

Full Length Research Paper

Charting a vibrant environmental literacy scale for potential teachers

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With this study, a standard scale whose validation and reliability were tested will be contributed to literature in order to determine environmental literacy of prospective teachers. A case study was used as a research method. The data was gathered with 187 prospective teachers randomly selected from the different teacher education departments. In terms of the construct validity of the Environmental Literacy Scale for explanatory analysis, principal component analysis was used. At the end of the research, scale consisted 24 items. Cronbach Alpha was calculated as .86 and scale accounted for 54.36% of total variance. Environmental literacy of prospective teachers can be determined with the standardization of the scale under four sub-scales which are “Environmental Responsibility”, “The Balance of the Nature”, “Affective Environment”, and “Environmental Activities”.

Keywords: Environmental literacy, teacher education, prospective teacher, scale development

INTRODUCTION

Human kind didn't face with environmental problems when they first emerged on earth; however, with the increase of world population and human based environmental problems also began to appear. Indian leader Mahatma Gandhi emphasized the fact that we should not destroy environmental sources and environment to meet our ambitions by saying “the earth has enough for everyone's need but not for anyone's greed” (Sarabhai and Chhokar, 2009). Environmental problems started to increase in our day, especially with the emergence of industrial revolution and ever since the machines dominate the world environmental problems reached its highest level. Upon realizing this fact, environmental problems were tried to be prevented by making international conferences and meetings.

Many countries such as India, Malaysia, Oman, New Guinea, Turkey, Fiji, Sri Lanka, Malta, Poland deal with environmental problems (Taylor et al., 2009) and they try their best to overcome this problem. The most important of them is to create environmental awareness in

educational policies. With the rise of environmental awareness, environmental problems will start to decrease. As for Turkey, it is seen that environmental education started to keep its place more intensely in our curriculum. The reasons behind this fact are increasing pollution rates, effects of global warming and various waste problems. Therefore, environmental subject matters were started to be added to curriculum in order to make students and teachers more aware and to inform them about environment (Yilmaz et al., 2002).

The most important thing in creating environmental awareness is to give environmental education to individuals (Strife, 2010). In other words, society's having environmental information and awareness will provide positive and sensitive behavioural changes, protection of natural environment and regaining the damaged environment thanks to education (Uzun and Sağlam, 2005). The purpose of this is to raise individuals who are sensitive towards the environment and who are able to solve environmental problems. The responsibility of this duty belongs to environmental educators whose main aim is to raise individuals who are environmentally literate and sensitive towards environment (Knapp, 2000). Depending on this fact, it is possible to say that people's acquiring proper behaviours regarding environment and their being

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their being educated about this matter is of crucial importance (Kızılaslan and Kızılaslan, 2005). Therefore, educational institutions and prospective teachers who are future teachers are under the responsibility of important duties.

Another purpose of giving environmental educational is to create environmental literacy. It can be inferred from the conducted studies that environmental literacy is important (Mancl et al., 1999; Loubser et al., 2001; Erdoğan et al., 2009).

Moseley and Utley (2008) applied a semi-experimental method to 115 students in pre-test and to 102 students in post test in their article named as "an exploratory study of prospective teachers' beliefs about the environment". They stated that the purpose of their study is to evaluate the expectations of primary school prospective teachers and effectiveness of environmental education.

Zak and Munson (2008) evaluated the comprehension of K-8 prospective teachers in terms of basic ecological concepts in their study. Fifty six prospective teachers participated in this study. Participants made concept maps defining the relations between 16 ecological concepts with each other. The author analyzed these participants according to their definitions, associations and organizations of the relations between these concepts. Consequently, the author emphasized that prospective teachers had rigid comprehensions before having started to learn concepts.

Perrotta and co-workers (2008) aimed at examining the sentence completion and drawings of 118 primary school prospective teachers while defining the environment in their study. The author also examined races and settlements of primary school prospective teachers on comprehending the environment. It is possible to deduce from the study that prospective teachers do not have the definition of environmental literacy determined by North American Association for Environmental Education. Contrary to widespread assumptions, the author claimed that neither the races nor the settlements of participants are influential in their environmental comprehension.

ßama (2003) aimed at determining environmental attitudes of prospective teachers in his article named as "Teacher Candidate Attitudes towards Environmental Problems". The relations between students' attitudes and their genders, departments-years, settlements where they lived for the longest period of time, educational levels of their fathers, and income levels of their families were tried to be evaluated by means of a scale developed by researcher.

Erol and Gezer (2006) stated their purpose in their article named "prospective of elementary school teachers' attitudes towards Environment and Environmental Problems" as determination of university students' attitudes towards environment and environmental problems. 225 prospective teachers were taken as sample in the study. Survey was conducted in the study

the study. The fact that environmental education will improve by raising individuals having environmental information and awareness was emphasized in the research.

In recent years, both supranational efforts and increasing academic studies draw attention to the existence of an environment in need of protection and environmental education. This, naturally, makes it necessary for students of all educational stages to have environmental literacy. Teachers and prospective teachers are under the great responsibility of creating and developing this awareness among students in this process. It is thought that prospective teachers' graduating as environmentally literate from educational faculties and creation of environmental awareness will enable next generations to grow up in environment which would not have lost its naturalness much. With this study, a standard scale whose validation and reliability were tested will contribute to literature in order to determine environmental literacy of prospective teachers. Standardization of the scale will enable the determination of prospective teachers' environmental literacy from different dimensions which allow us to offer some advices to the related institutions and foundations.

METHODOLOGY

Research Design and Sample

A case study research methodology was used in this study. The study was conducted with 187 prospective teachers randomly selected from the department of science and technology, mathematics, social science, primary, and pre-school prospective teachers training in education faculty in 2009-2010 spring training semester. The sample consisted of 127 boys and 149 girls. Age of students ranged from 17 to 24 years. Departments and frequencies of the sample are shown in Table 1.

Higher Education and Environmental Education Courses in Turkey

Turkey, as a candidate nation to join the European Union, is working to transform aspects of its education system in order to align them more closely with European standards. In this environment of change, Turkey introduced reform in teacher education in the 1990s through the National Education Development Project. One component of the Project was the improvement of prospective teacher education including changes in the structure of Turkey's faculties of education, called college of education or departments of education at universities elsewhere. Recently, the Ministry of Education in Turkey identified training of prospective teachers for delivering effective environmental education programming as an urgent need. In this process, some of the Environmental Education Courses introduced obligatory lessons for education faculties in Turkey.

After graduating from high school, students can enroll in higher education, which is compatible with the Bologna three-cycle system. When a student win university entrance exam in Turkey, he/she are enrolled a faculty in the light of his choices if exam score is sufficient for placement . For prospective teacher higher

Table 1. Departments and frequencies of the sample

Academic discipline	Frequency	%
Primary teacher education	34	18.2
Science and technology teacher education	64	34.2
Mathematics teacher education	30	16
Social science teacher education	33	17.6
Pre-school teacher education	26	14
Total	187	100

Table 2. Example of statements of the ELS

Item no	Statements
3	Natural places should be renewed for the benefit of human kind
5	The world has abundant resources however we should know how to use them
15	Whenever men interfere with nature they encounter with disasters” and
17	The balance of nature is really sensitive and it can easily be spoiled”.
20	I think about nature when I am not in school
21	I pay my attention when I hear something relating nature and environment outside the school
24	The reason why I participate in environmental campaigns/groups is to protect and to restore them

education carries out an educational program of at least four years' duration that culminates with the award of a Bachelor's degree.

Primary prospective teachers are taken in a 2 credit 'Environmental Education' Course in their second year and science prospective teachers are taken in a 3 credit 'Environmental Science' Course in their third year of university. Biology prospective teachers are attended a 3 credit 'Environmental Health' Course in their last year, and geography prospective teachers are totally taken in 4 credit 'Environmental Problems I-II' Courses, are divided into two semesters in their third year of university. All of these courses are compulsory, theoretical and seen as a general cultural course in Turkey.

Data collection tools and analysis

A scale consisting of two sections was used to accumulate the data in this study. The first section with open-ended questions was used to assess demographic information of subjects such as gender, age, the last education level, and some questions about environmental activities. The second section with Likert type questions, named "Environmental Literacy Scale" (ELS), was administered to develop environmental literacy scale for prospective teachers. The initial scale was consisted of 35 item and some of the items was developed by the authors and some of them was obtained from Bartosh (2009)'s study. All items were designed in accordance with a 5-point Likert-type rating scale, ranging from 1 (very unsure) to 5 (very confident).

In terms of the construct validity of the ELS for explanatory analysis, the SPSS 15-program was used. Firstly, in order to test whether or not the data obtained were compatible with the factor analysis, the results of KMO (Kaiser-Meyer-Olkin) and Bartlett Sphericity tests were analyzed. Secondly, principal component analysis with a varimax rotation was used to understand a number of factors and it was performed on the scores of the 35-item. There was no limitation on the factor numbers, because main aim of the study was to determine the dimensions of scale. For this reason, the data were analyzed for factor solutions, but items loaded on unrelated factors.

A variety of criteria was used to determine the number of common factors to retain: the eigenvalue greater than 1 criterion, the scree test, the amount of total variance explained, and the conceptual interpretability of the factor structure. In addition, as suggested in the literature (Büyüköztürk, 2006), the criteria for common factor variance were decided to be .30 minimum in a single factor. For item selection, a minimum difference value of .10, the difference between each item's high factor loading in one factor and high factor loading in other factors, was also accepted. Eigenvalues are a special set of scalars associated with a linear system of equations (i.e., a matrix equation) that are sometimes also known as characteristic roots, characteristic values, proper values, or latent roots (Marcus and Minc 1988).

The reliability coefficient of the scale was calculated by employing Cronbach's Alpha and split-half method. Internal reliability estimates were calculated for the total scale and four subscales. Example of statements of the ELS are presented in Table 2.

RESULT

Prior to conducting the scale, two indicators were examined to determine whether the sample was appropriate for this analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy index and Bartlett's test of sphericity are presented in Table 3.

As seen from Table 3, the Kaiser-Meyer-Olkin measure of sampling adequacy index was .89 for the sample. This result indicated that the data represented a homogeneous collection of variables that were suitable for the factor analysis. It was understood that this was an excellent value, as it was suggested in the related literature that KMO value should be greater than .60 in order to continue factor analysis of the value found (Büyüköztürk, 2006). Bartlett's test of sphericity was

Table 3. Kaiser-Meyer-Olkin (KMO) ve Bartlett's Test results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.892
Bartlett's Test of Sphericity	Approx. Chi-Square	1901.9
	df	276
	Sig.	.000

Table 4. Items extractions

Items	Initials	Extractions	Mean	SD
2	1,000	0.49	4.64	0.94
5	1,000	0.64	4.10	1.05
6	1,000	0.65	4.51	1.02
7	1,000	0.40	2.96	1.01
8	1,000	0.67	4.03	0.97
9	1,000	0.48	3.33	1.00
11	1,000	0.65	3.97	0.95
12	1,000	0.42	4.17	0.84
13	1,000	0.56	3.53	1.08
14	1,000	0.46	3.54	1.01
16	1,000	0.54	4.03	1.13
17	1,000	0.74	4.27	0.96
20	1,000	0.60	4.48	0.95
21	1,000	0.32	3.59	0.94
22	1,000	0.48	3.95	0.92
24	1,000	0.47	1.90	1.10
25	1,000	0.66	4.09	1.03
26	1,000	0.61	4.37	0.89
28	1,000	0.65	4.29	0.98
30	1,000	0.46	4.37	0.90
31	1,000	0.48	2.47	1.25
32	1,000	0.63	3.62	1.22
33	1,000	0.49	3.77	0.94
34	1,000	0.52	3.82	1.15

significant for the sample, $X^2_{(276)} = 1901.9$, $p < .000$, indicating that the sample and correlation matrix were appropriate for the analysis.

The result of the factor analysis showed that the scale had four factors. When the factor loading matrix was examined 7 item (1, 3, 4, 15, 19, 23, 27) with low factor loading and 4 item (10, 18, 29, 35) not loaded on the corresponding factor were excluded from the scale. After removing these items, the factor analysis repeated, and this second analysis also revealed that the ELS had a four-factor construct.

The factors were considered to see which eigenvalues were over 1 and items extractions with original numbers are presented in Table 4.

As seen from Table 4, the items extractions ranged from 0.32 to 0.74. This finding showed that items

common factor variances are high values. Total variance explained of the ELS is presented in Table 5.

As seen in Table 5, 24 items were loaded on the four factors. The four factors accounted for 54.36% of the total variance. Factor 1 accounted for 28.9% of the variance and contained 14 items. Factor 2 consisted of 3 items and accounted for 9.04% of the variance. The third factor accounted for 8.66% of the variance and contained 3 items. The final factor consisted of 3 items and accounted for 7.76% of the variance.

The reliability coefficient of the scale was calculated by employing Cronbach's Alpha and split-half method. Internal reliability estimates were calculated for the total scale and four subscales. The results confirmed that the ELS generally had high internal reliability. The internal consistency coefficient of the scale was found to be .86.

Table 5. Explained total variance of the ELS

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.1	33.7	33.7	8.1	33.7	33.7	6.9	28.9	28.9
2	2.1	8.7	42.4	2.1	8.7	42.4	2.2	9.04	37.94
3	1.6	6.6	49.0	1.6	6.6	49	2.0	8.66	46.6
4	1.3	5.4	54.4	1.3	5.4	54.4	1.7	7.76	54.36

Table 6. The means, standard deviations and factor loading of the ELS

Items	Factor loadings			
	I	II	III	IV
1	.830			
2	.796			
3	.783			
4	.769			
5	.767			
6	.714			
7	.686			
8	.665			
9	.664			
10	-.640			
11	.520			
12	.500			
13	.439			
14	.394			
15		.671		
16		.670		
17		.601		
18		.494		
19			.806	
20			.788	
21			.806	
22				.688
23				.481
24				.476

The internal consistency coefficient of the first subscale was .87, .62 for the second subscale, .69 for the third subscale, and .50 for the last subscale. Except for the last subscale, total scale and other subscale had over middle internal consistency. As can be seen in Table 6 with the reorganized item numbers, the scale consisting of 24 items, and four factors was obtained. The range of factor loadings was observed to change from .83 to .39.

DISCUSSION AND CONCLUSION

The scale used in this research was prepared and developed with the aid of Bartosh's study (2009) and researchers, and then it was applied to prospective teachers. At first, the scale consisted of 35 items; however

11 items which were considered to have low factor loading were removed from the scale and created environmental literacy scale consisting 24 items. Cronbach Alpha reliability coefficient of the scale was calculated as .86. It is possible to say that this reliability coefficient is at a good level (Büyüköztürk, 2006). The developed scale accounted for 54.36% of total variance. There is a percentage of 45,64% out of this rate which was explained by other factors apart from the scale. There are 14 items in the first factor (1st-14th items). When items of the first factor were interpreted, this factor was named as "*Environmental Responsibility*" since the third item of the first sub-factor is "*natural places should be renewed for the benefit of human kind*" and the fifth item is "*the world has abundant resources however we should know how to use them*". As it can be inferred from

the sample items, it is possible to determine environmental responsibility and sensitivity of prospective teachers by means of first factor. Cronbach Alpha coefficient of this factor was calculated as .87. This is a sufficient rate (Büyüköztürk, 2006) and 28, 9% of total variance can be represented within the scope of the first factor. When the studies in literature were examined, it was seen that responsibility aspect of environmental literacy was similarly met and results which are similar to results of our study were obtained (Bartosh, 2009; Erol and Gezer, 2006; Bama, 2003).

There are 4 items in the second factor (15th-18th statements). When items of the second factor were interpreted within themselves, this factor was named as "The *Balance of the Nature*". It is known that human kind face with global warming, greenhouse effect and the loss of ecological balance as a result of disruption in the balance of the nature (Çalık, 2009). For example; 15th item of this sub-factor is "*whenever men interfere with nature they encounter with disasters*" and 17th item is "*the balance of nature is really sensitive and it can easily be spoiled*". By means of these items in the second factor, it is possible to determine the ideas and opinions of prospective teachers related with the natural balance of nature. Cronbach Alpha reliability coefficient of this factor was calculated as .62. This rate is sufficient (Büyüköztürk, 2006) and it represents 9,04% of total variance. When studies in literature were examined, it was seen natural balance aspect of environmental literacy was similarly met and similar results were obtained (Taylor et al., 2009; Çalık, 2009).

There are 3 items in the third factor (19th-21st statements). When items of the third factor were interpreted within themselves, this factor was named as "*Affective Environment*". For example; 20th item of the third factor is "*I think about nature when I am not at school*" and 21st item is "*I pay my attention when I hear something related with nature and environment outside the school.*" As it can be deduced from the items, attitudes and behaviours of prospective teachers will be revealed by means of the third factor. Cronbach Alpha reliability coefficient of this factor was calculated as .69. This rate is sufficient (Büyüköztürk, 2006) and it represents 8.66% of total variance. Erol and Gezer (2006) and Bama (2003) stated that affective aspect is an important factor in the studies which were conducted in terms of environmental literacy.

The fourth factor consists of 3 items (22nd-24th statements). Items of the fourth factor were gathered under the title of "*Environmental Activities*". 22nd item of this factor is "*people express their ideas and opinions related with environment through art*" and 24th item is "*the reason why I participate in environmental campaigns/groups is to protect and to restore them*". As it can be inferred from these items, the level of prospective teachers in terms of participation in environmental activities will be searched. Determination of environmental

environmental activities in this study which is the fourth sub-factor of environmental literacy can be interpreted as supporting affective environment which is the previous sub-factor. It is known that attitudinal changes have effect on activities and operations which were made or will be made in addition to devotion (Özmen, Çetinkaya and Nehir, 2005; Bimlekli, 2001). Cronbach Alpha reliability coefficient of this factor was calculated as .50 and it represents 7.76% of total variance.

With this study, a standard scale whose reliability studies were conducted was developed in literature which can determine environmental literacy of prospective teachers. Environmental literacy of prospective teachers can be determined with the standardization of the scale under four sub-scales which are "Environmental Responsibility", "The Balance of the Nature", "Affective Environment", and "Environmental Activities".

Environmental education in Turkey has a relatively recent history (Taylor et al., 2009). However, the newly released curricula are enriched with environmental education, which has been integrated by virtue of environmental themes distributed across the social sciences and science in primary schools (Alım, 2006; Gökdere, 2005), and in biology (with only one topic—ecology) and in the environment and humans for students in higher education (Morgil et al., 2002).

Pre-service teachers will go on to play an important role in educating the future generations of students in Turkey (Tuncer et al., 2009). Teacher education programs in Turkey need to incorporate an improved environmental education program into their curricula. It is clearly known that if prospective teachers do not have environmental knowledge, concerns about environmental problems, and favourable environmental attitudes, it is unlikely that their eventual students will, themselves, be environmentally literate. Definitions of environmental literacy directly related with prospective teachers have a competent level of environmental knowledge. Also, it is known that prospective teachers' environmental knowledge and environmental attitudes were positively associated with increased environmental concern and responsibility. By collecting and analyzing information on the environmental literacy level of pre-service teachers at different levels with the ELS, we hope to advance the cause of environmental education and environmental literacy. Using of the ELS for determining prospective teachers' environmental literacy, not only prospective teachers' environmental knowledge, impacts of the course(s) their lifetimes, individual efforts and the adequacy of these efforts but also cultural characteristics will be known.

The main focus of teacher education programs is to develop prospective teachers as amateur environmentalists (İleri, 1998). However, this aim is being compromised by the fact that most professional environmental educators are not trained under the Turkish teacher education regime. Instead, they tend to come from environmental engineering departments in

Turkey, where the “engineering” dimension rather than the “professional environmental educator” dimension dominates (İleri, 1998). Also, environmental and sustainability education in Turkey is still at a beginning stage. Despite its popularity among some students, environmental education is still mostly considered by prospective teachers as an educational extra. Reminding the increasing rate of environmental problems of the country with increasing rate of industrialization and thus increasing the need for environmentally literate generations, Turkey needs to have revise university programs in order to comprise (include) environmental education.

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