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DEVELOPMENT OF A SCALE FOR ENVIRONMENTAL ETHICS APPROACHES. A STUDY OF VALIDITY AND RELIABILITY

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Abstract. The purpose of this study is to develop a valid and reliable assessment tool for identifying undergraduate students ethical approaches to the environment. The subjects were 694 students in university teacher training programmes during the 2012–2013 academic year. The research instrument was based both on a literature review and data obtained from open-ended questions. To determine construct validity of the scale, exploratory and confirmatory factor analyses were conducted. The Cronbach alpha inner-consistency coefficient for reliability was calculated to be 0.73. Results of exploratory factor analysis showed that the scale consisted of 3 sub-dimensions: anthropocentric, biocentric, and ecocentric environmental approaches. The scale comprised 25 items using the 5-point Likert scale. Confirmatory factor analysis confirmed the 3-factor structure of the scale. The value of factor loadings varied within the range of 0.42 to 0.82, and corrected item-tool correlations varied in the range from 0.21 to 0.53. The findings of the study show that the environmental ethics scale is a valid and reliable assessment tool for identifying students ethical approaches to the environment.

Keywords: environmental ethics, scale development, undergraduate students.

AIMS AND BACKGROUND

Recently, environmental problems like global warming, reduction of fresh water resources, air, land and water pollution, reduction of green areas, endangered species, depletion of the ozone layer, and destruction of wild lands have become environmental crises. Strbac[1] stated that developments in science and technology tend to produce urbanisation and a resultant demographic explosion and thus natural resources are consumed and ecosystems in the biosphere are damaged. As the Earth is losing its balance, requiring us to face these issues, the importance of environmental ethics has grown[2].

Environmental ethics, part of the broader concept of bioethics[3], examines the relationship between human beings and nature and suggests ways to live in har-

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mony with nature[2,4] by developing positive attitudes and constructive behaviour[5]. An ethical aproach to the environment encourages respect for the autonomy of all creation[6] by clarifying moral principles and norms such as ecological holism, reasonable means of harnessing and using resources, peaceful coexistence, and population control[2].

How we perceive our relationship with nature and deal with critical problems has become crucial. Whether people exhibit a holistic approach or an individualistic approach to the environment, the various theories of environmental responsibility are considered to be anthropocentric, biocentric, or ecocentric[6,7].

Anthropocentric environmental ethics, also called human-centred ethics, holds that humans are the most important life forms[2,7] and that nature has instrumental value for humans; thus human beings consume natural resources to fulfil their expectations of a better environment[2,4,7]. Anthropocentric activity damages the earth and the damage can not be healed easily[2]. People who take an anthropocentric approach disregard ecological equilibrium and harmony between humans and nature while they pursue their needs. However, according to environmental ethics, they must recognise the rights inherent in nature existence and development[2].

A. Leopold was one of the founders of environmental ethics[4]. He stressed that all natural substances have inherent value and, therefore, the rights claimed by humans should extend to all other substances and should be respected by humans[2].

According to the biocentric approach, also called life-centred environmental ethics, all forms of life have inherent value and therefore they have rights. Some biocentrists believe that protecting animals is more important than protecting plant species and that protecting mammals is more important than protecting invertebrates. On the other hand, some 'biocentric egalitarians' believe that all living organisms have an equal right to exist[7].

According to the ecocentric approach, since it has intrinsic value, a moral relationship with nature necessitates its protection[4,7,8]. The ecocentric approach parallels a biospheric value orientation[8] to the whole of nature, the ecosystem, the landscape, the rock formations, and so on[6]. Individuals who take this approach are the most likely to support the environment through caring behaviour[9].

Many previous studies have addressed the approaches to environmental ethics[6,9–11], and some have looked at issues of measurement. Thompson and Barton[9] developed a scale based on anthropocentric, ecocentric, and apathetic approaches. Anemiya and Macer[6] administered a questionnaire examining high school students attitudes towards environmental ethics. A few studies have examined the environmental ethics of people in Turkey, among which one was conducted by Tuna[12] investigating public environmental values along anthropocentric and ecocentric dimensions. Other studies have focused on students environmental ethics[13–16]. Such studies identified students environmental tendencies in terms of anthropocentric, non-anthropocentric, theocentric, ecocentric, individualistic, deep ecologist, and

apathetic approaches. Since understanding environmental issues and the need for environmental protection is a worthy goal of a university education[17], the intent of this study is developing a valid and reliable data collection tool for identifying undergraduate students positions in relation to 3 principal approaches to environmental ethics.

EXPERIMENTAL

Research model and sampling. This study, based on a survey model, was conducted during the 2012–2013 academic year. The research sample consisted of 694 3rd- and 4th-year students in a teacher training programme at Trakya University, 470 (68%) of whom were girls and 224 (32%) – boys. These pre-service students were from various teacher education programmes: 50.2% were in primary school education, 17.4% in science education, 17.2% in social sciences education, and 14.9% in pre-school education.

Data obtained from 453 participants were used to construct validity and reliability analyses, and data obtained from 241 participants were used in confirmatory factor analysis.

Process of developing data collection instrument. The first stage of developing an environmental ethics scale was a review of the literature and examination of instruments developed in previous studies[4,8,9,13,16,18]. In addition to these researches, open-ended questions about environmental issues were prepared and asked of pre-service teachers in the teacher training programme of a second university.

In consideration of the literature review and data obtained from open-ended questions, an item pool of 66 items was created.

The preliminary questionnaire was given to a group of 122 pre-service teachers as a test for understand ability. In addition, 3 academicians expressed their opinions about the items and the research instrument as a whole, and 2 other academicians examined the questionnaire grammatically. As a result, some of the items were re-framed or deleted.

A pilot study with 514 pre-service students was then conducted, after which 39 items were eliminated, leaving only 27.

The maximum score allowed by the final questionnaire is 135, the minimum 27, based on the Likert scale of *strongly agree* (5), *agree* (4), *undecided (neither agree nor disagree)* (3), *disagree* (2), *strongly disagree* (1). The purpose of the study was explained and the questionnaire administered to participants in the fall semester of 2012; administration took 15–20 min.

Data analysis. Exploratory factor analysis determined the construct validity of the scale. Confirmatory factor analysis was conducted later. Construct validity was supported by correlating sub-dimensions of the scale. To determine discrimination of items, mean scores of the top and bottom 27% of the participants were compared

with a *t*-test, and item-test correlations were calculated. In addition, the Cronbach alpha analysis determined the reliability.

RESULTS AND DISCUSSION

Findings on exploratory factor analysis (*EFA*). In this study, the Kaiser–Meyer–Olkin (KMO) test and the Bartlett test of sphericity were conducted before employing EFA to test the adequacy of data structure for factor analysis in terms of sample size. The KMO value of the scale was found to be 0.85, which means that the sample size was satisfactory. This demonstrated that the structure of data was adequate for employing factor analysis[19–21]. In addition, the chi-square value obtained from the Bartlett spherical test indicated that the data originated from a multivariate normal distribution[22] and were found to be significant ($X^2 = 3489.570$; $p<0.01$). Based on these results, the adequacy of data for factor analysis was recognised.

The varimax vertical rotation method was used to reveal the factor pattern of the principal component analysis of the scale and for openness and significance in interpretation. Eigenvalues of 27 items showed 6 components higher than 1. Contribution of sub-components was found to be 53.648%. Regarding contribution of sub-components to total variance, it was found that 3 components contributed, and the contribution decreased after the third component. As seen in Fig. 1, the scale has a 3-factor structure. It was decided to repeat the analysis in terms of 3 factors considered to be environmental ethics factors (anthropocentric, ecocentric, biocentric) during scale development. This analysis revealed that the 1st factor contributed to the variance with a rate of 20.239%, the 2nd factor contributed with a rate of 12.659%, and the 3rd factor contributed with a rate of 7.435%.

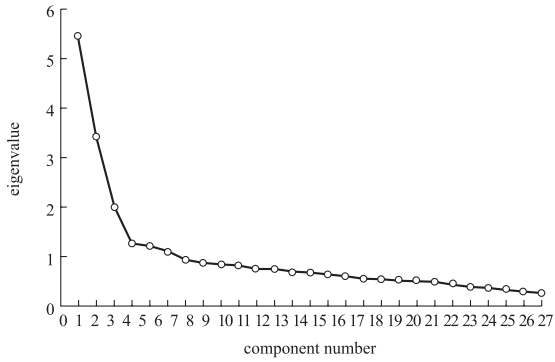

Fig. 1. Scree plot

The contribution of these 3 factors to the total variance was 40.333% (Table 1). This ratio is expressed as sufficient for multifactorial patterns[20,22]. Factor patterns and the value of factor loadings of items and variances can be seen in Table 1.

Table 1. Exploratory factor analysis (3 dimensions of environmental ethics)

Items	Factor 1	Factor 2	Factor 3
12	**0.428**	0.251	0.098
13	**0.552**	0.121	0.083
2	**0.483**	0.203	–0.236
4	**0.454**	0.251	0.117
6	**0.519**	0.007	–0.157
7	0.016	**0.735**	0.029
8	0.232	**0.806**	–0.012
21	0.257	**0.699**	0.014
16	–0.251	0.035	**0.557**
23	–0.044	–0.075	**0.706**
24	–0.393	–0.018	**0.503**
17	–0.247	0.040	**0.607**
1	**0.600**	0.282	–0.043
15	0.111	0.063	**0.571**
9	0.116	**0.748**	0.082
14	**0.632**	0.227	–0.053
19	**0.605**	0.042	–0.114
25	–0.113	0.131	**0.701**
5	**0.469**	0.072	–0.022
22	–0.135	–0.038	**0.554**
3	**0.584**	0.124	–0.075
20	0.224	**0.670**	–0.046
11	0.112	0.077	**0.551**
18	**0.569**	0.052	–0.103
10	0.150	**0.825**	0.023
26	0.293	–0.021	0.279
27	0.252	–0.107	0.385
Explained variance (%) (% of variance)	20.239	12.659	7.435

Although to some opinions the minimum loading factor value should be 0.30 for factor analysis, to other opinions it should be 0.40 (Ref. 23). In this study, the loading factor value was 0.40. When the results of the analysis considering the 3 factors were evaluated in terms of the loading factor and overlapping, it was found that items 26 and 27 were under 0.40 and no items were found to create overlapping.

After eliminating the 2 items that stayed under 0.40, factor analysis was repeated with 25 items. In this analysis the KMO value of the scale was found to be 0.86, and sampling size was found at a good level. These results revealed the adequacy of the data structure for factor analysis. Results of the Bartlett spherical test indicated that the value of chi-square was significant ($X^2 = 3337.304$; $p<0.01$).

Factor analysis revealed that the 1st factor contributed to the variance with a ratio of 21.779%, the 2nd factor contributed with a ratio of 13.396%, and the 3rd factor contributed with a ratio of 7.425%. The contribution of the 3 factors to the total amount of variance was 42.6%. Items under the 3 factors were evaluated in terms of content and named anthropocentric, ecocentric, and biocentric approaches. Table 2 shows the results obtained from analysis according to factor pattern, loading factor value of items, item-total correlation, item analysis (*t*-value), and the Cronbach alpha value.

Table 2. Results of exploratory factor analysis

	Items	Factor loading	Eigenvalue	% of variance	Factor-total correlations *r*	The Cronbach α value	*t*	Corrected item-total correlation
Biocentric	12	0.422	5.445	21.779	0.559*	0.78	–8.246*	0.374
	18	0.578					–5.336*	0.226
	13	0.560					–8.770*	0.372
	1	0.610					–8.293*	0.398
	2	0.492					–5.919*	0.223
	3	0.594					–4.820*	0.286
	14	0.636					–6.937*	0.365
	4	0.469					–8.752*	0.391
	19	0.612					–4.860*	0.224
	5	0.488					–5.112*	0.240
	6	0.500					–3.419*	0.350
Ecocentric	7	0.738	3.349	13.396	0.670*	0.86	–9.229*	0.421
	20	0.677					–10.854*	0.438
	8	0.807					–12.210*	0.535
	9	0.745					–11.828*	0.509
	21	0.703					–11.269*	0.499
	10	0.824					–11.592*	0.527
Anthropocentric	15	0.584	1.856	7.425	0.560*	0.76	–10.712*	0.386
	22	0.573					–5.866*	0.220
	16	0.571					–5.573*	0.217
	23	0.685					–7.702*	0.297
	11	0.565					–11.052*	0.391
	24	0.507					–2.639*	0.092
	25	0.728					–10.079*	0.400
	17	0.635					–6.828*	0.249
	Total Cronbach α					0.73		

* $p < 0.01$.

The scale ended up with 25 items and 3 factors as a result of exploratory factor analysis. As seen in Table 2, there are 11 items in the biocentric dimension and the values of factor loadings of items varies in the range from 0.422 to 0.636. The ecocentric dimension encompasses 6 items, and values of factor loadings of items vary in the range from 0.703 to 0.824. The anthropocentric dimension incorporates 8 items, and values of factor loadings of items vary in the range from 0.507 to 0.728. Table 2 also shows the total amount of item-correlation values representing the validity of each item, and it is seen that the correlation coefficient of items varies within the range 0.21–0.53. Klein[24] indicated that the total amount of item correlation test value should be 0.20. Analysis of the results showed that while some of the items were at a medium level, others were at a low level in terms of item correlation[25].

In addition, the *t*-test was used to determine the strength of distinctiveness of items in the scale[26]. For this purpose, 27% of the upper and lower groups were identified by ordering the scores obtained from 453 data in descending order. The *t*-test was calculated for each of the 2 groups of scores. In the analysis, a significant difference was found between the upper and lower groups ($p < 0.01$). This significant difference revealed the distinctiveness of items in the scale as expected. The Cronbach alpha reliability analysis was done to determine the reliability of total scores of the environmental ethics scale and the reliability of 3 dimensions. The internal consistency coefficient 0.77 was found for the initial scale, which consisted of 27 items. After employing factor analysis, 2 of the items were eliminated and the Cronbach alpha coefficient reliability was 0.73 for the whole scale. For each of the dimensions, the Cronbach alpha coefficient reliability is represented in Table 2. Results of the reliability analysis showed the adequacy of the reliability of the scale.

Confirmatory factor analysis. Confirmatory factor analysis (CFA) was employed to test the structure validity of 3 factors resulting from the exploratory factor analysis (EFA). Findings obtained from CFA are presented in Fig. 2 and Table 3. This analysis found that the ratio of chi-square to the degree of freedom was 1.83. Since this ratio is below 2, it can be considered as perfect fit[23]. In addition, this study revealed the following findings, respectively: for the RMSEA 0.05 was considered as a perfect fit; in the GFI, 0.86 was considered as an acceptable fit; in the AGFI, 0.83 was considered as an acceptable fit; for the SRMR, 0.06 was considered as an acceptable fit; and in the NNFI and CFI, 0.96 was considered as a perfect fit[20].

Table 3. Results of confirmatory factor analysis

X^2	490.61
SD	272
X^2/ sd	1.803
NNFI (non- normed fit index)	0.96
CFI (comparative fit index)	0.96
RMSEA (root mean square error of approximation)	0.05
SRMR (standardised root mean square residual)	0.06
GFI (goodness of fit index)	0.86
AGFI (adjusted goodness of fit index)	0.83
CFI (comparative fit index)	0.96

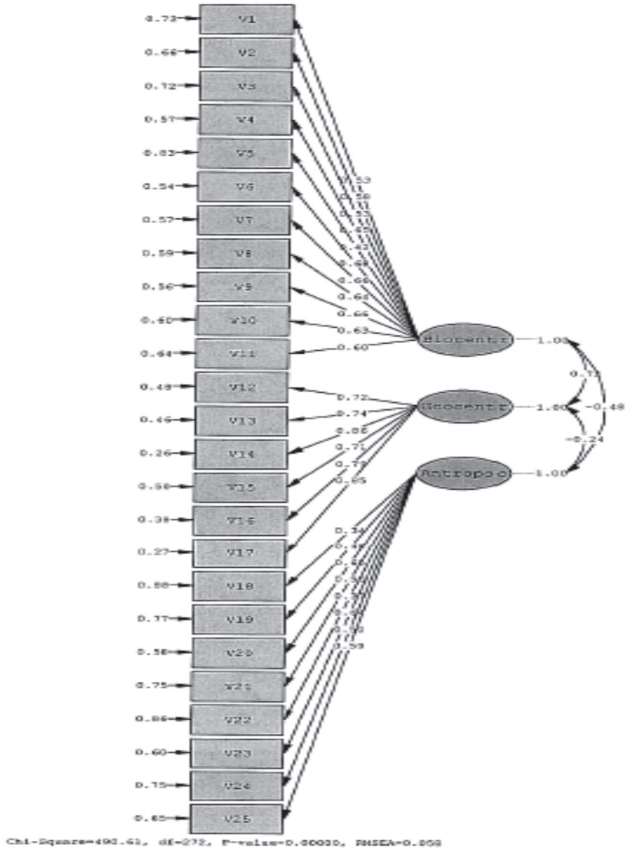

Fig. 2. Results of confirmatory factor analysis

Confirmatory factor analysis of the environmental ethics scale results demonstrated adequacy indices which were determined at a sufficient level for fitness with the model[27,28]. Figure 2 represents the model including standardised parameter estimates regarding scale factors and items of environmental ethics. The results obtained confirmed the validity structure of the 25-item scale for undergraduate students.

CONCLUSIONS

This study aimed to develop a valid and reliable environmental ethics scale that can be used to determine undergraduate students approaches to environmental ethics. For this purpose, exploratory factor analysis was conducted in order to investigate the construct validity of the scale, and also confirmatory factor analysis was conducted in order to test the fitness of the factor structure. As a result of these analyses, a 25-item scale was developed, grouped into 3 factors: biocentric, anthropocentric, and ecocentric. In the factor structure the values of factor loadings vary between 0.42 and 0.82. Total variance of the scale had a ratio of 42.60%. Adequate correlations were determined between the total score of the scale with the items and the total score with the dimensions.

Confirmatory factor analysis was applied to the 25-item scale. A ratio of X^2/sd was evaluated and found to be 1.80 which showed that the scale was relevant to the real data. It was also determined that other indices were found at an acceptable level.

In the light of these findings, it can be said that the 3-factor structure of the environmental ethics scale is a relevant model. Since the data were obtained from undergraduate students, it can be said that this scale is appropriate for these groups. Whether it is appropriate for lower level students depends on the results of other studies in this area.

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