousness while emphasizing individuals' roles in fostering a sustainable future.

Keywords − *Ecological footprint, biological capacity, sustainability in the ecosystem, climate change, ecological awareness*

1. Introduction

Human communities are closely intertwined with their environment, forming a unified whole. In creating this whole, natural resources are often used unknowingly, leading to one of today's and the future's greatest challenges: environmental pollution. According to survey results from the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the most significant global issues over the next 10 years will be climate change and biodiversity loss, making their resolution a primary challenge [1]. Ecological footprint studies, introduced by sustainability advocates Mathis Wackernagel and Bill Rees, emerged in the early 1990s during discussions about the Earth's human carrying capacity. These studies have played a vital role in raising awareness of ecological footprints as one of the most pressing global issues identified by UNESCO [2].

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Research shows that the ecological footprint is essential for maintaining a livable planet and ensuring sustainability [2-5]. The ecological footprint measures how much of the planet's biological capacity we use to counterbalance the effects of our consumption and is expressed in global hectares (gha). Biological capacity refers to the ability of renewable natural resources to sustain life in specific geographical areas and is also expressed in global hectares. The ecological footprint is divided into six main subcategories: carbon footprint, grazing land footprint, fishing ground footprint, forest land footprint, agricultural land footprint, and built-up land footprint [3].

Carbon footprint refers to carbon dioxide emissions from human activities such as transportation (cars, airplanes, etc.) and the burning of fossil fuels. It is the largest contributor to the ecological footprint, accounting for 0.46 of the total [4-5].

Grazing land footprint refers to the land used for livestock-related products, such as meat and dairy, and pastureland for grazing. It contributes 0.03 to the ecological footprint [4-5]. Fishing ground footprint measures the freshwater and saltwater areas required to sustain the seafood we consume, accounting for 0.02 of the total ecological footprints [4-5]. Forest land footprint calculates the forest area needed to produce textiles, cosmetics, paper, and wood materials. It contributes 0.11 to the ecological footprint [4-5]. The agricultural land footprint includes areas used for producing food, animal feed, vegetable oils, rubber, and fiber for the population. It is the second largest contributor, making up 0.35 of the total ecological footprints [4-5].

Built-up land footprint represents the impact of infrastructure such as transportation, housing, industrial buildings, and power plants. It accounts for 0.03 of the ecological footprints [4-5].

The primary goal of the ecological footprint is to quantify humanity's demand for ecological goods and services while preventing the Earth's ecological capacity from being exceeded and ensuring sustainability. Public awareness of the ecological footprint is one of the most critical factors in achieving these goals.

With a growing population and rapid industrial development, ecological challenges in Türkiye have become increasingly pronounced. A literature review reveals that Türkiye's biocapacity reserves have declined from 1961 to 2018, as shown in Table 1 [6]. As the table illustrates, biocapacity reserves have progressively moved into a negative trend, indicating that ecological limits have been exceeded.

Table 1. Ecological footprint and biocapacity amounts between 1961-2018

Years	Biological Capacity Per Capita	Ecological Footprint Per Capita	Biocapacity Reserve (+\-)
1961	2.6 gha	1.6 gha	+1.0 gha
1973	2.1 gha	1.8 gha	+0.3 gha
1980	2.1 gha	2.1 gha	0.0 gha
1991	1.9 gha	2.4 gha	-0.5 gha
1998	1.8 gha	2.8 gha	-1.0 gha
2005	1.6 gha	2.8 gha	-1.2 gha
2010	1.5 gha	3.2 gha	-1.7 gha
2018	1.3 gha	3.4 gha	-2.1 gha

As mentioned earlier, the problems highlighted by the UNESCO survey are climate change and biodiversity. For a more sustainable planet, the biological capacity per person must be equal to or greater than the ecological footprint per person, and biocapacity reserves are expected to show a positive trend [6]. In recent years, Ecological Footprint Awareness (EFA) studies have examined the relationship between individuals' consumption habits and environmental impact. The EFA scale consists of the subdimensions Energy, Laws, Recycling, Transportation, Water Consumption, and Food. The Energy subdimension includes 8 items, the Legal Scope subdimension includes 4 items, the Recycling subdimension includes 5 items, the Transportation subdimension includes 5 items, the Water Consumption subdimension includes 4 items, and the Food subdimension includes 4 items, totaling 30 items across 6 subdimension [7].

The conceptual understanding of the ecological footprint is of great importance for significantly contributing to the field. While the ecological footprint is often discussed regarding its environmental impacts and

calculation methods, its theoretical foundations and connections to sustainability concepts need to be explored in greater depth. A comprehensive discussion on the definition, historical development, and ecological footprint measurement across different sectors could provide valuable insights for researchers and policymakers. Furthermore, studies examining how various theoretical approaches to the ecological footprint intersect with environmental awareness and behavior can clarify its role in promoting sustainable practices. Expanding the conceptual boundaries of ecological footprint research will enhance understanding and contribute to developing more effective strategies for implementing environmental policies and raising awareness. This deeper understanding also opens opportunities to explore the relationships between the ecological footprint, consumption habits, and societal attitudes toward sustainability.

For example, the "Ecological Footprint Calculation Survey" is administered to 81 teacher candidates at Aksaray University [8]. Similarly, an individual ecological survey is conducted among 241 students and employees at Akdeniz University [9]. At Mustafa Kemal University Faculty of Agriculture, the ecological footprint of 91 academicians is evaluated using the same survey; despite their footprint being above the global average, it remained below the Turkish average [10]. The EFA scale, developed by Coşkun, is administered to 217 teacher candidates in the 1st and 4th grades of the Science Education and Turkish Language Teaching departments at Akdeniz University [11]. An ecological footprint survey is also applied to 390 engineering students at Sakarya University [12], while the same awareness scale is used with 433 students from Süleyman Demirel University's Faculty of Architecture [13]. The EFA scale developed by Çelik Coşkun and Sarıkaya is used by selecting 194 individuals from the faculty of sports sciences [14]. The scale is also administered to 66 teacher candidates from the Biology Education Department [15].

Additionally, the ecological footprint is calculated regionally in Southern Colorado [16], and the scale is applied to 536 classroom teachers across four districts in the city center of Diyarbakir [17]. The EFA Scale, developed by Coşkun, is administered to 47 science teacher candidates continuing their education in the 3rd and 4th years. The EFA levels of these 47 teacher candidates are examined about various demographic variables. A significant difference is observed between the class levels of the participants [18]. The EFA Scale is administered to students at the Faculty of Health Sciences at Sivas Cumhuriyet University. The students' EFA levels are found to be high [19]. In another study, the EFA Scale is administered to 85 students studying in the Forestry Engineering Department at Karabük University. It was found that the students scored the highest in the Legal Scope and Energy subdimensions, while the Transportation subdimension had the lowest score [20].

According to the 2021 census of the Turkish Statistical Institute, 15.3% of the Turkish population consists of Generation Z [21]. In a society where knowledge is passed down from generation to generation, raising awareness about ecological footprint and biocapacity is critical for individuals to continue their sustainable lives today and in the future. However, despite this important issue, there is no study in the literature focusing on the ecological footprint of Generation Z. This study aims to fill this gap by using the newly developed EFA scale to assess the awareness levels of Generation Z students at Selçuk University Faculty of Science regarding the ecological footprint.

2. Materials and Methods

2.1. Research Purpose, Scope, and Limitations

Human activities have a negative impact on climate change and biodiversity. If we fail to prevent the exceedance of ecological limits, our planet will move toward becoming uninhabitable. The most effective strategy for preventing ecological limit exceedance is to increase awareness among individuals and institutions regarding their ecological footprint. To protect the ecological balance and ensure the sustainability of human societies, it is essential to address the six main factors affecting the ecological footprint to meet the needs of present and future generations. This study aims to assess students' EFA and literacy levels at the Faculty of Science, Selçuk University.

2.2. Research Method

This study is conducted at the Faculty of Science, Selçuk University, to examine students' EFA levels. A face-to-face survey is employed to gather the data necessary for the study. The survey consists of two sections: the first section will collect sociodemographic information from the participants (such as age, gender, and expenditure patterns), while the second section will assess the participant's knowledge of the ecological footprint.

2.3. Research Group

The study population consists of university students from the Faculty of Science at Selçuk University. The sample size is determined based on the total student population of 1.722, following the principles outlined in the sampling guide [22]. To account for potential invalid responses, 250 questionnaires are planned for distribution, exceeding the 10% sample size. Table 2 presents a detailed account of the sample sizes calculated using the stratified sampling method, along with their distribution across departments and the targeted number of students for each department.

Table 2. Number of surveys to be applied by departments

Department	Number of Students	Survey to be Conducted
Actuarial Sciences	106	15
Biochemistry	221	33
Biology	311	45
Biotechnology	242	35
Physics	103	15
Statistics	154	23
Chemistry	165	24
Mathematics	420	60
Total	1722	250

2.4. Analysis of Data

The responses collected from the questionnaire are coded and entered into the Statistical Package for Social Sciences (SPSS) Program 22.0 software for analysis. To ensure the data is prepared for analysis, frequency analysis is conducted for each scale item, and the maximum and minimum values, means, and standard deviations are reviewed. Missing data and incorrect entries are identified, and the dataset is cleaned accordingly. Following the data validation process, frequency analysis is performed for categorical (grouped) data, while descriptive statistics are calculated for continuous (ungrouped) data from the final dataset. Descriptive statistics are utilized to report demographic information, and frequency analysis is conducted, including means and standard deviations, as appropriate for the data type.

The data is then transferred into SPSS 22, where relevant definitions and assignments are made to facilitate further analysis. After data entry, the statistical methods used in the study are determined. Given that established scales from the literature are employed, Confirmatory Factor Analysis (CFA) is conducted to validate the scales and their respective dimensions. Cronbach's alpha coefficient is calculated to assess the reliability of each scale. The total scores for each scale are computed after removing invalid items based on the fit values and factor loadings derived from the CFA.

The analysis of the resulting scores involved assessing the normality of the data distribution and the homogeneity of variance, which informed the choice between parametric and nonparametric tests. The Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity are used to evaluate the adequacy of the sample for factor analysis. The study examines the relationships between EFA and demographic and behavioral variables,

and various hypotheses are tested in this direction. These hypotheses and the way they are included in the analysis can be summarized as follows:

One of the main focuses of the study is to examine whether there is a significant difference between the EFA levels of the participants according to their gender. Another critical issue is to evaluate the effect of the place where the participants live on EFA. In addition, the effect of the parents' education level on individuals' EFA is investigated.

In the context of economic factors, the effect of the participants' monthly expenditure levels on EFA levels is analyzed. In terms of behavioral variables, the relationship between cigarette and alcohol use and awareness levels is examined. Finally, the effect of the participants' book reading habits on ecological awareness levels is investigated. Each hypothesis is analyzed using appropriate statistical tests to determine whether there is a significant difference between EFA levels. The Kolmogorov-Smirnov test is applied to evaluate the normality of the data. In cases where normality could not be achieved, the Mann-Whitney U test is used for comparisons between two independent groups, and the Kruskal-Wallis test is used for comparisons between three or more independent groups. With these methods, a comprehensive analysis is carried out to understand the effects of the study on different variables.

3. Findings

3.1. Demographic Findings

Table 3 presents the distribution of participants from the Faculty of Science at Selçuk University who completed the survey, organized by department. Of the total respondents, 10.27% (26 students) are from the Statistics Department, 17.78% (45 students) are from the Biology Department, 23.71% (60 students) from the Mathematics department, 5.92% (15 students) from the Physics department, 13.83% (35 students) from the Biotechnology department, 9.48% (24 students) from the Chemistry department, 5.92% (15 students) from the Actuarial Sciences department, and 13.04% (33 students) from the Biochemistry department.

Table 3. Distribution of descriptive statistics

		n	%
Department	Statistics	26	10.27
	Biology	45	17.78
	Mathematics	60	23.71
	Physics	15	5.92
	Biotechnology	35	13.83
	Chemistry	24	9.48
	Actuarial Sciences	15	5.92
	Biochemistry	33	13.04
Gender	Female	171	67.6
	Male	82	32.4
Place of residence	City center	182	71.9
	District	61	21.1
	Rural Areas	10	4.0
Mother's Education	Primary School	168	66.4
	High School	62	24.5
	Associate Degree	10	4.0
	Undergraduate and Postgraduate	13	5.1

Table 3. (Continued) Distribution of descriptive statistics

		n	%
Mother Occupation Group	Public	13	5.1
	Private	27	10.7
	Housewife	196	77.5
	Other	17	6.7
Father's Education	Primary School	113	44.7
	High School	78	30.8
	Associate degree	28	11.1
	Undergraduate and Postgraduate	34	13.4
Father Occupation Group	Tradesmen	44	17.4
	Public	43	17.0
	Private	67	26.5
	Other	99	39.1
Monthly expenses	Less than 1000₺	35	13.8
	Between 1000₺ and 2000₺	53	20.9
	Between 2000₺ and 3000₺	65	25.7
	Between 3000₺ and 4000₺	48	19.0
	More than 4000₺	52	20.6
Smoking	Yes	45	17.8
	No	208	2.2
Alcohol	Yes	28	28
	No	225	88.9

Table 3 presents the distribution of participants by gender, showing that female participants constitute a higher proportion than male participants, with 67.6% (171 participants) being female and 32.4% (82) male. In terms of residential locations, the majority reside in urban areas, with 71.9% (182 participants) living in city centers, followed by 21.1% (61 participants) in district areas and 4.0% (10 participants) in rural areas. Regarding the educational background of participants' mothers, 24.5% (62) have completed high school, 4.2% (10) hold an associate degree, 5.1% (13) possess an undergraduate degree, and 5.1% (13) have attained a postgraduate degree. Occupational categories show that 77.5% (196) of mothers are housewives, 10.7% (27) are employed in the private sector, 6.7% (17) belong to other occupational groups, and 5.1% (13) work in the public sector. For fathers, 30.8% (78) have completed high school, 11.1% (28) hold an associate degree, 13.4% (34) have obtained an undergraduate degree, and 13.4% (34) possess a postgraduate degree. Additionally, 39.1% (99) of fathers are employed in other occupational groups, 26.5% (67) work in the private sector, 17.4% (44) are tradesmen, and 17.0% (43) are employed in the public sector. The analysis of educational levels reveals that primary school graduates represent the largest group, with 66.4% (168) of mothers and 44.7% (113) of fathers having completed primary school. Monthly spending among the participants varies, with the largest group (25.7%, 65 participants) spending between 2000₺ and 3000₺. Additionally, 20.9% (53) report expenditures of 1000₺ to 2000₺, 20.6% (52) spend more than 4000₺, 19.0% (48) fall within the 3000₺ to 4000₺ range, and 13.8% (35) spend less than 1000₺. In terms of smoking habits, 82.2% (208 participants) are non-smokers, while 17.8% (45) are smokers. Regarding alcohol consumption, 88.9% (225) reported not consuming alcohol, whereas 11.1% (28) indicated that they do consume alcohol. The number of books read by participants each month is also analyzed. The results show that 33.2% (84) of participants read one book per month, 22.9% (58) read two books, and 16.6% (42) did not read any books. Additionally, 13.0% (33) read three books per month, 8.7% (22) read four books, and 5.5% (14) read five books.

3.2. Results of Validity and Reliability Analysis of Scales

For a measurement tool to produce accurate results, it is essential to be valid and reliable in scientific research. Accurate results are obtained when both reliability and validity criteria are sufficiently met. To ensure this, the scales' reliability and validity are assessed before analyzing the research data and testing the hypotheses. While there are different reliability analysis methods depending on the measurement tool used, the most commonly used method is internal consistency, which is assessed by calculating Cronbach's alpha coefficient. The alpha value ranges from 0 to 1, with a value of at least 0.70 generally considered acceptable.

Factor analysis is utilized to assess construct validity. CFA, which facilitates the interpretation of multiple variables, is commonly employed to test construct validity, particularly in the social sciences. For this study, Multi-Factor CFA is conducted on the EFA scale using the Analysis of Moment Structures (AMOS) 22 program to evaluate the validity of the scales. CFA examines whether the relationships within the structure defined by the variables align with the collected data. It also assesses the applicability of scales developed by other researchers in the social sciences to the research sample in the present study. Consequently, CFA is initially applied to determine the construct validity of the scales associated with the conceptual model of this research. Table 4 presents the KMO test values, which are used to assess the adequacy of the sample size for factor analysis and the suitability of the scales employed in the study.

Table 4. KMO and Bartlett test values of the EFA scale

Scales	KMO	Bartlett Test-Ki-Kare	p
EFA Scale	0.916	3143.670	<0.000

As presented in Table 4, the KMO coefficient for the scale used is 0.916, while Bartlett's Test of Sphericity indicated a significance value of p = 0.000. These results confirm the suitability of the variables for factor analysis, as both the KMO and Bartlett's test values meet the necessary criteria. Consequently, the data collected from the participants are deemed appropriate for factor analysis, suggesting that meaningful factors can be extracted.

To uncover the factor structure of the scales, both rotated (Component Matrix) and principal axis rotated (Rotated Component Matrix-Varimax) principal component analysis is applied. After conducting the necessary structural validity tests, the factor analysis results employed in this study are presented in the following section. Model fit indices are the primary indicators of whether the data support the tested model. Each fit index has strengths and limitations; therefore, it is advised not to rely solely on one fit index to assess whether the tested model is confirmed.

The Chi-square (χ^2) value, the most widely used and oldest goodness-of-fit index, tests the compatibility between the sample data and the theoretically proposed model by the researcher. The χ^2/df ratio offers more precise and reliable results when evaluating the overall model's goodness-of-fit, as it divides the Chi-square value by the degrees of freedom. The Goodness of Fit Index (GFI) assesses the model's fit independent of the sample size. The Comparative Fit Index (CFI) compares the covariance matrices of the theoretical and structural models. Finally, the Root Mean Square Error of Approximation (RMSEA) evaluates the degree of fit between the model and the sample covariance. RMSEA is particularly sensitive to model complexity and measures the discrepancy between the theoretical and model derived from the observed variables.

In cases where the fit indices are not satisfactory following CFA for EFA, adjustments should be made based on the modification indices. The CFA measurement model for this situation is presented below. Figure 1 illustrates the Multi-Factor CFA conducted on the EFA scale.

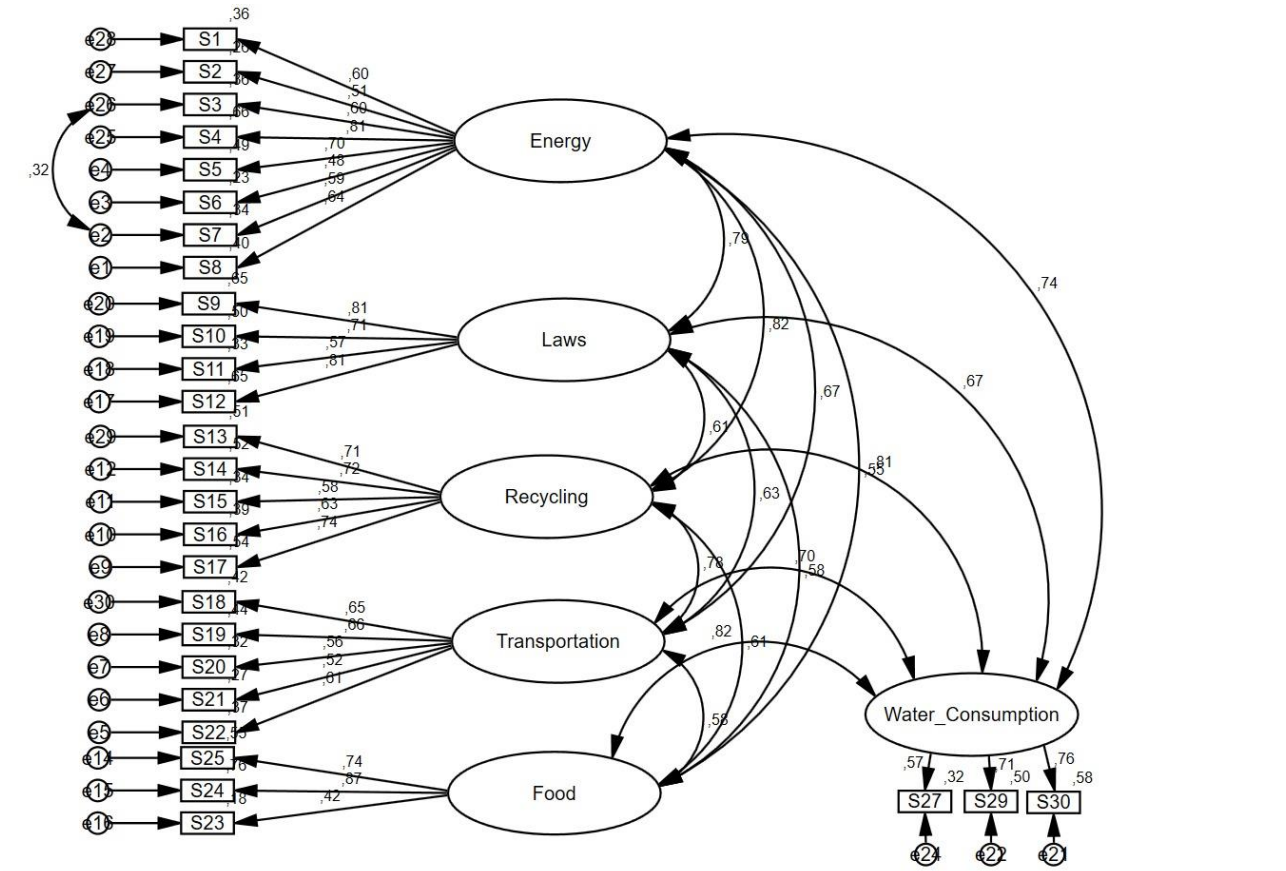

Figure 1. Multi-factor CFA on the EFA scale

Table 5 presents the CFA fit indices applied to the EFA scale.

Table 5. EFA scale CFA fit values

	χ^2	df	χ^2/df	GFI	CFI	RMSEA
Fit Values	653.477	334	1.957	0.868	0.923	0.062
Good Fit Values *			≤3	≥0.90	≥0.95	≤0.05
Acceptable Fit Values *			≤3-5	0.89-0.85	≥0.90	0.06-0.08

As a result of the CFA conducted on the EFA scale, it was determined that the fit indices did not meet the acceptable thresholds. Consequently, it is deemed necessary to modify the scale, leading to removing the 26th item from the Food sub-dimension and the 28th item from the Water Consumption sub-dimension. Table 6 presents the percentage of variance explained by the sub-dimensions of the EFA scale, along with the corresponding reliability coefficients.

Table 6. EFA scale sub-dimensions variance explanation percentage and reliability results

Scale/Code	Sub-dimension/Code	Variance Explanation Percentage	Cronbach Alpha Coefficient
EFA Scale	Energy	35.171	0.828
	Laws	7.203	0.810
	Recycling	5.439	0.806
	Transportation	4.941	0.738
	Food	3.970	0.705
	Water Consumption	3.453	0.710

Upon examining Table 6, it is evident that the energy dimension accounts for 35.171% of the total variance explained, while the laws dimension contributes 7.203%. The recycling dimension explains 5.439% and 4.941%, respectively. The total variance explained for the scale is 60.178%. Furthermore, the average variance extracted (AVE) value exceeds the accepted threshold of 0.40. The internal consistency coefficient, specifically Cronbach's Alpha, is computed to assess the scale's validity. The resulting Cronbach's Alpha value for the entire scale is found to be 0.926, which is well above the accepted threshold of 0.70. These results affirm that the scale demonstrates high internal consistency, indicating reliability. Table 7 provides the factor loadings for the items of the EFA scale.

Table 7. Factor loadings of EFA scale items

Scale	Sub-Dimension	Items/Expressions	Factor
EFA Scale	Energy	Do you prefer using clean and environmentally sustainable energy sources for heating	0.60
		Do you make sure that the windows are closed when the air conditioning is on?	0.51
		Do you make sure not to leave electrical appliances on for long periods of time?	0.60
		Do you prefer energy-efficient lighting and heating products?	0.81
		Do you prefer double-glazed windows because they provide thermal insulation?	0.70
		Do you use LED bulbs instead of old bulbs at home?	0.48
		Do you make sure that devices such as PCs, tablets, and televisions are not left on	0.59
		Do you avoid running washing machines, dishwashers, dryers, etc., without a full load	0.64
	Laws	Do you believe that positioning solar energy in urban structuring where it can be used	0.81
		Do you think that the government should encourage the sale of vehicles with minimal	0.71
		Do you believe that green areas should be preserved and not sacrificed for urbanization and	0.57
		Do you agree that industrial organizations should take measures to protect environmental	0.81
	Recycle	Do you recycle electronic waste?	0.71
		Do you make an effort to recycle household waste?	0.72
		Do you try to repurpose leftover food instead of discarding it?	0.58
		Do you separate household waste based on its type before disposing of it?	0.63
		Do you prefer using recyclable packaging when shopping?	0.74
	Transport	Do you prefer sharing a car with others to minimize environmental impact?	0.65
		Do you prefer using public transportation to reduce environmental harm?	0.66
		Do you prefer vehicles such as Ginger, scooters, and electric skateboards because they	0.56
		Do you prefer riding a bike to driving a car?	0.52
		When the distance is suitable, do you prefer walking over driving?	0.61
	Food	Do you avoid eating foods that are not in season?	0.42
		Do you buy only as much food as you need when shopping?	0.87
		Do you cook only the amount of food that will be consumed?	0.74
	Water Consumption	Do you prefer wiping your car instead of washing it to consume less water?	0.57
		Do you take care not to waste more water than necessary for personal hygiene?	0.71
		Do you prefer to water the plants at home/in the garden using the correct methods?	0.76

An item must exhibit a sufficiently high factor loading to be included in a factor. Items with a factor loading below the threshold of 0.50 are recommended for removal, as they do not contribute meaningfully to the factor structure of the measurement instrument [23]. In line with this criterion, the EFA scale, consisting of six dimensions and 28 items, has been confirmed, as shown in the table. A summary of the modifications made to the EFA scale is presented in Table 8.

Table 8. Changes made to the EFA scale

	Scales	Number of Statements	Number of Statements Extracted
EFA Scale	Energy	8	-
	Laws	4	-
	Recycling	5	-
	Transportation	5	-
	Food	4	1
	Water Consumption	4	1

3.3. Findings Regarding EFA Scores

In statistical analyses, it is considered essential that the data distribution adheres to the normality assumptions. Therefore, normality tests are conducted to assess whether the data obtained from the participants in this study met these assumptions. The Kolmogorov-Smirnov test is utilized to evaluate the conformity of the data to a normal distribution. The results from the Kolmogorov-Smirnov test for the EFA Scale scores reveal that the data do not follow a normal distribution, as the p-value ($p = 0.000$) is less than the 0.05 significance level. Based on these findings, nonparametric tests will be employed in this study: the Mann-Whitney U test will be used to analyze differences in mean values between two independent groups, while the Kruskal-Wallis test will be used to examine differences across three or more groups.

Table 9. EFA scale Mann-Whitney U test results

	Energy Mean+SE Mean Rank	Laws Mean+SE Mean Rank	Recycling Mean+SE Mean Rank	Transportation Mean+SE Mean Rank	Food Mean+SE Mean Rank	Water Consumption Mean+SE Mean Rank	EFA Total Score Mean+SE Mean Rank
				Gender			
Female (n=171)	33.883+0.384 128.47	17.859+0.212 133.22	18.853+0.332 131.62	18.590+0.340 135.73	11.888+0.173 129.663	11.812+0.196 133.69	112.888+1.330 133.36
Male (n=82)	33.170+0.669 123.93	17.000+0.374 114.03	18.060+0.493 117.37	16.853+0.492 108.80	11.292+0.344 121.51	11.097+0.290 113.05	107.475+2.005 113.73
p-value	0.643	0.043*	0.146	0.006*	0.403	0.034*	0.046*
				Smoking of Students			
Yes (n=45)	32.288+0.975 114.90	17.177+0.450 116.58	17.422+0.711 110.74	16.955+0.717 111.77	11.600+0.414 122.69	10.688+0.419 104.74	106.133+2.869 111.53
No (n=208)	33.947+0.351 129.62	17.668+0.208 129.25	18.851+0.296 130.52	18.259+0.307 130.30	11.716+0.176 127.93	11.774+0.174 131.81	112.216+1.201 130.35
p-value	0.220	0.275	0.099	0.122	0.660	0.023*	0.118
				Students' Alcohol Use			
Yes (n=28)	32.392+1.150 117.27	17.750+0.495 130.68	17.750+0.965 116.14	17.214+1.018 117.09	11.535+0.510 120.18	10.857+0.574 110.66	107.500+3.699 114.29
No (n=225)	33.808+0.352 128.83	17.560+0.204 126.54	18.702+0.286 128.35	18.128+0.293 128.23	11.715+0.171 127.85	11.671+0.169 129.03	111.587+1.170 128.58
p-value	0.257	0.770	0.403	0.446	0.597	0.206	0.329

Mann-Whitney U test, *statistical significant ($p<0.050$)

Based on the results presented in Table 9, no significant differences are found in the energy, recycling, and food scores when comparing students' genders. However, the scores for the scope of laws, transportation, water consumption, and EFA are found to be higher for female students than male students. Furthermore, the analysis revealed no significant differences in the energy, scope of laws, recycling, transportation, food scales, or EFA total scores based on students' smoking status. However, it is observed that non-smokers had higher scores on the water consumption scale than smokers (Table 9). Finally, as shown in Table 9, the p-values for the EFA scale and its sub-dimensions are greater than 0.050, indicating no significant differences between students who use alcohol and those who do not.

Table 10. EFA scale Kruskal-Wallis test results

Departments	Energy Mean+SE Mean Rank	Laws Mean+SE Mean Rank	Recycling Mean+SE Mean Rank	Transportation Mean+SE Mean Rank	Food Mean+SE Mean Rank	Water Consumption Mean+SE Mean Rank	EFA Total Score Mean+SE Mean Rank
Statistics (n=26)	31.923+1.159 114.26	16.769+0.632 116.24	18.487+0.908 131.36	16.923+0.904 115.37	11.282+0.484 118.90	10.692+0.467 105.58	106.076+4.003 118.24
Biology (n=45)	34.888+0.627 142.28	18.311+0.314 143.41	19.066+0.553 131.80	19.044+0.616 141.53	12.422+0.414 151.03	12.377+0.354 147.62	116.111+2.080 144.10
Mathematics(n=60)	34.011+0.508 128.68	17.595+0.319 127.01	18.505+0.441 123.99	18.359+0.430 129.72	11.404+0.272 116.16	11.674+0.262 128.21	111.550+1.724 124.79
Physics (n=15)	34.777+1.392 137.50	17.444+0.818 115.50	19.222+1.801 137.33	16.777+1.037 100.06	10.888+0.715 104.39	11.000+0.707 104.44	110.111+4.260 118.83
Biotechnology(n=35)	35.105+0.652 139.61	18.210+0.371 132.71	20.000+0.820 148.58	19.000+0.812 139.61	11.947+0.515 134.84	12.000+0.639 142.42	116.263+2.483 145.24
Chemistry (n=24)	33.500+1.784 118.25	16.666+1.145 95.42	19.666+1.605 150.92	17.500+2.045 120.83	11.666+1.085 115.75	10.666+1.358 113.58	109.666+6.264 115.75
Actuarial Science (n=15)	32.307+1.520 104.96	17.461+0.656 113.81	19.153+1.229 137.15	17.538+1.118 119.12	11.923+0.415 127.15	12.307+0.472 144.77	110.692+3.883 123.77
Biochemistry (n=33)	32.454+1.171 116.85	17.393+0.640 128.111	16.939+0.742 99.82	17.121+0.946 117.91	11.969+0.404 136.68	11.090+0.475 113.65	106.969+3.640 115.03
p-value	0.554	0.617	0.346	0.611	0.233	0.142	0.606

Kruskal-Wallis test, *statistical significant ($p<0.050$)

As a result of the Kruskal-Wallis tests conducted to examine the differences in the energy, scope of law, recycling, transportation, food, and water consumption scales, as well as the total EFA scores (which represent the sum of these scales), based on students' departments, the p-values for all scales are found to be greater than 0.050, as shown in Table 10. Therefore, no significant differences are observed between the groups. These findings indicate that the scale scores of the students are similar, regardless of their departmental affiliations.

Table 11. EFA scale Kruskal-Wallis test results

	Energy Mean+SE Mean Rank	Laws Mean+SE Mean Rank	Recycling Mean+SE Mean Rank	Transportation Mean+SE Mean Rank	Food Mean+SE Mean Rank	Water Consumption Mean+SE Mean Rank	EFA Total Score Mean+SE Mean Rank
Places Where Students Live							
City Center (n=182)	33.428+0.397 123.28	17.494+0.222 124.37	18.329+0.341 122.99	17.939+0.341 124.80	11.708+0.188 125.81	11.521+0.191 125.00	110.423+1.336 123.42
District(n=61)	34.000+0.618 129.19	17.803+0.345 129.88	18.868+0.444 128.64	18.229+0.530 130.42	11.590+0.358 128.95	11.557+0.314 124.80	112.049+1.914 128.38
Village(n=10)	35.600+2.696 181.30	17.800+1.569 157.30	21.800+1.396 189.90	18.400+1.746 146.10	12.100+0.657 136.10	12.800+1.162 176.80	118.500+8.713 183.80
p-value	**0.048***	**0.033***	**0.018***	0.611	0.873	0.085	**0.039**
Education Status of the Mothers of Students							
Primary Education(n=168)	33.779+0.405 128.03	17.756+0.223 131.04	18.678+0.320 126.32	18.214+0.346 128.57	11.797+0.192 129.31	11.720+0.198 130.43	111.946+1.321 128.18
High School (n=62)	33.661+0.728 129.97	17.322+0.418 122.86	18.435+0.651 129.21	18.145+0.565 130.48	11.693+0.359 130.11	11.354+0.341 121.49	110.612+2.496 131.53
Associate degree (n=10)	30.800+2.085 89.20	15.700+1.212 81.80	18.600+1.194 132.15	17.500+1.654 128.40	10.300+0.882 89.70	11.000+1.085 119.05	103.900+6.893 104.65
Undergraduate and Postgraduate (n=13)	34.153+1.170 128.58	18.000+0.518 129.31	18.307+1.272 121.27	15.461+1.243 88.96	11.461+0.605 111.04	11.307+0.535 115.04	108.692+3.791 107.31
p-value	0.419	0.182	0.977	0.289	0.312	0.751	0.540

Table 11. (Continued) EFA scale Kruskal-Wallis test results

	Energy Mean+SE Mean Rank	Laws Mean+SE Mean Rank	Recycling Mean+SE Mean Rank	Transportation Mean+SE Mean Rank	Food Mean+SE Mean Rank	Water Consumption Mean+SE Mean Rank	EFA Total Score Mean+SE Mean Rank
Father's Education Status of the Students							
Primary Education (n=113)	33.238+0.487 118.84	17.539+0.291 126.60	18.433+0.401 122.85	17.761+0.410 121.05	11.610+0.229 122.39	11.628+0.236 126.62	110.212+1.648 120.07
High School (n=78)	34.141+0.704 141.03	17.538+0.367 128.10	18.884+0.535 133.33	18.589+0.524 136.44	11.961+0.324 138.88	11.756+0.306 133.28	112.871+2.252 140.01
Associate degree (n=28)	33.785+0.958 126.25	17.321+0.529 115.38	19.000+0.646 133.13	17.964+0.844 128.77	11.714+0.479 126.29	11.464+0.483 125.32	111.250+2.926 129.48
Undergraduate and Postgraduate (n=34)	33.794+0.717 122.56	18.029+0.401 135.38	18.147+0.827 121.22	17.676+0.840 123.68	11.352+0.417 115.65	11.117+0.471 115.24	110.117+2.681 118.13
p-value	0.219	0.739	0.714	0.543	0.335	0.682	0.260
Students' Mother's Occupation Group							
Public (n=13)	35.000+0.816 138.15	18.153+0.504 133.46	19.615+0.873 141.65	18.538+1.107 136.35	12.307+0.485 139.54	12.230+0.579 142.85	115.846+3.218 141.69
Private (n=27)	32.444+1.089 108.91	16.963+0.701 115.67	17.666+0.930 111.22	15.407+0.967 88.78	10.333+0.541 89.17	11.444+0.460 124.02	104.259+3.682 99.02
Housewife (n=196)	33.693+0.394 128.46	17.581+0.217 127.54	18.683+0.307 128.08	18.352+0.309 131.11	11.846+0.182 131.60	11.515+0.192 125.61	111.673+1.278 129.59
Other (n=17)	34.058+1.158 130.41	18.117+0.520 133.82	18.294+1.330 128.35	18.058+1.246 133.12	11.647+0.605 123.47	12.058+0.558 135.68	112.235+4.069 130.32
p-value	0.556	0.808	0.606	**0.039***	**0.036***	0.805	0.191
Students' Fathers' Profession Group							
Tradesmen (n=44)	34.340+0.817 138.80	17.431+0.465 121.11	19.136+0.677 134.22	18.113+0.727 128.18	11.681+0.449 130.76	11.454+0.452 126.40	112.159+2.778 129.14
Public (n=43)	34.162+0.624 127.99	18.232+0.301 139.67	19.697+0.571 143.79	18.465+0.613 133.38	11.790+0.330 127.53	11.930+0.341 135.55	114.279+1.799 137.85
Private (n=67)	33.537+0.644 124.06	17.716+0.342 128.78	18.447+0.509 123.52	17.746+0.520 119.90	11.462+0.319 118.44	11.611+0.303 125.92	110.522+2.118 122.46
Other (n=99)	33.202+0.595 123.32	17.272+0.346 122.90	17.979+0.471 118.85	17.989+0.482 128.51	11.818+0.257 130.89	11.464+0.267 124.29	109.727+1.999 123.41
p-value	0.678	0.559	0.251	0.797	0.719	0.860	0.714
Monthly Expenditure Amounts of the Students							
Less than 1000₺ (n=35)	35.285+0.634 146.20	17.457+0.418 117.73	19.314+0.646 134.67	19.228+0.719 143.23	12.171+0.428 142.51	12.514+0.387 152.00	115.971+2.328 140.73
1000-2000₺ (n=53)	33.226+0.804 121.80	17.452+0.470 126.28	19.075+0.535 133.51	18.660+0.529 136.64	12.000+0.323 132.58	11.811+0.341 131.30	112.226+2.536 134.61
2000-3000₺ (n=65)	32.861+0.730 118.06	17.738+0.425 137.50	18.015+0.610 119.62	17.969+0.626 128.64	11.461+0.339 121.70	11.169+0.337 116.68	109.215+2.558 121.77
3000-4000₺ (n=48)	34.687+0.616 138.33	17.458+0.434 122.34	19.020+0.575 132.86	18.291+0.576 128.91	12.062+0.304 135.36	11.541+0.382 126.00	113.062+2.081 132.79
More than 4000₺ (n=52)	33.019+0.811 120.09	17.711+0.329 125.14	17.961+0.673 119.02	16.403+0.663 102.44	11.019+0.406 109.77	11.269+0.363 119.61	107.384+2.500 111.19
p-value	0.258	0.683	0.661	0.071	0.210	0.183	0.301

Kruskal-Wallis test, *statistical significant ($p<0.050$)

When examining Table 11, it is observed that no significant differences are found in the transportation, Food, and water consumption scores based on the students' residential areas. However, individuals in rural areas (villages) scored higher on energy, scope of laws, recycling, and total EFA scores than those in urban centers and districts. Regarding the tests conducted based on the occupational groups of the students' mothers, no significant differences are observed in the energy, scope of laws, recycling, water consumption, and total EFA

scores. However, it is found that the transportation and food scale scores of students whose mothers work in the public sector are higher than those of other occupational groups (Table 11). Finally, based on the results presented in Table 11, the analysis of score differences according to the educational background of the student's mothers and fathers, the occupational group of their fathers, and the students' monthly expenditure amounts indicated no significant differences. Specifically, the p-values are greater than 0.050, suggesting that the sub-dimension scores of the EFA scale are similar across these variables.

4. Conclusion

No significant differences are found between the ages of the students about the energy, recycling, transportation, food, water consumption, and EFA scales. The knowledge levels about EFA are nearly identical across all age groups. Similarly, no differences are observed between the genders regarding the energy, recycling, and food scales, with knowledge levels about EFA being almost equal for males and females. However, female students demonstrated higher knowledge levels than male students regarding transportation, water consumption, and EFA scale laws. Furthermore, no significant differences are observed in the transportation, food, and water consumption scales concerning the student's residence, and knowledge levels about EFA remained largely similar across different locations. On the other hand, students residing in urban centers and districts exhibited higher and comparable knowledge levels on the energy, recycling, and EFA scales compared to their peers living in rural areas.

The students' knowledge levels regarding EFA showed no significant differences based on their parents' educational and occupational backgrounds, with the knowledge levels being nearly identical across all groups. Similarly, no differences are observed in the knowledge levels regarding EFA within the context of the laws, recycling, transportation, food, and EFA based on students' smoking status, with the knowledge levels being almost the same for smokers and non-smokers. However, regarding the water consumption scale, students who did not smoke exhibited higher knowledge levels than those who smoked. There are no differences in the knowledge levels regarding EFA across alcohol consumption status, including within the context of the laws, recycling, transportation, food, water consumption, and EFA. Lastly, there is no significant difference in the knowledge levels about EFA based on the number of books students read in a month, with the knowledge levels being similar across different reading habits.

Table 12. Averages of EFA scale sub-dimensions

Energy	4.206
Laws	4.395
Recycle	3.719
Transport	3.605
Food	3.898
Water Consumption	3.860
EFA	3.947

Table 12 presents the average values of the EFA scale sub-dimensions and the overall EFA score. The analysis of the EFA scale and its sub-dimensions among students at the Faculty of Science Selçuk University indicated generally high awareness levels. However, lower scores were observed in the Recycling and Transportation sub-dimensions compared to others. To enhance EFA, it is suggested that awareness training be particularly focused on Recycling and Transportation. Various studies in literature address the impact of class level on EFA, but they disagree. For instance, Eraslan and Seçme [13] discovered a significant difference in EFA, specifically in the energy dimension, in favor of first-year students in architecture programs. A different study revealed varied results based on demographic structure. In this study, high-income young individuals living near large shopping malls and far from the airport were found to have a larger "transportation" footprint. Additionally, Akdeniz University Faculty of Economics and Administrative Sciences research revealed that participants' ecological footprints exceeded global and national averages. This study found that ecological footprints increased with higher income and age, while no significant gender differences were observed [9]. In conclusion, the literature shows that the ecological footprint varies across different demographic groups and

geographical regions. These findings emphasize the need for more comprehensive studies on ecological footprints and the importance of raising awareness by collecting additional data across various areas. It is encouraging that generation Z is increasingly aware of these issues, indicating positive prospects for raising ecological awareness.

The findings of this study provide valuable insights into the EFA and environmental awareness of Selçuk University Faculty of Science students. While the overall levels of ecological awareness are high, the relatively low awareness observed in the recycling and transportation sub-dimensions highlights the need for increased educational efforts and awareness campaigns. The findings of this study provide an essential foundation for understanding the relationship between ecological footprint and environmental awareness. Future research can build on these findings using larger, more diverse samples from different universities or individuals from various socio-economic backgrounds. Such studies could offer deeper insights into how environmental awareness levels influence students' environmental behaviors and sustainability practices in their daily lives.

Moreover, there is a need to develop effective and sustainable educational methods to promote environmentally friendly habits among students. Large-scale awareness campaigns utilizing modern digital media and social networks could significantly enhance ecological awareness. Investigating how such campaigns contribute to spreading environmentally friendly habits among students would provide valuable data and insights. Future studies on the effects of ecological awareness education on the environmental attitudes and sustainability consciousness of younger generations, particularly Generation Z, are crucial. These studies can contribute to developing strategies for changing environmental attitudes by understanding generational differences. Finally, developing strategies to improve the effectiveness of environmental sustainability policies and practices across society is essential. Such research could help individuals better understand their environmental responsibilities and contribute meaningfully to the necessary actions for a sustainable future.

Author Contributions

All the authors equally contributed to this work. They all read and approved the final version of the paper.

Conflicts of Interest

All the authors declare no conflict of interest.

Ethical Review and Approval

The research was reviewed and approved by the Board of Ethics of Selcuk University, Approval number: E-16.11.2022-407135.

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