Development Scale of Attitude to Ecological Literacy	Ekolojik Okuryazarlığa Yönelik Tutum Ölçeği Geliştirme Çalışması

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Development Scale of Attitude to Ecological Literacy [*]

Ekolojik Okuryazarlığa Yönelik Tutum Ölçeği Geliştirme Çalışması

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Abstract: The aim of the research is to develop a measurement tool to determine the ecological literacy levels of secondary school students. Within the framework of the purpose of the research, a literature review on ecology and ecological literacy was conducted. An item pool of 55 items was created. Language, meaning and content validity of the items forming the trial scale form was ensured. The data of the research was obtained with the participation of a total of 570 secondary school students studying in public schools in Turkey in the fall semester of the 2018-2019 academic year. Explanatory factor analysis, item analysis, item-total correlation, t-test and Cronbach Alpha statistical procedures were performed regarding the obtained data. The results of the research showed that all items of the scale had a statistically significant difference. The final scale was a 3-point Likert type, consisted of 6 factors and 24 items. The Cronbach Alpha reliability coefficient calculated for the overall scale is $(\alpha) = .83$. It shows that this value is reliable enough to measure the ecological literacy attitudes of secondary school students.

Keywords: Ecological literacy, validity and reliability, secondary school students.

Öz: Araştırmanın amacı, ortaokul öğrencilerinin ekolojik okuryazarlık düzeylerinin belirlenmesine ilişkin bir ölçme aracı geliştirmektir. Araştırmanın amacı çerçevesinde ekoloji ve ekolojik okuryazarlık ile ilgili literatür taraması yapılmıştır. 55 maddelik bir madde havuzu oluşturulmuştur. Deneme ölçek formunu oluşturan maddelerin dil, anlam ve kapsam geçerliği sağlanmıştır. Araştırmanın verileri, 2018-2019 eğitim öğretim yılı güz döneminde Türkiye'de devlet okullarında öğrenim gören toplam 570 ortaokul öğrencisinin katılımı ile elde edilmiştir. Elde edilen verilere ilişkin açımlayıcı faktör analizi, madde analizleri, madde toplam korelasyonu, t testi ile

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Cronbach Alpha istatistiki işlemleri yapılmıştır. Araştırma sonuçlarında, ölçeğin tüm maddelerin istatiksel olarak anlamlı farklılık olduğunu göstermiştir. Nihai ölçek 3'lü likert tipi özelliğinde, 6 faktörlü ve 24 maddeden oluşmuştur. Ölçeğin geneline ilişkin hesaplanan Cronbach Alpha güvenirlik katsayısı (α)= .83'tür. Bu değerin ortaokul öğrencilerinin ekolojik okuryazarlık tutumlarını ölçebilecek güvenilir yapıda olduğunu göstermektedir.

Anahtar Kelimeler: Ekolojik okuryazarlık, geçerlik ve güvenirlik, ortaokul öğrencileri.

Introduction

Ecology teaches people to see, think and interpret from a general perspective, within the framework of the relations between the elements that make up nature. Ecology education, on the other hand, aims to gain a literacy identity (Sless, 1992; Kışlalıoğlu and Berkes, 1993; Kaya and Kazancı, 2009). Today, expectations from literate individuals have been expanded within the framework of understanding, awareness, effective decision-making and behavior about controversial issues and issues faced by society (McBride, 2011). For this reason, different literacy is needed as it is aimed to manage and direct information from the individuals of the 21st century. In this sense, the term literacy has been expanded based on the knowledge and skills related to the related concept by referring to each different concept (McBride et al., 2013; Oğuz Haçat and Demir, 2019). Therefore, individuals are expected to have various literacy skills. Ecological literacy is one of the skills examined within the scope of literacy skills in education (Demir, 2021; 2022).

Ecological literacy takes the form of literacy to learn about environmental science (Makin, 2003). Ecological literacy is the understanding of individuals' relationships with natural systems and how they can make this relationship in a positive and sustainable way (Orr, 1992). Ecological literacy includes experiences about learning and attitude development. Thus, both knowledge and attitudes contain the necessary action to create change for sustainability (Eames & Aguayo, 2020). As a matter of fact, in the 21st century, as a result of the increase in ecological problems, it is important to raise ecologically literate individuals who are sensitive to the environment in order to ensure the continuity of the society (Demir and Koçoğlu, 2022; Demir and Ulukaya Öteleş, 2023). Therefore, ecological literacy constitutes various elements to learn about how the world supports a sustainable life, to be curious and interested, and to reflect it on behavior (Pitman & Daniels, 2016).

Conservation of ecology is very important for natural and human life. The survival of people in the coming years will be related to our ability to understand and live within the basic principles of ecology. However, the ecological awareness of individuals is still very low (Duailibi, 2006; Capra, 2007; Hanim et al. 2021). In this context, the

search for sustainable solutions begins, as the damage to the environment is felt more and more day by day. Therefore, it is necessary to raise ecologically literate individuals who can regulate the life and consumption habits of individuals in a way that does not harm ecology, maintain ecological balance, be aware of local environmental problems and take responsibility for the solution of these problems (Bruyere, 2003; Okyay et al. 2022). In this context, ecologically literate individuals can be raised with relevant courses and curriculum. The "environmental literacy" skill is included in the social studies course, which aims to raise active citizens; Environmental education and climate change courses, which aim to raise an individual who is sensitive to his environment, play an important role (Millî Eğitim Bakanlığı, 2018; 2022). Thus, students who grow up as ecologically literate in educational institutions will contribute to society and ecology as individuals who can examine nature and natural events from a critical perspective, develop ideas about ecological problems, and conduct research and inquiry. Students who are educated as ecologically literate in educational institutions will contribute to society and ecology as individuals who can critically examine nature and natural events, develop ideas about ecological problems, and make research and questioning. In addition, they will be role models for future generations (Yıldırım and Hablemitoğlu, 2013).

It is important to determine ecological literacy, which is one of the literacy types and whose importance is increasing day by day, and accordingly, the ecological literacy attitudes of the students. However, this study is important because there is no measurement tool in the literature to determine students' ecological literacy attitudes. In this context, it is thought that the research will contribute to the development of the ecological literacy attitude scale for secondary school students and to the relevant literature.

Method

This research was carried out according to the scanning model, with the aim of developing a measurement tool. Scanning design is to describe a past or present situation as it exists (Karasar, 2012). In this research, it is thought that this design is appropriate because of the development and description of the ecological literacy scale for secondary school students. In the research, information about the sample group, measurement tool development stages, data collection and analysis of the obtained data are given in the sub-headings.

Sampling

The scale data was obtained with the participation of a total of 570 secondary school students studying in public schools in Turkey in the fall semester of the 2018-2019 academic year. In order to conduct reliability and validity analyzes of the scale,

the number of samples should be at least five and at most ten times the number of items in the scale (Tavşancıl, 2018). Therefore, it can be said that in the current study, the number of scale items consisted of 55 people and the sample number was 570, and that the scale data were sufficient for the item analysis.

Developing the Scale

In the process of developing an ecological literacy scale for secondary school students, the following steps were taken by considering the literature (Karasar, 2012; Tavşancıl, 2018):

1. Determining the scope of the scale: At this stage, the studies on ecology and ecological literacy were examined and the framework of the scale was drawn.

2. Establishment of the scale item pool: A composition about ecological literacy was written to secondary school students. The documents obtained were examined and articles related to the ecological literacy attitude were written. The items were written in cognitive, affective and behavioral dimensions within the framework of both compositions and literature. A total of 121 items with positive and negative statements were prepared. Then, the points to be considered in the attitude items were reviewed and the items were renewed and updated as 72 items.

3. Obtaining expert opinions: Expert opinions (3 social studies educators, 2 geography educators, 1 assessment and evaluation educator, 4 social studies teachers, 2 Turkish teachers) were consulted in order to pre-test the prepared items and to ensure content and face validity.

4. Formation of the scale form: In line with the expert opinions, necessary corrections were made regarding the additions and deletions in the specified items. Finally, a total of 55 items, 25 of which were negative and 30 of which were positive, were arranged and ranked randomly. The items created are of triple Likert type (Disagree, Undecided and Agree).

Data Collection

The created pilot scale form was physically delivered to seventh grade students studying in a total of 5 public schools in a city center located in the Western Black Sea Region in 2018. The scale form was applied by the researcher in 1 class hour. Data collection took two weeks.

Analysis of Data

Before proceeding to the analysis of the obtained data, the data were checked. For this purpose, 20 out of 570 students who participated in the study were not included in the analysis, as some items were found to be missing or marked more than one

option. The data set was created by transferring the data to the SPSS 22.0 package program. Negative statements in the form were reverse coded and total scores were calculated. The analysis process of the data is detailed in Figure 1:
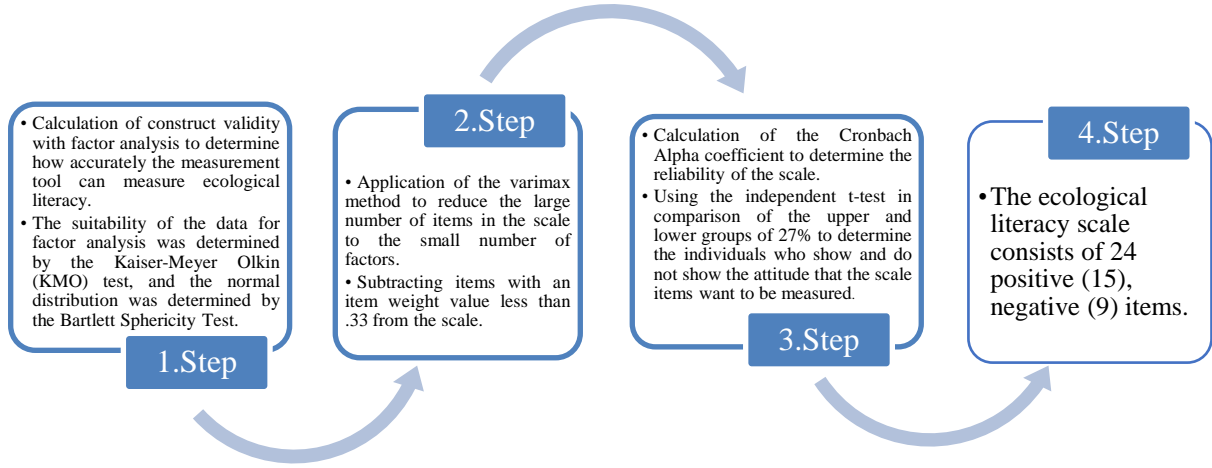
1.Step
- Calculation of construct validity with factor analysis to determine how accurately the measurement tool can measure ecological literacy.
- The suitability of the data for factor analysis was determined by the Kaiser-Meyer Olkin (KMO) test, and the normal distribution was determined by the Bartlett Sphericity Test.

2.Step
- Application of the varimax method to reduce the large number of items in the scale to the small number of factors.
- Subtracting items with an item weight value less than .33 from the scale.

3.Step
- Calculation of the Cronbach Alpha coefficient to determine the reliability of the scale.
- Using the independent t-test in comparison of the upper and lower groups of 27% to determine the individuals who show and do not show the attitude that the scale items want to be measured.

4.Step
- The ecological literacy scale consists of 24 positive (15), negative (9) items.

Figure 1. *Data analysis steps*

Research Ethics

The authors declared that they comply with all ethical rules. Ethical permission was obtained from Kastamonu University Social and Human Sciences Research and Publication Ethics Committee for this research, which is part of the doctoral thesis. Research and Ethics Committee (decision dated 12.10.2020 and numbered 03/8).

Findings

Analyzes for the Validity of the Attitude Scale

In order to determine how accurately a developed measurement tool can measure the phenomenon under consideration, the data obtained were calculated using factor analysis for construct validity (Tavşancıl, 2018). Factor analysis is a technique that explains items consisting of a large number of similar structures with fewer factors. It was aimed to create a new structure by examining the relations between variables with exploratory factor analysis in the developing attitude scale (Büyüköztürk, 2007; Karasar, 2012; Can, 2014). For this reason, in order to determine whether factor analysis can be performed on the developed scale, the adequacy of the sample size (Kaiser-Meyer-Olkin Test) and the multivariate normal distribution of the data (Bartlett's Test) should be determined. In Table 1, KMO and Bartlett's Test statistics for the ecological literacy scale are given.

Table 1. *KMO and Bartlett's Test statistics on ecological literacy attitude scale*

Kaiser-Meyer-OlkinValue		,880
Bartlett's Test Value	Approximate Chi-Square Value	7552,035
	7552,035	1485
	Degrees of Freedom (sd)	,00

When Table 1 is examined, the value calculated as KMO=,880 is sufficient for the factor analysis of the sample group; It was determined that the data were suitable for factor analysis with the Bartlett's Test calculated as .000 significance level and Bartlett's Test $\chi 2$= 7552.035.

Principal component analysis was carried out in order to reveal the factors of the obtained data, to reduce the data by grouping and to remove unnecessary items. In the total variance results explained in the first analysis of the ecological literacy scale, it was determined that the eigenvalues of the items were under a total of 15 factors greater than 1, and the variance percentages of the common factors ranged between 1,845 and 16,915. Since a large number of items in the scale should be expressed with a small number of factors, the varimax technique, one of the vertical rotation methods, was applied to the attitude scale developed (Karasar, 2012; Can, 2014). The total variance results of the ecological literacy scale explained in the second analysis are presented in Table 2.

Table 2. *Results of total variance explained in the second analysis of the ecological literacy scale*

Factor	Initial eigenvalues		
	Total	Percentage of variance	Stacked percent of variance
1	5,232	21,802	21,802
2	1,958	8,159	29,961
3	1,307	5,448	35,408
4	1,123	4,678	40,086
5	1,097	4,571	44,657
6	1,061	4,421	49,078

In Table 2, in the second principal component analysis of the research data, it is seen that the eigenvalues of the items are greater than 1, grouped under 6 factors, and the variance percentages of the common factors vary between 4,421 and 21,802. In line with these results, the results obtained by applying exploratory factor analysis in order to obtain a new structure are presented in Table 3.

Table 3. *The results of the exploratory factor analysis regarding the ecological literacy scale*

Pilot application item no	Main application item no	Items	Factor Loads
1.Factor (Ecological Sensitivity) Cronbach Alpha =,73 Eigenvalue= 5,232 Variance=21,802			
51	1	I like to walk to nearby places.	,722
50	2	I put food for stray animals near my house.	,594
24	3	I feel uneasy about the harm of wastes to living life.	,570
44	4	Living things other than humans also have the right to life.	,542
33	5	There are creatures that are in danger of extinction.	,486
30	6	Depletion of water resources worries me.	,434
2. Factor (Denial of Ecology) Cronbach Alpha = ,71 Eigenvalue=1,958 Variance=8,159			
43	7	I do not take the trouble to learn about the harms of waste to ecology.	,751
29	8	It is unnecessary to know the meanings of the symbols on the packaged products.	,740
32	9	When power tools are off, I do not pay attention to the fact that it is plugged in.	,684
39	10	People do not need nature to survive.	,569
16	11	I hesitate to participate in school activities that support the natural environment.	,362
3.Factor (Ecological Threat) Cronbach Alpha =,63 Eigenvalue=1,307 Variance=5,448			
38	12	It makes me happy to see buildings being built in forest areas.	,676
52	13	I take pleasure in harming nature's creatures.	,671
7	14	I like to pollute the environment.	,654
34	15	I use resources as I want to have better living conditions.	,615
4.Factor (Ecological Awareness) Cronbach Alpha = ,54 Eigenvalue=1,123 Variance=4,678			
6	16	I am happy to see myself as a part of ecology.	,636
12	17	I throw waste into recycling bins according to their characteristics.	,622
15	18	I am interested in natüre trips.	,584
48	19	I use both sides of the papers I write on	,421
5.Factor (Ecological Safety) Cronbach Alpha = ,47 Eigenvalue=1,097 Variance=4,571			
17	20	Ecological problems threaten the world.	,745
4	21	Global warming negatively affects the ecological balance.	,580
20	22	It saddens me that city life takes people away from nature.	,553
6. Factor (Ecological Importance) Cronbach Alpha = ,45 Eigenvalue=1,061 Variance=4,421			
1	23	Ecology is important to me.	,824
25	24	I take part in solving ecological problems for a livable world.	,414

When Table 3 is examined, the items with load values between ,722 and ,434 are the first factor "Ecological Sensitivity"; items with load values between .751 and .362

are "Denial of Ecology"; Items with a load value between .676 and .615 are "Ecological Threat"; items with a load value between ,636 and ,421 are "Ecological Awareness"; The items with a load value between ,745 and ,553 were named "Ecological Safety", and the items with a load value between ,824 and ,414 were named as "Ecological Importance", and a total of 6 factors was created.

Analyzes for the reliability of the attitude scale

In order to determine whether the scale is reliable or not, the Cronbach alpha coefficient was determined. Accordingly, the Cronbach's alpha coefficient of the scale was calculated as 0,83, and it can be said that the scale is at a highly reliable level. The values determined for the items in the ecological literacy attitude scale are presented in Table 4.

Table 4. *Statistics on ecological literacy attitude items*

Items	Item mean	Item standard deviation	Item total correlation value	Item deletion reliability coefficient
1.Item	2,50	,753	,48	,82
2.Item	2,46	,749	,40	,83
3.Item	2,63	,661	,46	,82
4.Item	2,61	,669	,50	,82
5.Item	2,66	,656	,49	,82
6.Item	2,65	,636	,48	,82
7.Item	2,35	,789	,35	,83
8.Item	2,44	,786	,47	,82
9.Item	2,44	,755	,41	,83
10.Item	2,51	,740	,46	,82
11.Item	2,42	,754	,39	,83
12.Item	2,36	,826	,39	,83
13.Item	2,47	,790	,38	,83
14.Item	2,74	,611	,27	,83
15.Item	2,21	,815	,27	,83
16.Item	2,60	,631	,33	,83
17.Item	2,55	,677	,32	,83
18.Item	2,59	,692	,38	,83
19.Item	2,47	,723	,36	,83
20.Item	2,46	,750	,30	,83
21.Item	2,62	,651	,31	,83
22.Item	2,48	,720	,37	,83
23.Item	2,76	,510	,20	,83
24.Item	2,40	,744	,35	,83
				Cronbach Alfa (α)= 0,83

Deleting the items with an item-total correlation value below 0.20 in the developed scale items; Items between 0.20-0.30 can be included in the scale; It is stated that items with 0.30 and above are good items (Büyüköztürk, 2007). When Table 4 is examined, it is seen that the item-total correlation values of the items are between 0.50-0.20. It can be said that the scale items are generally good items. In addition, the scale items "14, 15, 23" were included in the scale on the grounds that they were between 0.20-0.30, but when these items were deleted from the scale, it did not cause any change in the item deletion reliability coefficient.

Table 5 presents the results of the t-test for comparing the items that make up the scale, the 27% lower-upper group comparisons, in order to identify the students who show the attitude desired to be measured and students who can't (could not) show.

Table 5. *Unrelated t-test results of 27% top and bottom groups regarding ecological literacy attitude items*

Factor	Items	%27 top groups		%27 bottom groups				
		X	SS	X	SS	Sd	*t*	p
Ecological Sensitivity	1	2,94	,280	1,87	,787	295	15,52	,000
	2	2,85	,387	1,99	,817	295	11,63	,000
	3	2,93	,322	2,14	,813	295	11,00	,000
	4	2,96	,181	2,04	,787	295	13,94	,000
	5	2,98	,115	2,13	,851	295	12,06	,000
	6	2,97	,200	2,13	,785	295	12,59	,000
Denial of Ecology	7	2,85	,451	1,95	,808	295	1,90	,000
	8	2,96	,245	1,89	,798	295	15,64	,000
	9	2,85	,404	1,92	,789	295	15,64	,000
	10	2,94	,280	1,97	,817	295	13,60	,000
	11	2,83	,421	1,96	,825	295	11,44	,000
Ecological Threat	12	2,90	,392	1,85	,791	295	14,50	,000
	13	2,93	,343	1,97	,796	295	13,46	,000
	14	2,98	,164	2,48	,767	295	7,69	,000
	15	2,77	,532	1,93	,776	295	10,9	,000
Ecological Awareness	16	2,85	,387	2,25	,781	295	8,42	,000
	17	2,81	,485	2,16	,789	295	8,53	,000
	18	2,84	,462	2,14	,830	295	9,01	,000
	19	2,81	,421	2,04	,812	295	10,33	,000
Ecological Safety	20	2,85	,420	2,08	,801	295	10,45	,000
	21	2,89	,352	2,31	,806	295	7,97	,000
	22	2,87	,373	2,05	,777	295	11,53	,000
Ecological Importance	23	2,91	,297	2,60	,665	295	5,25	,000
	24	2,72	,478	1,92	,839	295	10,04	,000

According to Table 5, as the p value between the item averages should be .000, as a result of a significant difference between the upper group and the lower group, it can be said that the measurement tool distinguishes students who show the attitude to be measured and students who do not (Can, 2014).

The final stage of the scale development process and the final version of the scale were given and necessary corrections and adjustments were made. The developed scale was given its final form under the name of "Ecological Literacy Attitude Scale". During the pilot application process, the definition of ecology was included in the final scale form after the researcher was asked a lot about the definition of ecology. The attitude scale consists of 6 factors and a total of 24 items, 15 of which are positive and 9 of which are negative.

Conclusion

Educational institutions have an important role in raising the ecological literates of the future. As a matter of fact, no one is born ecologically literate, but it can be gained through education. Especially in the 21st century, there is a need for education in which students are knowledgeable, play an active role in social and environmental change, make environmental ethical judgments, and are taught to protect the environment (Mead, 2013). In this context, awareness of ecological problems should be created in children, who are the guarantee of the future. Therefore, it is important to develop an ecological literacy scale as a step towards creating a sustainable society.

In this study, it is aimed to develop a valid and reliable measurement tool that aims to determine the ecological literacy attitudes of secondary school students. First, a total of 72 items were prepared and presented to expert opinions. In this process, the attitude statements created within the scope of the criteria to be considered in writing the attitude items were corrected (Tavşancıl, 2018). As a result of the corrections, 17 items were removed from the data set and the candidate scale consists of 55 items. The candidate form was administered to 550 seventh grade middle school students. In order to conduct reliability and validity analyzes in the developed attitude scale, the sample size should be applied at least five to ten times the number of expressions in the scale (Tavşancıl, 2018). For this reason, it can be said that the sample of the study is suitable.

The obtained data set was subjected to exploratory factor analysis. During the development of the Özgün (2018) measurement tool, the construct validity of the scores obtained from the scale data can be calculated by factor analysis. Exploratory factor analysis is to obtain a new structure by examining the relationships between variables (Can, 2014). The obtained data set was subjected to exploratory factor analysis. Scale, "Ecological Sensitivity" (α: ,73), "Denial of Ecology" (α: ,71), "Ecological Threat" (α:

,63), "Ecological Awareness" (α: ,54), "Ecology Safety" (α: ,47), "Ecological Importen-ce" (α: ,45), a total of 6 factors. The load value of the items in the factors is between ,41 and ,75. The load value of the items in the factors is between ,41 and ,75. The developed scale, as it is an attitude scale, consists of an interval scale feature, a 3-point Likert for-mat, 6 factors and 24 items. Reliability is that the measurement is free from errors (Can, 2014). It has been determined that the total attitude scale is α: 0,83. It can be said that the attitude scale is at a highly reliable level. In this study, it is thought that the need in the literature is met by developing a scale to determine the ecological literacy attitudes of secondary school students.

Suggestions

It can be said that ecological literacy is one of the issues that should be empha-sized for the continuation of a sustainable life. It is necessary to draw attention to this issue from an early age and to provide students with knowledge, skills and attitudes. In this context, secondary school students are expected to be raised as ecologically lite-rate individuals. It is thought that the developed scale can be used in qualitative rese-arch that can be conducted with secondary school students. Different variables such as different class level, gender, socio-economic status can be taken as criteria and quanti-tative studies can be carried out. Since the scale is intended to be applied to students at different secondary school levels, reliability analyzes should be performed in the rele-vant study group. In addition, researchers who are considering working on this subject can develop a scale that includes different dimensions apart from the sub-dimensions in the current scale.

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