

# DEVELOPMENT AND VALIDATION OF ENVIRONMENTAL LITERACY SCALE FOR ADULTS (ELSA)

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## Introduction

Every day, more and more people recognise and are affected by the effects of environmental problems. The effects of global warming and the ozone layer depletion problem are on the news all over the world. In parallel with this, the amount of research on the minimisation of the effects of environmental problems has been increasing. Some studies have focused on the elimination of the effects of the environmental problems, while others have considered the prevention of those problems before they occur, as this is an easier and more effective way. Environmental education is one of the most promising research areas from the point of view of prevention of the effects of environmental problems.

The major reason for environmental problems is the unconscious activities of human beings (Gündüz, 1998). For this reason, humans should be primarily responsible for the solution process. Therefore, it can be said that a solution can only be found by increasing the number of environmentally conscious people.

“Environmental education” is a term that first appeared at the Tbilisi congress in 1977. It can be defined as “the education process of individuals by gaining the necessary information and skills and increasing their motivations and attitudes to put forward ideas on the solution of environmental problems and to behave environmentally friendly” (UNESCO, 1978). The goal of environmental education is to educate individuals in order to make them highly environmentally literate (Kışoğlu et al., 2010). According to Roth (1992) an environmentally literate individual can comprehend the relationship between natural and social systems, believes in the unity of human beings and nature, is aware of the effects of technological developments on the environment and knows that he/she can learn environmental information throughout of his/her life. Environmental literacy has four constituents: knowledge, attitude, behaviour and awareness. An individual should have



JOURNAL  
OF BALTIC  
SCIENCE  
EDUCATION

ISSN 1648-3898

**Abstract.** *In this study, the development and validation of the Environmental Literacy Scale for Adults (ELSA) is explained. The data were collected from 332 adults whose ages ranged from 18 to over 56. The principal component analysis rotated to varimax rotation was used to obtain evidence for the validity of the scale. The scale was composed of 20 items and had three main dimensions: “environmental consciousness”, “environmental anxiety” and “environmental awareness”. A reliability analysis of the instrument revealed Cronbach-Alpha coefficients of 0.881 for the whole of the scale, 0.807 for the first dimension, 0.765 for the second dimension and 0.715 for the last dimension. Considering the results obtained from the validity and reliability studies, it can be asserted that ELSA can be used to determine adults' views and levels of environmental literacy.*

**Key words:** *adults, environmental literacy, scale development.*

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these constituents in order to be accepted as an environmentally literate person (Koç & Karatekin, 2013).

The most important way to overcome the environmental problems is by environmental education and environmentally literate individuals can be educated by environmental education. From this point of view, it is obvious that the literacy of the individuals should be determined and developed. There are many studies on the development and validation of various scales. For instance, in a study by Sama (2003) a scale was developed with the aim of determining the attitudes of university students to environmental problems. The scale was then used to investigate the students' attitudes by some demographic variables. Dunlap and his colleagues (2000) improved the New Environmental Paradigm (NEP) scale that had been originally developed by Dunlap and Van Liere in 1978. Berberoğlu and Tosunoğlu (1995) developed the Environmental Attitude Scale (EAS) by performing validity and reliability studies with Turkish university students; this resulted in a 4 factor and 47 item scale. Teksöz and his colleagues (2010) developed the Environmental Literacy Scale, which had been originally developed at Michigan State University. Leeming and his colleagues (1995) have developed the Children's Environmental Attitude and Knowledge Scale (CEAKS) and Alp and his colleagues (2006) developed the Turkish version of this scale by applying it to 6<sup>th</sup>, 8<sup>th</sup> and 10<sup>th</sup> grade children (1977). They determined the students' environmental attitudes and knowledge and investigated the effect of grade and gender on environmental attitude. Uzun and Sağlam (2006) developed an Environmental Attitude Scale for high school students.

It can be seen from literature that research about environmental literacy has generally been carried out on students. However, environmental literacy is not a term restricted to individuals of a particular age or with specific knowledge or profession. It is everyone's responsibility to protect the environment that we all live in. Therefore, environmental literacy is a term that can be used for everyone in society. The aim of this study was to develop an environmental literacy scale for individuals regardless of their age, income level, educational level or profession. In this respect, it was considered that all the items in the scale should be capable of response from all the individuals in society and should cover all of adults (i.e. common examples from everyday events for examples; prefer to use public transportation, use recycling boxes, use e-bills). As distinct from the other scales in the literature, there is no need to have a specific environmental knowledge in this newly developed scale. Besides, it is a known fact that children show a high tendency to copy their parents' attitudes (Jersild, 1983) and families have a very important place in the development of their children's social behaviour and values (Morgan, 1990).

By examining the studies in the literature one can see that most of them have been conducted with university students, teacher candidates, and elementary or high school students, with the aim of determining their environmental attitudes, knowledge or literacy. The scales in the literature are composed of items that can determine the qualities of the subject group and require the group to have some knowledge and background to reply to the items. However, by taking into account that not all individuals in society have an equal education level, knowledge and background to respond to the items, and that protecting the environment is not just one group's responsibility, a scale with items that do not need certain levels of education or knowledge will be useful. Adults can be defined in a more general way as individuals over 18 years of age and constitute an important part of society. Accordingly, the aim of this study is to develop and validate an environmental literacy scale for adults. It will be possible to determine and compare the differences in the environmental literacy of individuals by using this scale. The development and validation process of the scale is described in the following paragraphs.

## Methodology of Research

The development and validation of the Environmental Literacy Scale for Adults (ELSA) has been accomplished in the following steps:

1. Construction of items and content validation
2. Study group and administration
3. Construct validation and reliability analysis

Step 1: Construction of the items and content validation. Since the scale was intended to determine the literacy of individuals about environmental issues, researchers have searched the literature for similar scales and also accomplished a brainstorm exercise about the environmental issues that one can face in daily life. Items expressing these situations were noted down. An item pool that contained 36 items was developed, taking into account these items, the items from other scales regarding environmental issues (Aslan et al., 2008; Çabuk &



Karacaoğlu, 2003; Ek et al., 2009; Kaya et al., 2009; Aydın, 2010; Yeşilyurt, Gül & Demir, 2013) and also the redesign of some items. Special care was taken to make it clear that all the individuals who responded to the scale were able to reply no matter what their educational level, age, income level or profession are.

For the purpose of content validation (Büyüköztürk, 2011), three professors (working on environmental sciences and environmental education) were asked to examine the quality and quantity of the items and suggest any necessary revisions. Then, three adults examined the items in terms of comprehension. They were told to read each item and express what they understood and the researchers made the necessary revisions, if there were any. A pre-scale was developed at the end of these evaluations by eliminating 4 items from the item pool. There were 10 negative and 22 positive items in this pre-scale. It also included two opposite items (control items) in order to control the voluntary responses of the adults. A five-point Likert type range (strongly agree-5 points, agree-4 points, undecided-3 points, disagree-2 points and strongly disagree-1 point) was chosen, taking into account the respondents' age ranges and also the fact that odd number scales are used more frequently in educational science studies (Tezbaşaran, 1997).

Step 2: Study group and administration. The data were examined through control items and 45 forms were eliminated since these forms were thought to be involuntary responses. 4 forms were also eliminated because they contained many items with no responses. The remaining 332 forms were used as data for this study. Table 1 represents the distribution of the study group according to various properties.

**Table 1. Distribution of the study group according to various properties.**

	N	%
<b>Gender</b>		
Female	140	42.2
Male	192	57.8
Total	332	100.0
<b>Age</b>		
18-25	113	34.0
26-35	120	36.1
36-45	58	17.5
46-55	27	8.1
56+	14	4.2
Total	332	100.0
<b>Educational level</b>		
Illiterate	2	0.6
Elementary school	13	3.9
Secondary school	19	5.7
High school	77	23.2
University	183	55.1
Postgraduate	38	11.4
Total	332	100.0
<b>Occupations</b>		
Informatics	8	2.4
Education	67	20.2
Finance	7	2.1
Health	51	15.4
Sales marketing	4	1.2
Tourism	4	1.2
Other	151	45.5
Total	292	88.0



	N	%
Monthly income (€)		
≤224	7	2.1
225-345	53	16.0
346-690	112	33.7
691-1383	113	34.0
1384≥	24	7.2
Total	309	93.1

In summary, according to Table 1, the sample was composed of 140 female (42.2%) and 192 male (57.8%) adults whose ages ranged from 18 to over 56. Researchers collected data by face to face discussion with the adults. Respondents were told the aim of the study and were asked to respond voluntarily.

Step 3: Construct validation and reliability analysis. The Statistical Package for the Social Sciences (SPSS, version 18.0) was used to analyze the data. After eliminating the forms that were thought to be involuntary responses, item analyses were accomplished. An item-total correlation analysis was done and 10 items with values smaller than 0.30 were eliminated. A total of 22 items were included in the following analysis.

The negative items were reverse coded before the factor analysis. The Explanatory Factor Analysis (EFA) was used to determine the validation of the scale. The Kaiser-Meyer-Olkin test (KMO) and Barlett Sphericity test were used to examine the availability of the sample size and of the data to factor analysis. Even though there was some disagreement about the sample size in scale development studies, Child (2006) proposed that sample size should be at least five times the number of items that were to be subjected to factor analysis. Sample size in this study was sufficient according to this criterion. A KMO test to examine the availability of the sample size was also performed and the sample size was found to be appropriate for this criterion. The extraction method was chosen as principal component analysis. The total variances of the items were calculated and the items with a value smaller than 0.30 were eliminated. Items that could fall under more than one factor and coefficients that suppressed values smaller than 0.10 were also examined. The factor rotation method Varimax was chosen.

Reliability analyses were done using the calculation of Cronbach's Alpha coefficient and split-half reliability coefficient that measured the internal consistency estimates of the test scores of the scale (Büyüköztürk, 2011).

## Results of Research

In this section, the results of the Explanatory Factor Analysis (that was done to validate the construct validation of the scale) and reliability analysis (by calculation of Cronbach Alpha coefficient and split-half coefficient) are given.

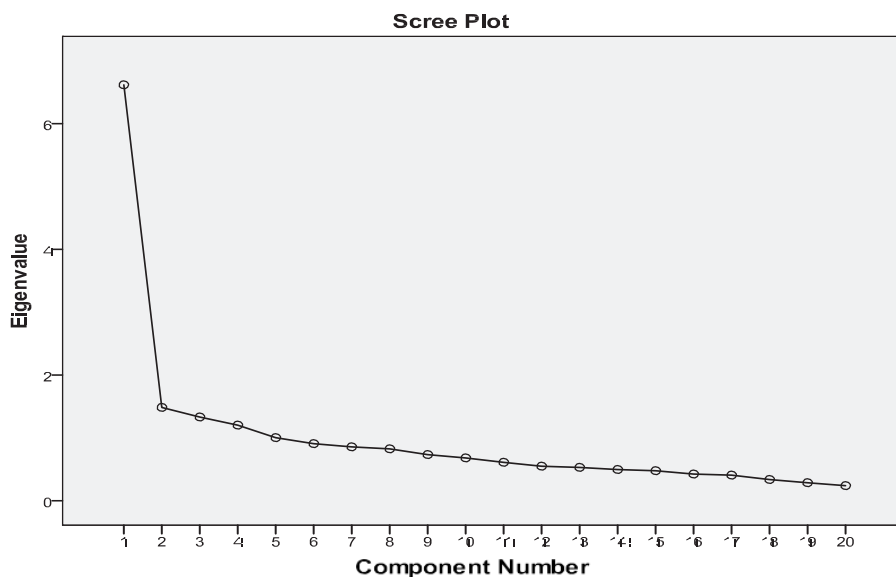
### Factor Analysis

Explanatory Factor Analysis (EFA) is a technique used to identify the factors that statistically explain the variation and co-variation among measures (Green & Salkind, 2005); it was performed to validate the construct validation of the scale. Before conducting EFA, the sample size was tested by the KMO and the KMO coefficient was found as 0.88. This shows that

the sample size was sufficient for the factor analysis. The Bartlett sphericity test was performed to ensure that the data were appropriate for the factor analysis. The results of this analysis [ $\chi^2(190)=2286.40, p=0.00$ ] were found to be statistically meaningful. Then, we decided to perform factor analysis since the KMO coefficient was higher than 0.70 and the Barlett sphericity test gave statistically meaningful results (Green & Salkind, 2005).

EFA was conducted in two stages: factor extraction and factor rotation. In the **factor extraction**, principal component analysis (for all 20 items with an eigenvalue over 1) was chosen as the extraction method. The first analysis showed that there were five factors in the scale. The total variance explained by these factors was 58.19%. There were a few items in each factor and some of them had loading values smaller than 0.30. Those items were extracted and the analysis was repeated. At the end of the analysis it was found that there were 3 factors and 20 items in the scale. The plot of the eigenvalues (scree plot) obtained at the end of the analysis can be seen in Figure 1.





**Figure 1: Plot of eigenvalues (scree plot).**

Eigenvalues are helpful in deciding how many factors should be in the analysis. Many criteria have been proposed in the literature for deciding how many factors to extract based on the magnitudes of the eigenvalues. One of them is the examination of the scree plot and to retain all factors with eigenvalues in the sharp descent part of the plot before the eigenvalues start to level off (Green & Salkind, 2005). From figure 1 it can be concluded that there should be 3 factors to be rotated.

In the **factor rotation**, the varimax method was used as the rotation method. The lower cut- point of the factor loadings was specified as 0.25, which means items with factor loadings smaller than this value were not included. The rotated factor matrix from the factor analysis is given in Table 2 and Total Variance Explained is given in Table 3.

**Table 2. Rotated factor matrix.**

Items	Factor		
	1	2	3
21. I believe that government should support the renewable energy sources (sun, wind, water, geothermal).	0.734		
22. Environmental education should be given from the beginning of elementary education in order to provide environmental awareness.	0.705		
26. I, as well as others, have responsibility for the protection of the environment.	0.699		
20. I'm in favour of using solar power in traffic lights and street lamps in order to keep the future generations' life.	0.635		
19. I'm in favour of using energy sources like solar power and natural gas since the gases given out from stoves are more harmful.	0.534		
31. I would use recycling boxes if there were any.	0.533		
29. I would use e-bill in order to protect the environment.	0.515		
27. I would throw away my garbage if there were nobody there. (-)	0.506		
4. There is nothing wrong with pouring waste cooking oil into the sink. (-)	0.311		



Items	Factor		
	1	2	3
8. I think we will not find a place to have picnic within a few generation.	0.755		
7. I think everybody should sow a tree in his or her life.	0.646		
3. I think seeds should be kept for the future of life.	0.578		
2. I would throw old newspapers; empty glass-plastic bottles, and cans to recycling boxes.	0.550		
13. I think indiscriminate hunting can cause environmental problems.	0.464		
12. I would warn people if they caused harm to the environment.	0.388		
30. When I read a newspaper I pay attention to the topics related to the environment.			0.707
23. For the protection of environment caused by waste, I watch TV programs that give information about re-use of them.			0.666
32. I would like to learn about environmental issues.			0.569
17. I would rather buy environmentally friendly items than economic ones.			0.567
11. I prefer to use public transportation rather than private transportation to protect the environment.			0.566

**Note:** 4 and 27 numbered items were negatively scored.

**Table 3. Total variance explained.**

Factors	Eigenvalues	% of Variance Explained
F1	6.62	33.08
F2	1.48	7.42
F3	1.33	6.66
Total		47.17

*F1: Environmental consciousness level*

*F2: Environmental anxiety level*

*F3: Environmental awareness level*

According to Table 2, the first factor of the scale includes 9, the second one includes 6 and the third one includes 5 items. After examining each item in each factor, the first factor was named as "environmental consciousness level" (4, 19, 20, 21, 22, 26, 27, 29, 31), the second one was named as "environmental anxiety level" (2, 3, 7, 8, 12, 13), and the third one was named as "environmental awareness level" (11, 17, 23, 30, 32). The first, second and the third factors accounted for 33.08%, 7.42% and 6.66% of the total variance explained respectively. In total, all three factors explain 47.17% of the variable variance.

#### Reliability Analysis

Cronbach's Alpha coefficient of the scale was calculated. This coefficient was found to be 0.881 for the whole scale. Then, Cronbach's Alpha coefficient was calculated for each factor separately and was found to be 0.807 for the first factor, which is the environmental consciousness level; as 0.765 for the environmental anxiety level factor and as 0.715 for the third factor, that is the environmental awareness level. It can be said from these results that the scale is reliable, since a newly developed scale has to have a Cronbach's Alpha coefficient at least 0.70 (Polit, 1996; Nunnally & Bernstein, 1994).



**Table 4. Item-Total correlations and Cronbach's Alpha if item deleted.**

Item no	Item-Total correlation	Cronbach's Alpha if item deleted
2	0.545	0.873
3	0.493	0.875
4	0.444	0.877
7	0.536	0.874
8	0.396	0.880
11	0.377	0.881
12	0.510	0.875
13	0.608	0.872
17	0.380	0.879
19	0.485	0.876
20	0.511	0.875
21	0.634	0.872
22	0.543	0.874
23	0.459	0.876
26	0.595	0.873
27	0.395	0.879
29	0.314	0.882
30	0.504	0.875
31	0.635	0.871
32	0.654	0.871

Item-Total correlations and Cronbach's Alpha if item deleted values are given in Table 4. Item-Total correlations range in between 0.314 to 0.654.

The Split-half coefficient using the Spearman-Brown formula (Büyüköztürk, 2003) was also calculated for the reliability analysis. It is important to carefully choose which items to include in each half so that two halves are as equal as possible. Different item splits may produce dramatically different results (Green & Salkind, 2005). In the analysis the items in each half were chosen as follows:

Half 1: m2, m4, m19, m20, m21, m22, m26, m27, m29, m31.

Half 2: m3, m7, m8, m11, m12, m13, m17, m23, m30, m32.

The results of this analysis can be seen in Table 4.

**Table 5. Results of the reliability analysis (Cronbach's Alpha and Spearman Brown Coefficients).**

Factor	Cronbach's Alpha coefficient	Spearman-Brown coefficient
1	0.807	0.551-0.711
2	0.765	0.655-0.791
3	0.715	0.540-0.701
Overall	0.881	0.682-0.811

From Table 5, the Spearman-Brown coefficient was 0.711 for the first factor, 0.791 for the second factor, 0.701 for the third factor, and 0.811 for the overall scale. These results obviously show that the newly developed scale is reliable.



## Discussion

In this study ELSA, which consisted of 20 items, was developed to determine and compare the environmental literacy levels of adults. As a result of the exploratory factor analysis, the scale has 3 factors. Explained total variance is found to be 47.17%. The alpha reliability coefficients of the scale is 0.881 and also the split-half coefficient was also calculated. The Spearman-Brown coefficient is 0.811 for the overall scale. The lowest score that can be obtained from the scale is 20, the highest score is 100. On the scale, high scores indicated that individuals' environmental literacy levels are high and low scores indicated that individuals' environmental literacy levels are low.

Determination of the environmental literacy of individuals can be used to represent the value that is given to environmental issues by a person or society. As is known, one way to handle environmental problems is to develop new technologies and solutions (which is generally after environmental problems have occurred), while another way is to prevent these problems developing by education. This second way can only be possible with individuals who have high environmental literacy levels. Also it is a known fact that children tend to mimic their parents' behavior and therefore more environmentally conscious parent means more environmentally conscious children. Therefore, determination of the environmental literacy of individuals is important. Although there are many studies in international literature, there are few studies in Turkey and they generally have been focused on the determination of environmental attitudes of elementary school or university students (Karatekin & Aksoy, 2012; Güven & Aydođdu, 2011; Teksöz, Şahin & Ertepinar, 2010; Alp, Ertepinar, Tekkaya & Yılmaz, 2006; Tuncer, Ertepinar, Tekkaya & Sungur, 2005; Yılmaz, Boone & Anderson, 2004).

Atasoy and Erturk (2008) have developed a scale that was aimed at determining the environmental attitudes and knowledge level of elementary school students. Aslan, Sađır and Cansaran (2008) have done research to adapt of "Attitude and Knowledge Scale Towards Environment" into Turkish. The reliability of the scale was found  $\alpha=0.860$ . Also, Okur and Yalçın Özdilek (2012) have developed an environmental attitude scale that composed of 14 Likert type sentences. The reliability of the scale was found  $\alpha=0.733$ . Similarly, Gokce, Kaya, Aktay and Ozden (2007) and Ozsevgec and Artun (2012) have developed a scale that can be used to determine environmental attitudes of elementary school students. Uzun and Saglam (2006) have developed an environmental attitude scale for secondary school students. The scale includes "behavior" and "attitude" dimensions but excludes "emotion" dimension temporarily. The reliability of the scale was found  $\alpha=0.800$ . Güven (2011), Şama (2003), Okur-Berberođlu and Uygun (2012), Berberođlu and Tosunoglu (1995), Kaplowitz and Levine (2005), Özbek-Tunç, Akdemir-Ömür and Düren (2012), Fernandez- Manzanal, Rodriguez-Barreiro and Carrasquer (2007), Nisbet, Zelenski and Murphy, (2009), Koç and Karatekin (2013) and Pe'er, Goldman and Yavetz (2007) have done research (either by developing a new scale or adaptation of an original scale) to determine the environmental attitude or behaviour of university students.

In literature considering the reliability of scales which were developed to determine the environmental literacy were ranged between 0.70 and 0.89. In this aspect the ELSA can be use to determine the environmental literacy of adults. In view of it's important to raise the next generation by adults who have awareness that environmental conscious, this scale should be contribute the literature.

## Conclusions

This study aimed to develop an Environmental Literacy Scale that would enable to determine and compare the environmental literacy levels of adults. The results of the study indicate that this scale is a valid and reliable assessment instrument, which can be used for the determination of adults' environmental literacy levels and which also can contribute to the literature.

In the future, the reliability and validity studies may be tested with different participants. Also, to save the environment and to achieve an awareness of environment, not only students but also all community should be educated. In this respect, environmental education should be given in school and out of schools.

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**Appendix 1. Environmental Literacy Scale for Adults (English Form)**

Items	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1. I believe that government should support the renewable energy sources (sun, wind, water, geothermal).					
2. Environmental education should be given from the beginning of elementary education in order to provide environmental awareness.					
3. I, as well as others, have responsibility for the protection of the environment.					
4. I'm in favour of using solar power in traffic lights and street lamps in order to keep the future generations' life.					
5. I'm in favour of using energy sources like solar power and natural gas since the gases given out from stoves are more harmful.					
6. I would use recycling boxes if there were any.					
7. I would use e-bill in order to protect the environment.					
8. I would throw away my garbage if there were nobody there.					
9. There is nothing wrong with pouring waste cooking oil into the sink.					
10. I think we will not find a place to have picnic within a few generation.					
11. I think everybody should sow a tree in his or her life.					
12. I think seeds should be kept for the future of life.					
13. I would throw old newspapers; empty glass-plastic bottles, and cans to recycling boxes.					
14. I think indiscriminate hunting can cause environmental problems.					
15. I would warn people if they caused harm to the environment.					
16. When I read a newspaper I pay attention to the topics related to the environment.					
17. For the protection of environment caused by waste, I watch TV programs that give information about re-use of them.					
18. I would like to learn about environmental issues.					
19. I would rather buy environmentally friendly items than economic ones.					
20. I prefer to use public transportation rather than private transportation to protect the environment.					

Received: December 11, 2013

Accepted: May 24, 2014

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