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Examining the relationship between ecological literacy and ecological footprint awareness[1]

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Abstract

This research was conducted to determine the ecological literacy and ecological footprint awareness of high school students and to examine the relationship between these variables statistically. The research was designed using the relational screening model. The study sample consists of 962 high school students from all grade levels who continue their education in Ankara in the 2022-2023 academic year. The sample was determined according to the convenience sampling approach. As a result of the research, it was determined that the students' ecological literacy and ecological footprint awareness were at a moderate level. It was determined that the students' levels of ecological behavioural literacy and ecological emotional literacy, which are sub-dimensions of ecological literacy, are low; their ecological ethical literacy levels are at a medium level, and the sub-dimension where the students are at a high level is ecological awareness literacy. The students' awareness of food is higher than that of the other sub-dimensions. It was concluded that the students are sensitive about food shopping, organic food, and plastic products used in food products, and their awareness of these issues is at a considerable level. According to the relational screening result, it was determined that as the students' ecological literacy levels increase, their ecological footprint awareness rises at the same rate.

Keywords: Ecological literacy, ecological footprint awareness, high school students, relational screening.

Introduction

Ecology is the scientific discipline that studies the effects and relationships between living cells and populations (Çepel, 1992). Living cells are affected by non-living populations on the one hand, while their existence also affects non-living populations. However, when all living cells are considered, humans undoubtedly have the most significant impact on their environment. Therefore, the responsibility for the rapid and irregular changes in the living and non-living environment has been placed on humans (Kışlalıoğlu & Berkes, 1990). The concern of entrusting the world and life to ecologically literate generations with awareness is becoming an increasingly important issue. Following the Industrial Revolution, the relationship between humans and the environment can be said to have changed entirely in favour of humans. With this process,

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environmental values have become elements that can be bought and sold like goods and are now evaluated solely according to human needs. Individuals are destroying living structures, drying up green areas, and continuing to harm nature in order to earn more income (Talas, 2012).

In order to guide societies around the world in protecting and developing the environment and to find common ground, the United Nations Conference on the Human Environment was held in Stockholm in 1972. At the end of the conference, countries published a 26-article declaration, and Article 19 of this declaration is directly related to environmental education. This article emphasizes the importance of education on environmental issues by examining ecological literacy and ecological footprint awareness. The educational content addresses the need to protect and improve the environment, emphasizing its necessity for the overall development of humanity. It states that information must be disseminated through educational content (United Nations [UN], 1972). The gains achieved due to this conference were discussed at the International Environmental Workshop held in Belgrade, the capital of present-day Serbia, in 1975. At the UNESCO workshop, a global framework known as the Belgrade Convention was adopted for environmental education. Within this framework, environmental action aims to carry out studies to develop all ecological relationships, including the interactions between humanity and nature and between people.

The objectives of environmental education are summarized in bullet points:

1. Awareness: To contribute to individuals and social groups gaining sensitivity about the environment as a whole and related issues.
2. Knowledge: To contribute to individuals and communities gaining a basic understanding of the natural environment, related issues, and humanity's critical responsibility and role in this environment.
3. Attitude: To assist individuals and social groups in acquiring social values, intense concern for the environment, and motivation to actively participate in its protection and improvement.
4. Skills: To equip individuals and social groups with the skills to address environmental issues.
5. Evaluation ability: To support individuals and social communities in analyzing environmental measures and education programs from ecological, political, economic, social, aesthetic, and educational perspectives.
6. Participation: To contribute to developing a sense of responsibility and urgency among individuals and social communities regarding environmental issues and to take appropriate actions to resolve these issues (Belgrade Charter, UNESCO, 1975).

Ecological literacy

Ecological literacy refers to the ability to perceive self-sustaining developments that ensure the continuity of life in nature, or to demonstrate knowledge, skills, attitudes, and sensitivity toward the Earth (TEMA Foundation, 2015). Individuals should be educated to overcome the challenges faced by today's societies and develop sustainable solutions. Ecological literacy is the expression of the skills required to live, explore, and/or study the environment using environmental awareness, thought, and mental habits (Berkowitz et al., 2004).

When considering ecological literacy and its basic components, the following five factors

emerge:

- ecological knowledge literacy;
- ecological awareness literacy;
- ecological ethical literacy;
- ecological emotional literacy; and
- ecological behavioural literacy.

Ecological literacy, at its core, guides the acquisition and dissemination of ecological knowledge, enhances ecological conservation awareness, and ultimately fosters the sustainable development of ecological behaviour to achieve a higher level of ecological literacy. In other words, the five dimensions of ecological literacy form a whole, and each is theoretically equally important (Figure 1).

They interact and influence each other. Ecological knowledge literacy is fundamental, ecological awareness literacy points to the action dimension, ecological ethical literacy emphasizes moral standards, ecological emotional literacy is the internal driving force, and ecological behavioural literacy is the ultimate goal.

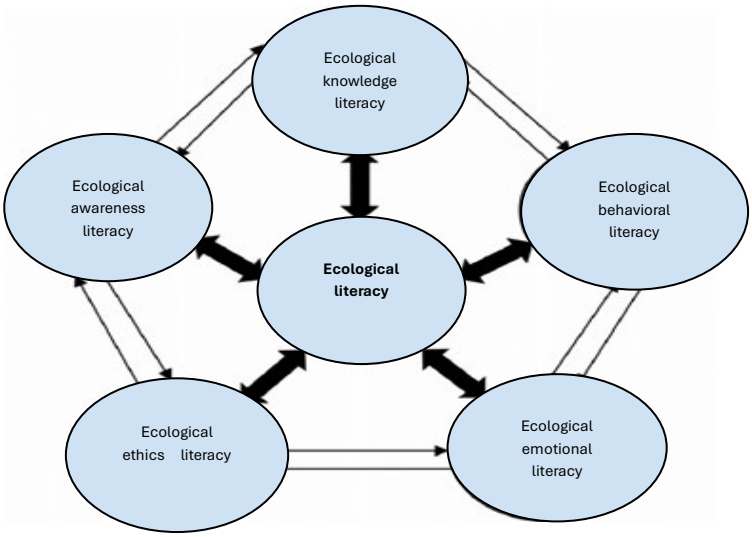

Figure 1 The formation process of ecological literacy (Huang et al., 2021).

Ecological literacy encompasses experiences that raise awareness, community lifestyles, ethical structures, ecology-based knowledge, and ecological interactions (Mitchell & Mueller, 2011). While defining ecological literacy may seem simple at first glance, it is a complex and detailed scientific concept that requires careful consideration (Jordan et al., 2009).

Ecological literacy is considered a comprehensive framework consisting of subheadings such as the totality of information related to the phenomena that constitute the environment, awareness of a clean environment, and the ability to take environment-based initiatives (Orr, 1992). Ecological literacy has been explained as understanding the main building blocks of ecology and concretizing this understanding in life rather than in theoretical knowledge (Çapra, 1999). Ecological literacy is the harmony people provide to the living spaces they inhabit (Lees, 2017).

Ecological literacy is about minimizing consumption, ensuring environmental equality, and caring about future generations that will sustain humanity (Bowers, 2001). Ecological literacy is defined as awareness of all components that directly or indirectly affect nature and the need to protect

them (Noviana et al., 2018), the ability to understand the environment, the establishment of a personal, intimate connection with the environment, and emotions that encourage society to move in this direction (Kassas, 2002). Ecological literacy is defined as thinking, understanding, living, and working in an ecology-focused manner (Bruyere, 2008).

Ecological footprint awareness

To understand the concept of ecological footprint, it is important to consider various aspects such as its measurement, impact on different sectors, and relationship with economic and environmental factors. Ecological footprint reflects humans' impact on the environment and measures the amount of natural resources required to sustain current consumption and waste production. It is a multidimensional concept encompassing many factors, including energy consumption, economic growth, globalization, and environmental sustainability.

The ecological footprint is typically measured in units called global hectares. This metric quantitatively shows the balance between the given area's natural resources and the waste generated by human demands and activities. With rapid population growth, industrialization, urbanization, and technological advances, humans have adopted an aggressive attitude toward consuming natural resources to meet their needs. Since the 1980s, ecological issues have become a global concern (Artvinli et al., 2019).

It is not possible to continuously consume more to increase human well-being and happiness. People must discover happiness by maintaining their consumption habits at a certain sustainable level for both present and future generations (Saylar & Akyüz, 2019).

To identify the factors shaping the ecological footprint, a structural model is proposed, emphasizing the harmful impacts of food, energy, and water use. The findings indicate that food, water, and energy consumption negatively influence the ecological footprint, whereas waste and housing-transportation have no significant effect. Moreover, as participants' awareness of food, water, and energy consumption increased, their ecological footprints decreased accordingly (Çam & Çelik, 2022). Additionally, studies examining the effect of foreign trade product diversity on the ecological footprint indicate that the ecological footprint is a more comprehensive environmental variable than carbon emissions. This perspective emphasizes the importance of considering various environmental factors when assessing ecological impact (Güzel & Oluç, 2022).

Ecological footprint is a concept used to measure environmental sustainability in general. Important indicators such as biological capacity and consumption determine the ecological footprint. The consumption of renewable natural resources used in producing products consumed by society is referred to as the ecological footprint (Şimşek & Bursal, 2019). On the other hand, biological capacity refers to the world's ability to produce renewable natural resources (Bayraktar, 2019). When the consumption amount per individual exceeds the biological capacity required for each individual, it indicates that consumption in that region is unsustainable (Şimşek & Bursal, 2019). The primary purpose of the ecological footprint is to reveal that consumption habits are unsustainable (Ruževičius, 2011). The ecological footprint can be divided into five categories: transportation, food, housing, services, and consumer goods. The ecological footprint is calculated by multiplying the amount of consumption by the required production area and is typically expressed in global hectares (kha) (Karakaş et al., 2016).

The main objective of this study is to examine the relationship between ecological literacy and ecological footprint awareness, which are important for a sustainable future, at the high school level. In this regard, the objectives of the research are as follows:

- To determine the level of ecological literacy among high school students,
- To determine the level of ecological footprint awareness among high school students,
- To reveal the relationship between ecological literacy and ecological footprint awareness.

Method

This research was conducted using the relational screening model to determine the ecological literacy and ecological footprint awareness of high school students and statistically examine the relationship between these variables.

Research design

The research was designed using a correlational survey model. Correlational survey is a model that allows for examining the relationship between two or more variables (Fraenkel, Wallen, & Hyun, 2012). Correlational survey research is a research model that aims to determine the existence of co-variation between two or more variables (Karasar, 2014). The purpose of this study is to determine high school students' ecological literacy and ecological footprint awareness, to examine whether there are statistical differences according to gender, grade, and field of study variables, and to reveal the relationship between these variables.

Sample

The study sample consists of high school students enrolled in the 2022-2023 academic year. A convenience sampling approach was used when determining the sample for the study. In the convenience sampling method, the researcher selects a sample that is close to the problem situation and easy to access (Fraenkel, Wallen, & Hyun, 2012). The study sample consists of 962 high school students of all grade levels who are continuing their education in the districts of Yenimahalle, Keçiören, and Çankaya in Ankara. The demographic characteristics of the sample group are provided in Table 1.

Table 1 Demographic characteristics of the participating middle school students

Variable	Category	f	%
Grade Level	9	414	43,04
	10	386	40,12
	11	105	10,91
	12	46	4,78
Gender	Female	527	54,8
	Male	435	45,2

Data collection tool

The data for the study were collected using the Ecological Literacy Scale and the Ecological Footprint Awareness Scale.

Ecological Literacy Scale: Ha et al. (2022) developed the ecological literacy scale. The scale consists of 40 items and five subscales on a five-point Likert scale in its original form. The subscales of the scale are ecological knowledge literacy, ecological awareness literacy, ecological ethics literacy, ecological emotion literacy, and ecological behaviour literacy. The Cronbach's alpha internal consistency coefficient for the entire scale is 0.888. Alkan and Cantürk

(2024) carried out the Turkish adaptation of the scale. Validity and reliability studies were conducted with 500 high school students. The scale consists of five dimensions and 24 items in Turkish form. In the original scale, literacy is represented by eight items in each dimension. In the Turkish adaptation study, the number of items in some dimensions was reduced in the analyses to ensure validity. Upon examination, it was determined that the items were removed from the scale due to their loading on multiple factors and overlapping. It is quite normal for some items in a scale prepared in Chinese to be incomprehensible in Turkish culture or to be perceived as similar to other items. The reduction in the number of items reflects the scale's dimensionality. The Cronbach's Alpha internal consistency coefficient of the scale is 0.816. The reliability coefficient for the ecological behaviour literacy factor is α=.790, the reliability coefficient for the ecological knowledge literacy factor is α=.699, the reliability coefficient of the ecological emotional literacy factor is α=.639, the reliability coefficient of the ecological ethical literacy factor is α=.666, and the reliability coefficient of the ecological awareness literacy factor is α=.579.

Ecological Footprint Awareness Scale: The scale was developed by Coşkun, Çelik, and Sarıkaya (2014). It consists of 46 items on a 5-point Likert scale. The scale has five sub-dimensions: energy, waste, food, water consumption, and transportation. The Cronbach's alpha internal consistency coefficient for the entire scale is 0.80, while the sub-dimension coefficients are 0.87, 0.80, 0.55, 0.71, and 0.73, respectively. The minimum score obtained from the scale, which has been tested for validity and reliability with prospective classroom teachers, is 46, while the maximum score is 230.

The scale was developed for prospective teachers. Validity and reliability studies for high school students were conducted with 300 high school students. Accordingly, exploratory and confirmatory factor analysis studies were conducted to assess the scale’s construct validity. In the exploratory factor analysis, principal component analysis was performed to determine the structure of the factors, and the Varimax orthogonal rotation method was used for this purpose. According to the exploratory factor analysis results, the scale adapted for high school students explains 55.59% of the total variance. The exploratory factor analysis resulted in a structure of 5 factors and 22 items. The items and factor loadings included in the scale are shown in Table 2.

Table 2 Items and factor loadings on the scale

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Item 12	.795				
Item 13	.796				
Item 14	.739				
Item 16	.667				
Item 15	.567				
Item 7		.730			
Item 9		.731			
Item 8		.648			
Item 10		.615			
Item 11		.573			
Item 6		.538			
Item 3			.745		
Item 4			.729		
Item 5			.693		
Item 1			.601		
Item 2			.508		
Item 21				.829	
Item 22				.753	

Item 20				.732	
Item 18					.758
Item 17					.646
Item 19					.641
Eigenvalue	4.715	3.475	1.519	1.324	1.197
Explained total variance (Total= % 55.59)	13.51	13.28	11.94	9.42	7.45

The data obtained were subjected to internal consistency analysis to calculate the scale's reliability. The reliability findings obtained from the analysis are presented in Table 3.

Table 3 Internal consistency

Factor	Article numbers	Cronbach's Alpha
Food	5	0.732
Transportation	6	0.774
Energy	5	0.791
Waste	3	0.579
Water consumption	3	0.729
Total	22	0.822

The scale's reliability value is high, and the internal consistency coefficients of the five factors and the scale as a whole are quite good, ensuring that the scale performs consistent calculations.

Data analysis

The study's dependent variables are ecological literacy and ecological footprint awareness, while the independent variables are gender, class, and field of study. The study data were analyzed using SPSS and AMOS software packages. The ecological intelligence scale was developed for teacher candidates. The study began with a validity and reliability study of the scale for high school students. Since the ecological literacy scale was adapted for high school students, the reliability of the scale was tested for the sample data. The construct validity of the ecological footprint awareness scale was examined using exploratory and confirmatory factor analysis. The factor structure of the scale was determined using exploratory factor analysis, and confirmatory factor analysis was then performed to examine whether the determined factor structure corresponded with the scale. The reliability of the scale was examined using Cronbach's alpha internal consistency coefficient. Whether ecological literacy and ecological footprint awareness showed significant differences according to gender was examined using an independent samples t-test. The change in dependent variables according to class and field of study was determined using one-way ANOVA. In contrast, the relationship between ecological literacy and ecological footprint awareness was determined using correlation analysis.

Findings

The Findings section should introduce the results of the research in the form of texts, tables, and figures, and the interpretation of these results. The last section of the main text should draw conclusions from the previous section, discuss them with the relevant literature, and propose suggestions for policy, practice, and future research. The Findings section must not include any subheadings.

Findings related to research objective 1

The first sub-problem is "What is the level of ecological literacy among high school students?" The data for the sub-dimensions and the total of the ecological literacy scale were examined using descriptive statistics, including the minimum and maximum values, mean scores, and

standard deviation.

Table 4 Descriptive statistics for the ecological literacy variable

Variables	M	SD	Minimum	Maximum	N
Ecological literacy	2.56	.47	1.00	5.00	651
Ecological behaviour literacy	2.29	.75	1.00	5.00	651
Ecological knowledge literacy	1.89	.67	1.00	5.00	651
Ecological emotion literacy	1.98	.69	1.00	5.00	651
Ecological ethics literacy	2.62	.53	1.00	5.00	651
Ecological awareness literacy	3.99	.98	1.00	5.00	651

It is understood that high school students prioritize ecological awareness literacy, and that ecological ethical literacy is also quite important. It is also noted that students give the least importance to ecological knowledge literacy. Upon examining the findings, it is thought that students do not have the necessary thought structures regarding knowledge-based topics such as ecosystems, environmental hazards (acid rain, white pollution, ozone layer depletion, etc.), and low-carbon lifestyles. It has been revealed that students have a high level of awareness based on human-nature relationships.

Findings related to research objective 2

The second sub-problem is "What are the levels of ecological footprint awareness among high school students?" The data for the sub-dimensions and the ecological footprint awareness scale total were examined using descriptive statistics, including minimum and maximum values, mean scores, and standard deviation.

Table 5 Descriptive statistics for the ecological footprint awareness variable

Variables	Mean	SD	Minimum	Maximum	N
Ecological footprint awareness	2.70	.63	1.00	5.00	651
Food	3.11	.74	1.00	5.00	651
Transportation	2.92	.99	1.00	5.00	651
Energy	2.74	.76	1.00	5.00	651
Waste	2.35	.89	1.00	5.00	651
Water consumption	2.44	.92	1.00	5.00	651

The results show that high school students are aware they should avoid consuming foods produced outside the season, prefer products made nearby rather than those imported from abroad, and avoid buying processed products or those stored in plastic containers. However, it can be concluded that students have a low level of awareness regarding waste, such as separating recyclable household waste from trash and not throwing away leftover food.

Findings related to research objective 3

The third sub-problem is: Is there a relationship between ecological literacy and ecological footprint awareness? The aim is to determine whether there is a relationship between ecological intelligence, literacy, and ecological footprint awareness, and if so, to what extent. The relationship between the data obtained from the ecological literacy and ecological footprint awareness scales was examined using Pearson correlation analysis.

Table 6 Pearson correlation coefficient for the relationship between variables

Variables	1	2	3	4	5	6	7	8	9	10
1. EL1	1.00									
2. EL 2	.331**	1.00								
3. EL 3	.477**	,365**	1.00							

4. EL 4	.455**	,244**	,390**	1.00					
5. EL 5	.315**	,122**	,072	,206**	1.00				
6. EFA 1	.240**	,094*	,038	,197**	,281**	1.00			
7. EFA 2	.338**	,132**	,177**	,220**	,232**	,470**	1.00		
8. EFA 3	.352**	,181**	,195**	,247**	,264**	,483**	,622**	1.00	
9. EFA 4	.437**	,292**	,293**	,273**	,190**	,354**	,441**	,535**	1.00
10. EFA 5	.387**	,237**	,223**	,232**	,205**	,334**	,426**	,467**	,520**	1.00
EL-EFA	.496**								

*p<.001 ** p<.005

The highest correlation value (.496) was found between ecological literacy (EL) and ecological footprint awareness (EFA).

Discussion

This scientific study examined the levels of ecological literacy and ecological footprint awareness among high school students and the relationships between these variables. Based on the data obtained from the study, which aimed to determine students' levels of ecological literacy using the ecological literacy scale, it was determined that, in general, high school students' levels of ecological literacy were low. However, when the sub-dimensions of ecological literacy —namely ecological behavioural literacy, ecological knowledge literacy, ecological emotional literacy, ecological ethical literacy, and ecological awareness literacy —were examined individually, differences were observed in the students' levels in these sub-dimensions. It was found that students' ecological behavioural literacy and ecological emotional literacy levels were low, their ecological ethical literacy levels were moderate, and the sub-dimension in which students were at a high level was ecological awareness literacy. It was also determined that students' levels of ecological knowledge literacy were the lowest among these sub-dimensions.

In general, ecological literacy has four dimensions. These dimensions are cognitive, affective, behavioural, and spiritual (The Centre for Ecoliteracy, 2013). The cognitive dimension involves analyzing a specific action's positive or negative effects on nature; the affective dimension involves loving and respecting all forms of life; the behavioural dimension involves contributing to ongoing environmental activities; and the spiritual dimension involves approaching all natural events in the universe with awe. An ecologically literate person sees themselves as a stakeholder in the universe, lives in harmony with the environment, and is aware of the positive and negative effects they have on the environment. Ecologically literate individuals know regional living areas and can connect regional issues with universal concerns (Jordan et al., 2009). In this context, it is imperative that the course content is added to the curriculum so that students can learn about it, which produces positive feedback for each of the dimensions of ecological literacy. A study conducted in 2021 on second-year social studies teacher candidates who took the Environmental Education course revealed that teacher candidates emphasized ecological literacy more in cognitive and affective dimensions, but neglected the behavioural dimension (Durmuş & Kınacı, 2021). To develop students' environmentally conscious behaviors and encourage environmentally responsible practices, one must begin by developing environmental knowledge, literacy, and emotional attachment (Mustafaoğlu & Alkan, 2025). According to the Organization for Economic Cooperation and Development (OECD, 2009), ecological literacy is the ability to provide the living conditions necessary for individuals to sustain their natural lives and the ability to live in harmony with the universe. Therefore, the constraints of natural resources

and the necessity of living in harmony with the universe should be instilled in children from a young age (Cutter Mackenzie et al., 2014).

The question of how to raise ecologically literate individuals, a topic long debated, has been addressed with various approaches and methods. However, the focus of all these efforts is as follows: For lasting and sustainable environmental education, it is necessary to deeply understand the relationship between nature and humans, abandon a human-centred perspective, and prioritize awareness, knowledge, attitude, skills, and participation. Both the analysis results and the literature review studies reveal that the ecological literacy levels of high school students in our country are not at the desired level. It is essential for family associations, non-governmental organizations, and public institutions, including educators, to carry out joint efforts to remedy this situation. When examining the preschool education program included in the new curriculum system announced by the Ministry of National Education in May 2024, it is thought that science skills studies will contribute to the development of ecological literacy (Ministry of National Education, Maarif Model Teaching Programs, 2024). When the place of ecological literacy in the high school curriculum is detailed, it is stated that the outputs related to the ethical, emotional, and behavioral dimensions of ecological literacy are insufficient. Topics and learning outcomes related to ecological literacy in the curriculum are limited in the general program; therefore, it needs to be structured in a way that supports ecological literacy (Acarlı, 2024).

When the data obtained in the study were examined, it was determined that high school students' awareness levels of their ecological footprint were generally moderate. When the sub-dimensions of ecological footprint awareness were examined, differences were observed. Students' awareness of food was higher than that of other sub-dimensions. It was concluded that students are sensitive to food shopping, organic food, and the plastic products used in food products, and that their awareness of these issues is significant. It was determined that their awareness of transportation and energy is moderate, while their awareness of waste and water consumption is low. It can be concluded that students are far from having ecological awareness regarding household cleaning, water conservation, and water waste. When examining studies related to ecological footprint awareness, we observe that students respond positively to such studies.

The ecological footprint is a concept that concerns all segments of society. Therefore, it is crucial to conduct studies that summarize the meaning of this concept simply and understandably so that it can reach all segments of society. In this context, the philosophy and importance of the ecological footprint should be consistently emphasized in art, sports, and politics to create a more livable ecosystem for future generations.

Statement of researchers

Statement regarding informed consent

Participants participated in the study voluntarily by reading informed consent.

Statement regarding ethical approval

The ethical approval authority was obtained from the Hacettepe University Graduate School of Educational Sciences Research Ethics Committee, Türkiye (Approval No: E-51944218-300-

00002614412).

Conflict statement

The authors declare no conflicts of interest.

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