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Science and Mathematics Teacher Candidates' Environmental Knowledge, Awareness, Behavior and Attitudes

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The purpose of this study was to measure science and mathematics teacher candidates' environmental knowledge level, awareness, behavior and environmental attitudes. Four instruments comprising Environmental Sensitivity Scale, environmental Behavior Scale, Environmental Attitudes Scale and Environmental Knowledge Test were administered to a total of 138 elementary student teachers to collect data. Their responses were analyzed using percentage, factor analysis and correlation analysis. The findings of the study showed that: (1) students' environmental awareness was high; (2) they were sensitive to environment and tended to protect it; (3) participants were familiar with general topics related to environment whereas they have low information level as to technical, conceptual and important environmental issues. However, students' environmental awareness and positive attitudes have been detected not to reflect their behavior. Concerning the study results, suggestions have been made to help teacher candidates' deal with environmental problems.

Keywords: environmental awareness, environmental behavior, environmental knowledge, teacher candidates.

INTRODUCTION

Environment is described as all kinds of biotic & abiotic (social, cultural, historical, climatic, physical) factors affecting a living organism or a vibrant community, the duration of life (Armagan and Köksal, 2010; Yücel and Morgil, 1998). In general terms, environmental issues are defined as adverse effects of the

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artificial environment created by people, in the natural environment (Aydoğdu and Gezer, 2006). Climate change, drinking water, scarcity, urbanization for the sake of destruction of forests, water resources, pollution and uncontrolled population growth, are presented to be the most important of these issues (Todaro, 1994; Uttara, 2012). These matters are among the foremost ones that humankind is encountering and universally concerned about and that urgently needs resolutions in the twenty-first century (Wang et al., 2010). Researchers like Wang and his colleagues argued that the fundamental way to resolve problems of the environment is by fostering and raising public environmental awareness, enhancing people's sense of responsibility for protecting the environment, and promoting harmony between humankind's behavior and the environment by means of environmental education and training. In this perspective, teachers and teacher educators are called to implement in school or university settings educational programs dealing with environmental education. On the other hand, students as leaders of tomorrow need to have experience in taking initiative relative to the urgent requirements of society in areas of global challenges (Obasoro, Oyinloye, Ilesanmi and Adams, 2013).

Environmental attitudes are a psychological tendency that is expressed by evaluating the natural environment with some degree of favour or disfavour (Hawcroft and Milfont, 2010; Milfont, 2007a). Thompson and Barton (1994) developed a set of questions that are designed to measure two value-based environmental attitudes: ecocentric and anthropocentric. Ecocentric concerns center on the intrinsic value of plants and animals. In contrast, anthropocentric concerns are based on the effect that environmental damage will have on the quality of life for all humans (Schultz, 2000).

To generate an environment-friendly society, one of the most important ways is through to become a society having environmental awareness and environmental impact permanently. In the creation of this culture, there is a great mission for the teachers & teacher candidates which will give direction to the community in the education of youth by assuming the most important role. Therefore, it is important to investigate whether the teacher candidates themselves and mostly those in science and mathematics have the necessary environmental awareness and the way they act toward the environment. Despite the multitude studies conducted on the environmental problems in Turkey, this study is important to demonstrate the relationship between the education received by teacher candidates and the building of environmental awareness in society as one of the steps to be taken on behalf of the maturation about the environmental consciousness. The purpose of this study was to measure elementary science and mathematics teacher candidates' environmental knowledge level, awareness, behavior and environmental attitudes at Akdeniz University. In other words, researchers would like to investigate the degree to which science and mathematics student teachers enrolled in the department of education: (1) know about general environmental issues, technical and conceptual environment-related issues; (2) are sensitive about environmental problems; (3) show pro-environmental behavior and (4) exhibit pro-environmental attitudes.

The research questions that have guided this study were the following:

1. What is Akdeniz University science and mathematics teacher candidates' knowledge of environmental issues?
2. What is Akdeniz University science and mathematics teacher candidates' sensitivity of environmental?
3. What is Akdeniz University science and mathematics teacher candidates' behavior towards environmental issues?
4. What are Akdeniz University science and mathematics teacher candidates' environmental attitudes?

The rationale for conducting this study is manifold. First, this study is needed because of the lack in Turkey of a sufficient number of studies focusing on ecocentric and anthropocentric attitudes and ideas towards environmental protection. Using quality scales during data collection, participants' behaviors and thoughts with reference to environmental protection could be determined to know whether their motives are based on human-centered or environmental centered attitudes. Second, the results of this research would probably add to the existing literature regarding teacher candidates' awareness, sensitivity and attitudes towards environmental problems. Third, the results of this study may help teacher educators at Akdeniz University and in developing countries throughout the world to take the necessary actions to enhance teacher candidates' content knowledge and pedagogical content knowledge related to teaching of environmental education in schools. Finally fourth, we think that the outcome of this study would most likely inform decision makers or education leaders at the Ministry of Education in Turkey about how to raise public awareness in the country starting from schools and universities.

METHODOLOGY

The purpose of this study is to measure the level of knowledge of future educators based on their attitudes and behavior toward environmental issues. In this study, the Convenience Sampling method was selected among non-randomized sampling techniques as the sample selection concept. Due to the limitations that exist in terms of money and manpower, and easy to transport and perform, the freshman and the senior students studying in the departments of science and mathematics of Akdeniz University are selected.

In this context, a series of surveys have been conducted with the students in question. Within this research, "Environmental Sensitivity Scale (Özdemir, Yıldız, Ocaktan, Sarışen, 2004)", ""Environmental Behavior Scale (Uzun and Sağlam, 2006)", "Environmental Attitudes Scale (Morgil, Arda, Seçken, Yavuz, Özyalçın Oskay, 2004)", and "Environmental Knowledge Test (Yavuz, 2006)" were used with permission from the owners mentioned above. A few questions were adapted according to teacher candidates. After receiving approval of the scales' content validity by the opinions of the 3 experts in the field of Educational Sciences, Biology Education and Science Education, of Education Faculties, in Akdeniz University, Dokuz Eylul University & Pamukkale University, a total of 153 questionnaires were administered to students. From the obtained surveys, of questionnaires data loss ≥ 20% are not included in the study. In this way, 13 polls sifted, and the analyses were carried out on the basis of the remaining 138 questionnaires.

29.7% of respondents were male and 70.3% were female. The difference in this ratio, although it is not our choice, seems to be reflected naturally in the results with the same proportion, on account of the fact that it has been also found between male and female students registered in the classes as mentioned. Due to the more crowded the class quota of students in mathematics education, the participants' rate in this section is 66.7%, while the participants from the science education department's ratio seems to have stayed at 33.3%. Yet, because of the less number of final-year students, the majority ofparticipantratio is seen that they're in the first-year students (62.3%). The Urban areas in the circles of where participants grew up ranked at the first with 47.8%. The proportion of respondents stating that their mother does not employed is 70.3%, whereas the rate of participants who stated that their father employed is 67.4%. The education level of mothers (44.9%) and fathers (30.4%) of the majority of participants is elementary school (See Table 1).

Table 1. Demographic Profiles of Participants

Gender	n	%	Department	n	%
Men	41	29.7	Science Education	46	33.3
Women	97	70.3	Mathematics Education	92	66.7
Mother's Job Status	n	%	Father's Job Status	n	%
Employed	33	23.9	Employed	93	67.4
Unemployed	97	70.3	Unemployed	10	7.2
Retired	8	5.8	Retired	34	24.6
Mother's Educational Status	n	%	Father's Educational Status	n	%
Elementary School	62	44.9	Elementary School	42	30.4
Middle School	27	19.6	Middle School	29	21.0
High School	34	24.6	High School	35	25.4
University	14	10.1	University	32	23.1
Classes	n	%	Environment you grew up	n	%
First Year	86	62.3	Rural Areas	38	27.5
Final Year	52	37.7	Urban Areas	66	47.8
			Coastal Region	34	24.6

Results of environmental tests administered to all participants are shown in Table 2. Accordingly, participants' correctly response rate about the questions related to general environmental issues is over 50%; however, Environment-related technical and conceptual questions correctly the response rate is below 50%. In general terms, the participants' the average rate of the right response of environmental knowledge test questions is 41.68%, while the average rate of the wrong response is 51.29% (See Table 2.).

Table 2. Correct Answer Percentage of Environmental Knowledge Test

Propositions	**Correct Answer**	**%**	**Wrong Answer**	**%**	**Blank**	**%**
Which of the following can cause air pollution?	91	65.9	34	29.8	6	4.3
Which of the following is wrong about oil?	82	59.4	40	34.1	9	6.5
Which of the following is an example of clean energy sources?	82	59.4	42	35.5	7	5.1
Which of the following obtaining energy methods give less damage to the environment?	80	58	44	36.9	7	5.1
Which of the following causes an extreme increase of atmospheric CO2, CH4, water vapor and hydro-fluoro carbons?	79	57.2	39	33.4	13	9.4
What causes the greenhouse effect?	74	53.6	50	41.3	7	5.1
What name is given to the branch of science that studies living creatures' interaction with each other and with the environment?	64	46.4	58	47.1	9	6.5
Which of the following is not among the things to do against air pollution?	60	43.5	57	46.4	14	10.1
What is sustainability?	53	38.4	72	57.3	6	4.3
Which of the following cannot be obtained after a result of the combustion of fossil fuels?	49	35.5	67	53.6	15	10.9
Which of the following is an example of the particle?	41	29.7	75	59.4	15	10.9
Which of the following is not one of the least environmentally damaging fuels?	33	23.9	88	68.9	10	7.2
What is a particle?	30	21.7	88	68.9	13	9.4
Which of the following can cause thinning of the ozone layer?	25	18.1	102	80	4	1.9
Which of the following is not a greenhouse gas?	20	14.5	99	76.8	12	8.7
Averages of Ratio		41.68		51.29		7.03

In order to check the construct validity, the factor analysis of the five-point Likert-type scale used in the research process was performed. During the analysis, the factor loadings are limited to 0.50. As the rotation method, varimax method was used. Scales and analysis results subjected to factor analysis are presented below:

Firstly, "environmental sensitivity scale" consisting of 20 questions was subjected to factor analysis. Prior to analysis, which is the opposite of propositions; DUY 1, DUY 3, DUY 4, DUY 13 and DUY16 were re-coded. After the analysis, as the value of KMO = 0.881 was obtained. Factor loadings found less than 0.50; DUY2 (I am not uncomfortable with established factories near residential areas), DUY5 (Progressive deterioration of the world's ecological balance, worries me for the sake of the future) and DUY15 (Used papers & other materials will go to the garbage, are no different to me) propositions were remained outside the analysis. For the remaining 17 propositions, α = 0.897. The proportion of the total variance explanation for the obtaining single factor is 42.05% (See Table 3).

Table 3. Factor Analysis Results for the Scale of Environmental Sensitivity

PROPOSITIONS	**Factor Loadings**	**Eigen Value**	**Mean ($\bar{X}$)**	**Reliability (α)**
FACTOR 1. SENSITIVITY (DUY)		8.411	3.90	
DUY19 For environmental awareness, tree planting activities should be done	.848		4.05	.897
DUY18 The media organizations should show sensitivity to environmental issues	.843		4.03	
DUY6 It would make me happy, if the place nearby me became a forested area	.770		4.16	
DUY17 For environmental education, should be started at an early age	.759		4.06	
DUY20 Industrial enterprises should fulfill their duties of environmental issues	.747		4.24	
DUY8 Pesticides and insecticides used unconsciously disrupt the biological balance	.736		3.89	
DUY9 It worries me that giving wastewater to the sea and rivers without treatment process	.730		3.98	
DUY10 Before throwing my trash in a dumpster, I accumulate it in nylon bags.	.730		3.99	
DUY7 Of food to stay healthy, I keep them in closed containers	.688		3.90	
DUY12 Countries possess nuclear, chemical & biological weapons makes me uncomfortable	.631		3.92	
DUY11 It is not observed any effort to collect wastes separately for recycling.	.617		3.91	
DUY14 I collect one side of used paper to use the back side also.	.612		3.85	
DUY3 I don't think that air pollution increases respiratory diseases (R)	.580		4.09	
DUY1 I see no harm in eating seafood coming from regions where the sea was dirty (R)	.587		4.07	
DUY16 I don't think that soil loss due to erosion constitutes an important problem (R)	.536		3.70	
DUY4 I don't believe that sprays and deodorants deplete the ozone layer (R)	.544		4.09	
DUY13 I am concerned about the increasing base station (R)	.521		2.29	
Description Ratio for Total Variance (%)			42.05	
KMO			.881	
Bartlett's Test of Sphericity		Approx. Chi-Square: 1535.975 df. 190 Sig. ,000		

Secondly, "environmental behavior scale" consisting of 20 questions was subjected to factor analysis. Prior to analysis, which is the opposite of propositions; DAV13 and DAV15 were re-coded. After the analysis, as the value of KMO = 0.821 was obtained. Factor loadings found less than 0.50; DAV5 (I'd prefer to use bags or paper bags instead of plastic bags), DAV13 (There is a nuclear power plant near the place I live, does not bother me), DAV14 (I generally attend the panels, symposiums, meetings or conferences regarding environmental protection), DAV15 (I don't give up my living standards for the sake of the environment), DAV17 (I care the stores where I am going to shop to whether the green certified), and DAV18 (I throw garbages to the environmental recycling bin by separating them as glass, paper and plastic) propositions were remained outside the analysis. For the remaining 14 propositions, α = 0.894. The proportion of the total variance explained for the obtaining single factor is 33.02% (See Table 4).

Thirdly and finally, "environmental attitude scale" consisting of 20 questions was subjected to factor analysis. Prior to analysis, which is the opposite of propositions; CTU2, CTU4, CTU6, CTU8, CTU10, CTU12, CTU14, CTU15, CTU17 and CTU19 were re-coded. After the analysis, as the value of KMO = 0.837 was obtained. Factor loadings found less than 0.50; CTU8 (No institutions including the United Nations cannot interfere countries to use their natural resources as they wish), CTU15 (In the world, there are inexhaustible energy sources enough for many years), CTU16 (After purification of domestic and industrial wastewater should be given to the nature), CTU17 (In national parks & forests, the government should allow construction of buildings for tourism purposes), CTU18 (Urban sprawl is one of Turkey's most important problem), and CTU20 (To see houses built in places where animals live, saddens me.) propositions were remained outside the analysis. For the remaining 14 propositions, α = 0.907. The proportion of the total variance explained for the obtaining single factor is 34.13% (See Table 5).

Table 4. Factor analysis results for the scale of environmentalists behavior

PROPOSITIONS	**Factor Loadings**	**Eigen Value**	**Mean ($\bar{X}$)**	**Reliability (α)**
FACTOR 2. BEHAVIOUR (DAV)		6.604	3.74	
DAV20 On the beach, and picnic, I throw my trash in a nearest dumpster by storing in nylon bags	.734		4.05	.894
DAV4 I disperse my used clothes to other people can use	.689		3.73	
DAV7 I change my habits in order to contribute to the solution of environmental problems.	.684		3.94	
DAV16 I support the activities carried out for the use of renewable energy sources.	.680		3.78	
DAV11 I turn off the light when leaving a room	.661		4.19	
DAV12 I warn insensitive, unconscious & reluctant people, which is the main cause of environmental pollution	.657		3.79	
DAV1 I read publications what I find about the environment	.647		3.48	
DAV6 I take care to well-washed fruits & vegetables	.641		4.07	
DAV8 I take the time to learn something about the environment	.641		3.81	
DAV10 I would save energy	.636		3.98	
DAV9 Although more expensive, I buy products that do not harm the environment	.636		3.47	
DAV19 I'm known by my friends as someone sensitive to the environment	.617		3.43	
DAV2 I avoid throwing used paper, and deliver to the trash collector.	.560		3.45	
DAV3 I use detergents that do not harm the environment	.501		3.21	
Description Ratio for Total Variance (%)			33.02	
KMO			.821	
Bartlett's Test of Sphericity		Approx. Chi-Square: 1147.677 df. 190 Sig. ,000		

Table 5. Factor analysis results for the scale of environmental attitudes

PROPOSITIONS	Factor Loadings	Eigen Value	Mean ($\bar{X}$)	Reliability (α)
FACTOR 3. ENVIRONMENTAL ATTITUDE (CTU)		6,827	4.06	
CTU5 Energy and water conservation in homes and workplaces should be done	.790		4.29	
CTU14 Exhaust emission inspection is unnecessary in vehicles (R)	.776		4.08	
CTU9 Global warming causes major tragedy for humanity	.753		4.22	
CTU3 In households and industries, it should be expanded to use of natural gas and bioenergy which are less harmful to the environment	.725		4.08	
CTU11 Rapid population growth and unplanned urbanization accelerates environmental pollution	.720		4.15	
CTU12 To take measures for the protection of endangered species is an empty effort. There are a large number of species in the world, what if some may become extinct. (R)	.714		3.97	
CTU6 The environment harm of Pesticides and synthetic hormones used in agriculture is negligible (R)	.693		3.85	
CTU13 Countries should attach importance to environmental issues, the Ministry of Environment and Society should be established	.651		4.20	
CTU7 Rapid destruction of natural resources creates a major problem for the future (R)	.633		4.08	
CTU10 As the ozone layer is thinner in certain areas, only those regions are under threat (R)	.628		3.86	
CTU1 In schools, radio and television, awareness-raising activities should be carried out in environmental issues	.616		4.02	
CTU2 Because much of the world is water, water resources will not deplete (R)	.608		4.01	
CTU4 Due to the waste is separated by bacteria, no time environment is not contaminated (R)	.582		3.83	
CTU19 I don't worry about environmental problems (R)	.530		4.22	
Description Ratio for Total Variance (%)			34.13	
KMO			.837	
Bartlett's Test of Sphericity			Approx. Chi-Square: 1341.416 df. 190 Sig. ,000	

In order to identify the relationship obtained between the factors, the correlation analysis was performed. Accordingly, DUY has a positive relationship with the right way between DAV (r=.614; p=.000<.001) & CTU (r=.710; p=.000<.0001). Additionally, there is another positive relationship with the right way between DAV and CTU (r=.529; p=.000<.001) (See Table 6).

Table 6. The Results of Correlation Analysis

Factors Statistics	Factors Statistics	1.	2.	3.
1.DUY	r	1		
	N	138		
2.DAV	r	.624*	1	
	p	.000		
	N	138	138	
3.CTU	r	.710*	.529*	1
	p	.000	.000	
	N	138	138	138

*Significant to .001

RESULTS

With this study conducted, the future of teacher candidates' environmental awareness, attitudes, knowledge levels and degrees of exhibiting environmental behavior, were determined. As a result, participants were observed to be sensitive to environmental issues. Additionally, their circumferential positions were identified as aimed at the protection of the environment. Even participants' environmental awareness and environmental attitudes have been supporting each other. So, environmental attitudes of the participants who are environmentally sensitive are oriented to protect the environment. This situation reveals that one of the most important steps of having the environmental awareness is an attitude towards environmental protection.

Another important finding obtained in this study, are related to participants' level of environmental information. The correct response rate of the environmental knowledge test applied to participants is 41.6%, whereas the wrong response rates are 51.2%. This shows that the environmental knowledge level of the participants is not good enough that it was expected. As this topic is considered in terms of the content of the questions, it is emerging the fact that the participants are familiar with the general subjects; however, they have very low levels of information on technical, conceptual, and important issues related the environment.

Though the exhibit degrees of the environmental behavior of the participants are close to very good level, are not sufficient. When examined the average number of propositions on the scale of the environmentalists' behavior, it is seen that the participants' level of interest is high for some of the propositions, and is low for others.

When this scale is taken on the basis of the premise, the reason for this situation clearly arises. Participants tend to behave environmentally friendly so long as they become in accordance with their own interests and it does not require any cost. Otherwise the level of this trend is decreasing. For example, the average of the answers given for the premise of "DAV11: I turn off the light when leaving a room" is ($\overline{X}$=) 4.19. According to the results obtained, the compelling reason for the participants to turn off the light is not caused from the wastage of electricity derived from environmental sources; rather they cannot afford the cost economically. The average of another question with hypothesis "DAV3: I use detergents that do not harm the environment" is ($\overline{X}$=) 3.21. This value is close to the instability, reveals that participants avoid incurring costs that will arise about the protection of the environment. Seen from this perspective, it is concluded that the participants exhibit utilitarian behavior in environmental protection, and act inan environmental conservation manneras long as it is in the interests. This behavior means that the participants display anthropocentric (human-centered) behavior, and are far from ecocentric (environmental-centered) behaving. With the most direct words, the participants exhibit environmental behavior not voluntarily, but in accordance with their own interests.

According to these results, future educators sensitive to the environment and tend to protect it. However, aforementioned sensitivity & protection tendency just stay on the intellectual level and cannot be transformed in behavior due to those individual interests. Of a lack of information about the environment is also thought to play an important role in the development of environmental protection behavior. One of the most important ways to generate an environment-friendly society is through to become a society having environmental awareness and environmental impact permanently, as a culture. In the creation of this culture, there is a great mission for the teachers which will give direction to the community in the education of youth by assuming the most important role. Therefore, it is of great importance to gain this awareness and to internalize it in the educational process for the teacher

candidates which will play a key role to build the future of a society. Environmental courses will be placed in the curriculum; environmental field trips will be organized by educational institutions with the participation of students, encouraging the participation of students, for social responsibility projects about environmental issues, through media, performing environmental programs like activities are important applications needs to be operated to gain environmental awareness and to convert behavior by internalizing.

Therefore, in the pedagogical context, we believe that this study will provide an added value to the teacher candidates who will play a key role in building the future of our society to gain this awareness and in terms of the internalization of it during the training process.

CONCLUTION

On the subject of environmental problems, education is the most effective way of raising awareness of the people. Teachers are the ones that will provide this training. All training opportunities should be used in terms of the achieving the desired level of knowledge for teachers to be gained this awareness during their education. Thus, this research is important from the point of revealing teacher candidates' level of knowledge and attitudes towards environmental issues. In addition, the conversion of positive attitudes into behavior can be achieved in light of this information. Taking into consideration the results of the survey, some projects and researches can be done to improve the level of teachers' knowledge and attitudes towards environmental issues. In this way, the level of environmental knowledge and attitudes of teachers who will train our children in the future can be increased, and converted into behavior. Without being fully identified of teacher candidates' attitudes and knowledge levels towards the environment, it should not be expected from them a brilliant success in environmental education. In our country, the lack of a sufficient number of researches regarding in the ecocentric and anthropocentric perspective has made this survey necessary to explore our teachers' attitudes toward the environmental issues.

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