COMPARATIVE EVALUATION OF THE ENVIRONMENTAL CULTURE OF 8TH GRADE STUDENTS IN BULGARIA AND TURKEY

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Abstract The article reports the results from an investigation of the ecological and general scientific knowledge of students in the upper grade of elementary school (8th grade, 15 year old) in Bulgaria and Turkey with the aid of a questionnaire, containing 40 terms from ecology, geography, biology, chemistry, nature conservation, health and nutrition. It has allowed us to investigate the effects of several factors such as the students' social status (Turkey), the science education in school, school entrance exams in biology (Bulgaria), the interrelation between environmental and scientific knowledge, evaluation and self-evaluation, analysis and self-analysis. On the basis of the results and the conclusions of their analysis the students' achievements in respect to the state educational standards have been evaluated. Furthermore, adequate measures are recommended to teachers in order to overcome the deficiencies and shortcomings in students' knowledge and understanding. The research identifies several problems for future investigation.

Keywords: environmental culture, environmental education, scientific knowledge, ecological knowledge, social status of students, interest in biology, students' achievements

Introduction

Adequate knowledge of environmental issues has a crucial influence on eight grade students in the formation of their behavior and attitude towards nature and natural resources. Whilst some students continue their education into the next grade, and enrich their environmental and scientific culture, others leave school to start a job without adequate knowledge in this area. Scientific culture is fundamental for the development of environmental culture, which in its turn is indispensable for sustainable development. UNESCO makes regular decisions and undertakes actions for implementing environmental education in school curricular, aiming at the enhancement of environmental culture of every citizen of our Planet.[1)]

Environmental education (EE) has a long history and is an essential part of the educational system of every nation. Different problems concerning EE have previously been investigated and discussed: the meaning and scope of the concept environmental literacy[2)] (Hines et al., 1986), the philosophy of EE (Stapp et al., 1968), analysis of science and technology course curriculum in Turkey (Erdogan, 2007), critical analysis of research in EE (Hart & Nolan, 1999), conceptualization of EE (Kostova, 2003), research on responsible environmental behavior (Hines et al., 1986), issues of EE (Stawinski, 2000). More recently topics under investigation include challenges in the field of environmental educational research (Meyers et al 2007), children's education under the influence of social and global political changes (David, 2007), factors affecting children when taking action for the environment (Chawla & Cushing, 2007), young people's concerns about the future (Hicks & Holden, 2007), effect of restricted opportunities of neighborhoods' surroundings of children on their physical exercises and environmental learning (Malone, 2007), new ecological paradigm in environmental ethics (Lundmark, 2007), conservation learning in zoos and aquariums (Ballontyne et al., 2007), action competence in EE and many others. As a result of their research, Suzuki et al.[3)] came to the conclusion that environmental consciousness and behavior of people changed positively due to information on environmental assessment and especially of environmental impact on the next generation. Based on our environmental education research and findings and those of others we have concluded that environmental culture plays a crucial role in shaping environmentally responsible behavior. This concept still needs to be clarified and conceptualized. Environmental culture is a subcomponent of the concept culture.

General culture is a very complex concept, containing many components and having more than 300 definitions. One of the many definitions of general culture (after UNESCO) refers to the unity of knowledge, achievements, technological skills, traditions, perceptions, customs, values, habits and other capabilities of society and human inherited traditions and patterns. Per example the environmental education could be considered as a process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings (Schmieder, 1977). Education has a decisive role in the development of culture and it involves the process and the results of teaching and learning of knowledge, attitudes and skills. One of the aims of education is development of environmental culture, involving not only knowledge but convictions and practical readiness for actions in correspondence with the requirements of a responsible attitude to nature (Zverev, 1980), culture of attitude to nature, responsibility for rational use of natural resources and protection of natural environment from pollution and destruction in all forms of human activity (Kostova, Naidenova & Dodova, 1978). Environmental culture is divided into mental and material, social and individual, represented by mental and material values, regulating the relationships between society and nature (Kutov et al., 1984). The concept of environmental culture embraces a system of knowledge, environmental values, standards (norms) and regulations for the interaction of society and nature, skills and habits for learning and protecting nature and natural resources. Knowledge, skills, habits, values and deeds are considered as indicators of individuals' environmental culture and can be seen in their attitude to nature. The human environmental culture is a result of historical development of humanity (Kostova, 1985, p. 9).

Environmental culture has some features in common with environmental consciousness and environmental literacy. Sustainable development is a key concept for understanding environmental culture.[1)] In the history of environmental education the development of environmental culture has always been a priority goal (Kostova, 1995). Environmental literacy is defined as „functional literacy in the same sense that function – problem solving, community participation – is considered the operating principle of environmental education."[1)] Its core is built from the understanding of ecological principles and their application in everyday life. The latter contains the basic concepts of ecological science. Environmental literacy comprises of the integrating environmental concepts population growth, cycle of matter, flow of energy, self-regulation of ecosystems, biodiversity and environmentally responsible

behavior. Each integrating environmental concept is based on an ecological (natural) law and non-compliance leads to environmental problems. They are conceptualized at different levels – knowledge, understanding, application, analysis, synthesis and evaluation.

Environmental education and the development of environmental culture are issues of central significance to humanity[4,5] (Jacobson et al., 2006). This concept is also considered and analyzed in Turkey (Erdoğan, 2007; Atasoy, 2007) but a comparative study of environmental culture in respect to Turkey and Bulgaria has not been published yet.

Method

The sample of investigation of environmental culture includes two groups (T1 and T2) of students from two Turkish schools in Bursa and two groups (B1 and B2) of students from two Bulgarian schools in Sofia. The school Haznedaroglu Ozkan (T1) is representative of students with low social status „ whilst Ozel Chakar Ilkoretim Okulu (T2) represents students of higher social status. The two Bulgarian groups were also different: students in group B1 (17th Secondary school) had no specialized interest in biology whilst those in group B2 (National science and mathematical school) had a special interest in biology and had passed an entrance biology exam, choosing this area for future professional orientation. The participants from Turkey were 82, from which 36 in T1, and 46 in T2. From Bulgaria there were 92 participants, of which 40 in B1 and 52 in B2. The investigation took place during the 2005/2006 academic school year. It should be pointed out that the groups from both Bulgaria and Turkey are not representative for the countries as a whole and for this reason the results of this investigation cannot be used to make general conclusions about the environmental culture of all students. Our aim is not to compare the two countries but to compare samples T1 and T2 with respect to the social status of the students and B1 and B2 with regards to the students' interest in biology. And although the two groups from Turkey and Bulgaria are not identical they include students of the same age who study subjects with comparable contents. Therefore some data can be obtained about positive aspects and shortcomings of environmental education in the two countries.

Data collecting was done with a questionnaire, containing 40 terms from different areas (biology, geography, ecology, chemistry, nature conservation health and nutrition). These terms were chosen after careful anal-

ysis of the textbooks for sixth, seventh and eighth grades in Bulgaria and Turkey. The students were expected to have studied all of the chosen terms as they were included in their textbooks. The following criteria were used for selecting the terms:

- significance in the chosen area;
- relevance to the environment and to man's attitude to it;
- part of the students curricular;
- significance for further education in higher grades.

As a result of the content-analysis a concept map was created, showing the relations between concepts and building a conceptual system (Fig. 1).

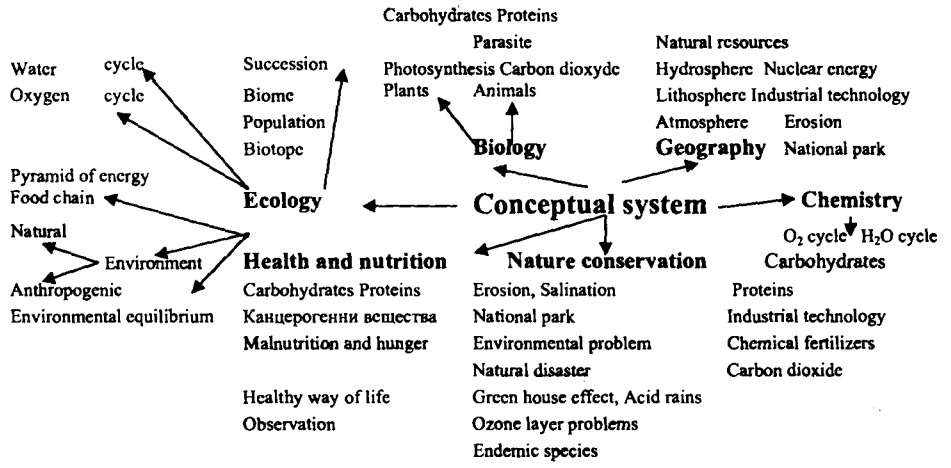

Figure 1. Structure of the conceptual system for investigating environmental culture of students

The following 11 ecology terms were selected: natural and anthropogenic environments, food chain, ecological pyramid of energy, cycles of oxygen and water, environmental equilibrium, biotope, population, biome, succession. They are connected with the structure and the processes in the biosphere.

Geography was represented by 8 terms: hydrosphere, lithosphere, atmosphere, natural resources, atomic energy, industrial technology, erosion, national park. They characterize the structure of the Earth`s crust and some consequences from the impact of society on nature.

Basic biological concepts were chosen – plants and animals, representing two kingdoms of living things, parasite, connected with biotic interactions, photosynthesis, a process at the basis of cycle of matter, carbohydrates

and proteins, substances that are formed in the process of photosynthesis and are decomposed in respiration, carbon dioxide, important in air pollution and in global climate change.

Chemical terms, chosen for the questionnaire included terms used in chemistry (cycle of oxygen and water), in biology (carbohydrates, proteins, carbon dioxide), in geography (industrial technology) and the term chemical fertilizers, related to scientific and ecological culture and playing a significant role in pollution. Physics was not represented if the term atomic energy and industrial technology, used in geography are not taken into account.

Nature conservation was represented by 12 terms – one from chemistry (chemical fertilizers) and two from geography (erosion, national park). The rest of the terms natural disaster, environmental problem, greenhouse effect, acid rains, ozone layer problems, salination, and endemic species refer to the consequences from unreasonable human activity, creating environmental problems and activities that are important for their solution – nature conservation and sustainable development.

Health problems are interlinked with environmental problems, since deterioration of the environment makes a direct and indirect negative impact on human health. Therefore six health-related terms were also included: two used in biology (carbohydrates and proteins), two related to negative consequences from deteriorated natural environment (cancer inducing substances) or social environment (undernourishment or hunger) and two referring to protecting and studying health (healthy way of life and observation). The fact that some of the terms were used in more than one scientific area shows their interdisciplinary character and their conceptualization in the process of studying more than one subject.

The method has already been used and validated in a number of previous studies (Georgieva, 1995; Kostova & Georgieva, 1997; Kostova, 2003 and many others), using the usual procedures, e.g. (Claus & Ebner, 1971). The validity of our survey instrument is 0.86, and the reliability is 0.77. The instrument was created in Bulgarian and adequately translated into Turkish by one of us (EA), a Bulgarian -Turkish bilungual.

The questionnaire included instructions with the tasks and a table with concepts. Three tasks were formulated: I) read every concept carefully and put a mark in one of the three columns of the table, which best describes your opinion – know, heard of, never heard of; II) choose five concepts that you know best and explain them; III) assess and evaluate your explanations, using a scale from one (lowest mark) to five (highest mark). The Table with

randomly arranged concepts from No 1 to No 40 was administered to every student (Table 1).

Table 1. A Model of the table in the questionnaire for studying students' knowledge

No	Terms	Know	Heard of	Never heard of
1	Natural environment			
....	.....	.....	.....	.....
40	Healthy way of life	.....	.....	.....

A separate worksheet with the tasks and the table of concepts was prepared for each student from the four groups. The testing of the students was carried out on a prearranged date for each school in the presence of on of us (EA). The environmental culture was assessed on three levels – lack of environmental culture (have not heard of) awareness (heard of) and understanding (know). The choice and the explanations of the terms were used as proofs of their conceptualization.

Assessment and evaluation of the explanations, given by students on their chosen concepts was done using criteria agreed upon prior to the test:

5 – complete and precise definitions, supported with adequate examples;

4 – incomplete definitions, supported with adequate examples;

3 – explanations using adequate examples without mistakes;

2 – from 3 to 4 examples, but with not more than one mistake;

1 – from 1 to 2 examples, but with not more than two mistakes;

0 – the concept is not chosen;

Each student wrote his name and the name of the school on the worksheet and also put a mark at the end of the paper, showing his level of evaluation.

The work sheets were collected and analyzed.

Results and interpretations

Self-evaluation of concepts according to the criteria "know, heard of, never heard of" (Table 2) shows that the variable T1 with a low social status and B1 with non-defined interests to biology have lower achievements from the variables T2 and B2.

Table 2. Evaluation of students' knowledge according to the criteria "know, heard of, never heard of"

Samples	Total number of terms		Know		Heard of		Never heard of	
	Number	%	Number	%	Number	%	Number	%
T1	1440	100	717	50	472	33	251	17
T2	1840	100	1159	63	447	24	234	13
B1	1590	100	1035	65,1	389	24,5	166	10,4
B2	2085	100	1415	67,9	472	22,6	198	9,5

Pearson's simple linear coefficient of correlation r of the two variables T1 and T2 in respect to the criterion "know" is + 0.90, which means high positive correlation. For the two variables B1 and B2 it is + 1.00, showing perfect positive correlation. The coefficient might be so high because it refers to the personal self-evaluation of students. They themselves decide whether they know or do not know each one of the given terms. For example 12.2% of students from Turkey and 32.6% of students from Bulgaria marked the term sustainable development as known, but no one attempted to explain it. The correlation coefficient was calculated using the equation of Pearson-Brave (Claus & Ebner, 1971).

The percentage of terms marked as "know" is much higher in all variables than the percentages of the other two criteria – "heard of" and "never heard of" but the variables T2 and B2 show much better results. In variable T1 8 terms were marked in the column know by 90% of the students, but in the variable T2 90% of the students marked 13 terms in the same column (Table 3).

Table 3. Terms, marked "known" by more than 90 % of the students in T1 and T2

T1		T2	
Terms	Percentage	Terms	Percentage
1. Natural environment	94	4. Atmosphere	96
6. Animals	100	6. Animals	98
7. Plants	100	7. Plants	98
10. Natural disaster	97	9. Food chain	93
12. Nature conservation	92	10. Natural disaster	98
24. Erosion	97	12. Nature conservation	98
26. Photosynthesis	92	14. Natural resources	93
40. Healthy way of life	94	24. Erosion	96
		26. Photosynthesis	96
		28. Proteins	91
		31. Observation	96
		34. Carbon dioxide	93
		40. Healthy way of life	91

Only one concept – natural environment in T1 is marked by a higher percentage of the students than in T2. Seven concepts – animals, plants, natural disaster, nature conservation, erosion, photosynthesis and healthy way of life, are marked by more than 90% of the students in T1 and T2 (Table 3). Probably they were dealt with equally in the teaching of the two groups, explaining the similarity in the students` results. More than 90 % of the students in B1 had marked 11 terms in the column "know", while those in B2 had marked 13 terms (Table 4).

Table 4. Terms, marked "known" by more than 90 % of the students in B1 and B2

B1		B2	
Terms	Percentage	Terms	Percentage
1. Natural environment	100	2. Hydrosphere	100
4. Atmosphere	95	4. Atmosphere	98,1
6. Animals	100	6. Animals	100
7. Plants	100	7. Plants	98,1
10. Natural disaster	97,5	9. Food chain	96,2
12. Nature conservation	95	10. Natural disaster	92,3
26. Photosynthesis	100	15. Population	90,2
29. National park	91,9	19. Parasite	100
31. Observation	92,3	25. Water cycle	94,2
34. Carbon dioxide	94,9	26. Photosynthesis	100
40. Healthy way of life	92,5	31. Observation	92,3
		34. Carbon dioxide	98
		40. Healthy way of life	96,2

The terms natural environment, nature conservation and national park are marked "know" by a higher percentage of B1 than B2 participants, the results most likely due to the more practically oriented teaching of B1 students. More than 90 % of B2 students marked five terms as "know" – hydrosphere, food chain, population, parasite, cycle of water. In our view this result means that teaching in this school is more academically oriented and these concepts received a greater attention. With regards to 8 terms the results between B1 and B2 are very similar. These concepts are: atmosphere, animals, plants, natural disaster, photosynthesis, observation, carbon dioxide, healthy way of life.

There is a coincidence between the four variables with respect to five terms – animals, plants, natural disaster, photosynthesis, healthy way of life. These concepts are very essential both for scientific and environmental cultures of students, though it is difficult to make a distinction between them as

scientific culture is fundamental for environmental culture. In the syllabuses of the two countries those concepts are dealt with adequately.

Bulgarian students had conceptualized better the terms from the realm of Nature conservation, as the mean of their highest achievements is 2.89, while Turkish students had better conceptualized the terms from the area of health and nutrition as the mean of their highest achievements is 1.84. Students were evaluated according to a five point scale from 1 (the lowest) to 5 (the highest) (Table 5).

Table 5. Comparative knowledge of students from Bulgaria and Turkey in science areas

Science area	Bulgaria			Turkey		
	B1	B2	Mean	T1	T2	Mean
Ecology	1,69	1,49	1,59	1,19	2,07	1,63
Geography	2,27	3,39	2,77	1,82	2,21	2,05
Biology	2,45	3,91	2,85	2,20	2,10	2,15
Chemistry	2,05	3,19	2,58	0,85	1,75	1,30
Nature conservation	2,61	3,46	2,89	1,18	2,00	1,59
Health and nutrition	1,97	3,27	2,62	1,88	1,80	1,84
Total mean			2,55			1,76

Bulgarian students achieved the lowest score in ecology (total mean 1.59), while those from Turkey, in chemistry (total mean 1.30). B1 had higher score than B2 in ecology, and T1 had higher score than T2 in health and nutrition, but the differences are not significant.

Pearson's simple linear coefficient of correlation r of T1 and T2 in respect to their assessment and evaluation by the researchers is + 0.41, which means positive correlation. For B1 and B2 it is + 0.82, showing positive correlation as well. Students with higher social status (Fig. 2) and students with distinct interest in biology learned more successfully and achieved better results (Fig. 3). Students both in T2 and B2 had better conditions for learning, not only with respect to better equipment and cozy classrooms but also better qualified teachers.

The mean number of terms for B1 and B2, evaluated with a mark 3 or higher (bearing in mind that the highest mark is 5) was twenty (half of the

checked terms). The mean number of terms for T1 and T2 was seven. On five concepts the students from the two countries showed high mean score: hydrosphere, natural disaster, parasite, acid rains, thinning of ozone layer. There is a coincidence between self-evaluation and evaluation only for one term – natural disaster. Students from T1 and T2 had better knowledge of the concepts anthropogenic environment and ecological pyramid of energy than students from B1 and B2. In contrast students from B1 and B2 showed better knowledge than T1 and T2 of the concepts: lithosphere, atmosphere, environmental problem, food chain, nature conservation, natural resources, greenhouse effect, water cycle, photosynthesis, proteins, national park, endemic species, undernourishment and starvation, healthy way of life (Table 6). The mean score of students' achievements in B1 and B2 is 2.52 and in T1 and T2 it is 1.83.

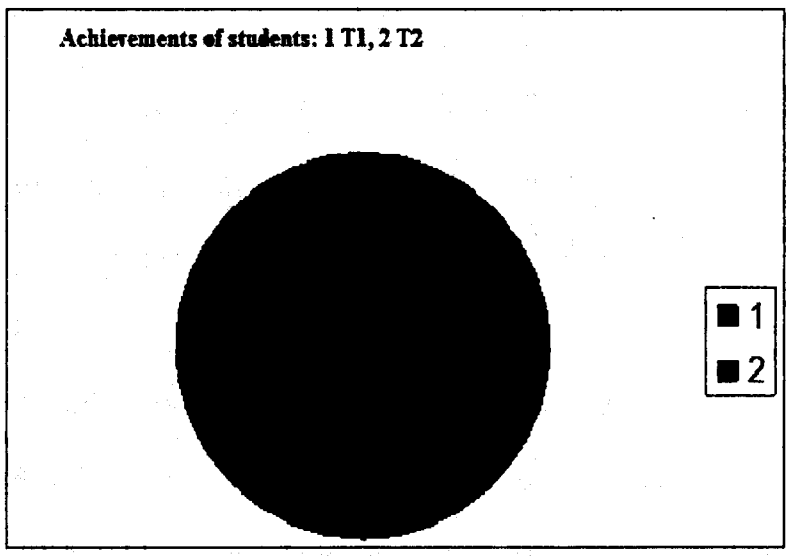

Figure 2. Achievements of students: 1. Achievements of students in T1 and 2. Achievements of students in T2

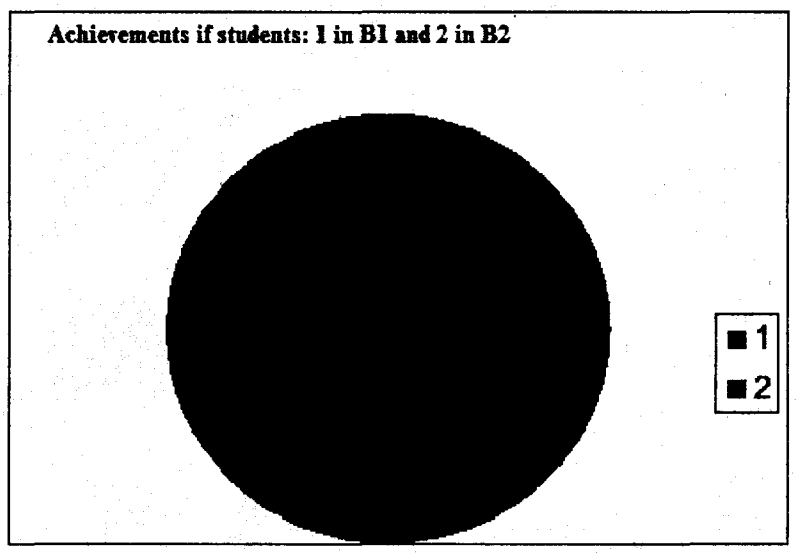

Figure 3. Achievements of students in B1 (1) and in B2 (2).

Table 6. Comparative knowledge of students from Bulgaria and Turkey

Number	Science areas and terms	Bulgaria			Turkey		
		B1	B2	Mean	T1	T2	Mean
I	**Ecology**	1,69	1,49	**1,59**	1,19	2,07	**1,63**
1	Natural environment	1,36	3,66	**2,51**	2,40	2,00	**2,20**
9	Food chain	2,00	4,25	**3,12**	2,00	3,30	**2,65**
11	Environmental equilibrium	1,00	0	**0,50**	1,70	2,00	**1,85**
13	Anthropogenic environment	3,00	0	**1,50**	3,00	3,00	**3,00**
15	Population	3,66	1,50	**2,58**	0	3,00	**1,50**
16	Biotope	0	2,00	**1,00**	0	0	**0**
17	Oxygen cycle	3,33	0	**1,66**	0	2,5	**1,25**
18	Biome	0	0	**0**	0	0	**0**
22	Pyramid of energy	0	0	**0**	2,00	4,00	**3,00**
23	Succession	0	0	**0**	0	0	**0**
25	Water cycle	4,33	5,00	**4,66**	2,00	3,00	**2,50**
II	**Geography**	2,27	3,39	**2,77**	1,82	2,21	**2,05**
2	Hydrosphere	4,60	4,20	**4,13**	3,00	3,50	**3,25**
3	Lithosphere	2,90	3,40	**3,15**	1,00	0	**0,50**
4	Atmosphere	4,00	4,32	**4,16**	2,3	3,00	**2,65**
14	Natural resources	3,00	4,00	**3,50**	2,70	2,70	**2,70**
36	Nuclear power	0	3,66	**1,63**	3,00	2,70	**2,85**
39	Industrial technologies	0	0	**0**	0	0	**0**
24	Erosion	1,66	3,60	**2,63**	2,60	2,50	**2,55**

29	National park	2,00	4,00	**3,00**	0	3,3	**1,65**
III	**Biology**	2,45	3,91	**2,85**	2,20	2,10	**2,15**
6	Animals	2,33	2,70	**2,51**	2,40	2,70	**2,55**
7	Plants	1,91	3,87	**2,89**	2,20	2,8	**2,5**
19	Parasite	**2,80**	**4,27**	**3,53**	4,50	2,60	**3,55**
26	Photosynthesis	**3,38**	**3,70**	**3,54**	2,40	3,00	**2,70**
21	Carbohydrates	**1,50**	**4,00**	**2,75**	0	2,00	**1,00**
34	Carbon dioxide	**3,75**	**3,83**	**3,54**	2,00	2,00	**2,00**
28	Proteins	**1,50**	**5,00**	**3,25**	2,00	0	**1,0**
IV	**Chemistry**	**2,05**	**3,19**	**2,58**	0,85	1,75	**1,30**
8	Chemical fertilizers	**0**	**4,50**	**2,25**	0	2,80	**1,40**
17	Oxygen cycle	**3,33**	**0**	**1,66**	0	2,50	**1,25**
21	Carbohydrates	**1,50**	**4,00**	**2,75**	0	2,00	**1,00**
25	Water cycle	**4,33**	5,00	**4,66**	2,00	3,00	**2,50**
28	Proteins	**1,50**	**5,00**	**3,25**	2,00	0	**1,00**
34	Carbon dioxide	**3,75**	**3,83**	**3,54**	2,00	2,00	**2,00**
39	Industrial ecologies	0	0	**0**	0	0	**0**
V	**Nature conservation**	2,61	3,46	**2,89**	1,18	2,00	**1,59**
5	Environmental problem	3,40	3,60	**3,50**	0	0	**0**
8	Chemical fertilizers	0	4,50	**2,25**	0	2,80	**1,40**
10	Natural disaster	3,12	4,00	**3,56**	3,50	3,60	**3,55**
12	Nature conservation	2,80	3,66	**3,23**	2,10	2,60	**2,35**
20	Green house effect	4,00	4,40	**4,20**	0	2,30	**1,15**
24	Erosion	1,66	3,60	**2,63**	2,60	2,50	**2,55**
27	Acid rains	3,00	5,00	**4,00**	3,00	3,30	**3,15**
29	National parks	2,00	4,00	**3,00**	0	3,3	**1,65**
30	Ozone layer problems	4,00	4,20	**4,10**	3,00	3,60	**3,30**
32	Endemic species	4,00	4,60	**4,30**	0	0	**0**
37	Sustainable development	0	0	**0**	0	0	**0**
38	Salination	0	0	**0**	0	0	**0**
VI	**Health and nutrition**	1,97	3,27	**2,62**	1,88	1,80	**1,84**
21	Carbohydrates	1,50	4,00	**2,75**	0	2,00	**1,00**
28	Proteins	1,50	5,00	**3,25**	2,00	0	**1,00**
33	Malnutrition and hunger	3,00	3,00	**3,00**	2,60	1,90	**2,25**
35	Cancerous substances	0	4,50	**2,25**	2,50	2,50	**2,50**
40	Healthy way of life	3,57	3,14	**3,35**	2,20	2,20	**2,20**
31	Observation	2,25	0	**1,12**	2,00	2,20	**2,10**
Total mean score		2,17	2,88	**2,52**	1,60	2,07	**1,83**

Pearson's simple linear coefficient of correlation r of T1 and T2 from one side and B1 and B2 from the other side in respect to their assessment and evaluation by the researchers is + 0.91, which means positive correlation.

The correspondence between the achievements of the students from Turkey and those from Bulgaria is very high.

Some terms were not chosen for explanation. Students from B1 did not choose 6 terms and students from T1 and T2 did not choose 8 terms. Five of these were common in both countries: biome, succession, sustainable development, salination (increasing soil salinity) and industrial technology. These concepts, though mentioned in the textbooks, are studied in greater details in higher grades of the secondary school – in 9th and 12th grades in Bulgaria. The concept sustainable development was marked in the column "know" by 11.5 % from T1 and T2 together and by 32.6 % from B1 and B2 together. Many students from Turkey (total mean for T1 and T2 = 46.5%) marked the same concept "heard of" and 42% marked it "never heard of". For Bulgaria the situation is the following: 42.4% "heard of" and 25 % "never heard of". This concept is leading in the international literature, especially after UN Summit in Rio de Janeiro in June 1992[6] and after UN Decade (2005 – 2014) for Education for sustainable development.[7] Eight grade students in both countries do not understand it.

The concept sustainable does not receive good explanation on empirical basis in teaching and textbooks and remains meaningless for students. The concept biome is introduced in the biology textbooks of seven grade students in Bulgaria. The geography textbooks use the term nature zone, which confuses students, because they do not perceive them as synonyms. The concept succession, though not very difficult for explanation, is difficult for students to understand even in the upper grades of secondary education. Salination is mentioned in geography textbooks, but is not explained very well and students` attention is not kept very long on it. It is connected with irrigation and cycle of water, has a practical value but does not stimulate students` understanding. The situation with industrial technology is the same. It is perceived as information but is not conceptualized.

B1 and B2 did not choose to explain the term ecological pyramid of energy, but T1 and T2 did not explain the concepts environmental problem, biotope and endemic species. The concept ecological pyramid of energy is mentioned in the textbooks, but is better dealt with in upper grades. Biotope and endemic species are also mentioned but are used exhaustively in next grades. Environmental problem is a concept with a very high degree of generalization and students found it difficult to define, but not so difficult to give examples.

The total mean score of T1 and T2 versus B1 and B2 (Fig. 4) on the six science areas shows the achievements of students in the four groups. The total mean score of students in the four groups is 3.05.

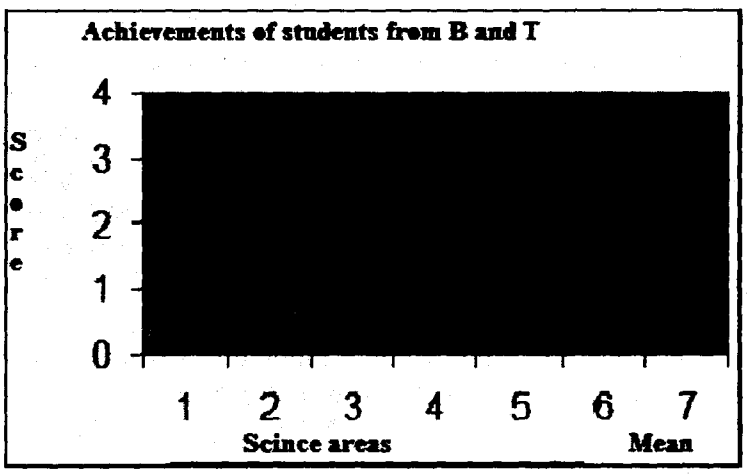

Figure 4. Achievements of students in science areas: Mean score for B1 and B2 as well as for T1 and T2. Science areas: 1. Ecology, 2. Geography, 3. Biology, 4. Chemistry, 5. Nature conservation, 6. Health and nutrition, 7. Total mean

The total number of students below the mean score is 80, but the total number of students at the mean score and above it is 94 (Table 7, Fig. 5).

Table 7. Comparative achievements of students from T1, T2, B1, B2. "A" horizontal – marks; "A" vertical – variables (samples of students); X – total mean score; Σ – sum of students

A	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	X
T1		4	3	2	4	4	2	5	8	1	-	1	2	-					2.42
T2		1	-	5	6	5	7	3	5	5	2	1	1	2	-	3			2.82
X																			**2.62**
B1	1	-	-	-	4	-	2	1	3	5	8	4	3	3	2	1	1	2	3.38
B2	-	-	-	1	1	1	-	-	3	2	5	4	4	12	3	7	6	4	3.61
X																			**3.49**
Σ	1	5	3	8	15	10	11	9	18	13	15	10	10	17	5	11	7	6	3.05

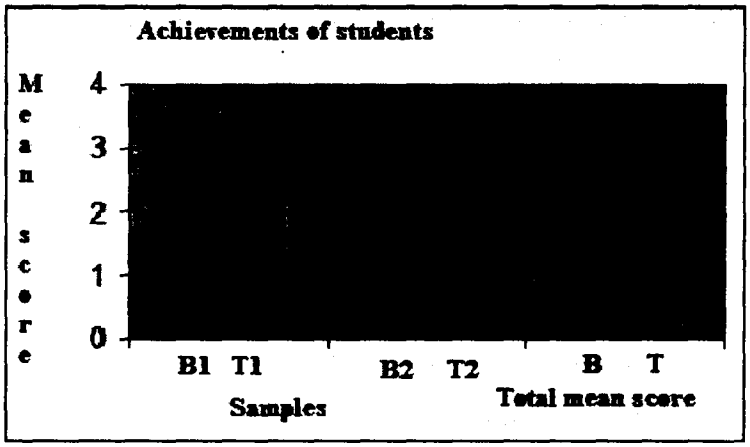

Figure 5. Achievements of students, based on their individual marks (score) on Table 7

The analysis of the explanations of concepts, given by students shows lack of theoretical rationalization, lack of skills for complete and precise wording, lack of good understanding of the word "know" (Table 8).

Table 8. Explanation of students of the chosen terms (B1 and B2)

No	Term	Brief characteristic of the answer	Mean score		Total mean
			B1	B2	
1	Natural environment	Everything around us not made by man; plants, animals, insects; the environment in which different species of animals and plants live; everything that surrounds us	1.36	3.66	2.51
2	Hydrosphere	Water envelope (water layer) of Earth, water basins; water basins and the organisms in them; water environment of life; all water basins; water part of Earth. *Mistake*: science of seas, oceans and rivers	4.06	4.20	4.13
3	Lithosphere	Hard envelope of the Earth, made of rocks; the rocky envelope of the Earth; the outermost layer of Earth; *Mistake:* stone layers of the Earth, the hard envelope inside the Earth globe; science of soils and rocks	2.90	3.40	3.15

4	Atmosphere	Air layer of the Earth; the uppermost layer of the Earth, made of gases and other substances; air envelope, air environment	4.32	4.00	4.16
5	Environmental problem	Affects ecology, natural environment, air, water around us; pollution, extinction of animals; affects the environment, flora, fauna, all ecosystems	3.40	3.60	3.50
6	Animals	Living things, feed, breathe, feel: bear, lion, dog; carnivorous and herbivorous; examples only: living, multicellular, man is a mammal; dependent nutrition, move; kingdom to which they belong; fauna, move; *Mistake*: All living things on Earth	2.33	2.70	2.51
7	Plants	Have root, stem, twig, flower; part of the environment essential for man; living, independent nutrition, examples: bushes, trees; cleaning air; photosynthesize, need water, mineral salts, soil, do not move actively; kingdom in hierarchy of nature; flora, indispensable for life, poplar	1.91	3.87	2.89
8	Chemical fertilizers	Used for soil enrichment to make it fertile; if often used they destroy it	0	4.50	2.25
9	Food chain	The stronger eats the weaker; grass → gazelle; Producers, consumers, reducers	2.00	4.25	3.12
10	Natural disaster	Earthquakes. Fires, hurricanes, floods, volcanoes, very bad, harmful, nature is above man, created by nature and bring misfortune	3.12	4.00	3.56
11	Environmental equilibrium	Made from natural products; balance in nature	1.00	0	0.50
12	Nature conservation	Protection and care of nature; protection from pollution and from extinction of species; protection of plants; plants should not be cut	2.80	3.66	3.23
13	Anthropogenic environment	Human activities that have negative influence on environment. Positive influences not mentioned	3.00	0	1.50
14	Natural resources	Obtained from Earth: crude oil, gold, coal; all oars and minerals and the living nature	3.00	4.00	3.50

15	Population	Inhabitants of a country; groups of individuals from one and the same species that interbreed and have a fertile offspring; breed and create offspring; striving to have offspring	3.66	1.50	2.58
16	Biotope	All non-living conditions, including climatic; *Mistake*: living organisms and the environment they live in	0	2.00	1.00
17	Oxygen cycle	In the atmosphere, we breathe it in and breathe out CO_2, constituent of compounds	3.33	0	1.66
18	Biome		0	0	0
19	Parasite	Harmful living thing, ticks; organism living on the expense of another organism; animal that lives on another animal; ecto- and endoparasites; *Mistake*: harmful animal, feeds on dead organisms	2.80	4.27	3.53
20	Green house effect	Over-warming of the planet, too much CO_2 is the cause	4.00	4.40	4.20
21	Carbohydrates	Useful for the human organism; nutritive substances, sources of energy	1.50	4.00	2.75
22	Pyramid of energy				
23	Succession				
24	Erosion	Destruction of rocks, soil destruction; action of water on stones and rocks; deterioration, chemical elements diminish	1.66	3.60	2.63
25	Water cycle	Evaporation, clouds, collision, rain; evaporation from water basins, sun, rain	4.33	5.00	4.66
26	Photosynthesis	Solar energy in nutritive substances; green plants transform CO_2 into O_2 ; independent nutrition – from inorganic substances built organic; utilize solar energy in order to feed; *Mistake*: independent nutrition of animals; from organic produce inorganic	3.38	3.70	3.54
27	Acid rains	Rains that dissolve harmful gases in the atmosphere	3.00	5.00	4.00
28	Proteins	Supplements, give strength, make the immune system stronger; nutritive substances made from amino acids, building materials, enzymes, in every cell	1.50	5.00	3.25

29	National park	Park with plants for walking; Tsar Boris` garden in Sofia, world parks, national and biosphere parks	2.00	4.00	3.00
30	Ozone layer problems	Harmful gases destroy ozone layer that protects us from UV rays; Destruction of ozone layer; holes, freons	4.00	4.20	4.1
31	Observation	Studying, investigations, observation of different objects	2.25	0	1.12
32	Endemic species	Lives in definite areas, small ecological plasticity	4.00	4.60	4.30
33	Malnutrition and hunger	Lack of food, lack of feeding, insufficient nutrition, total lack of food.	3.00	3.00	3.00
34	Carbon dioxide	Animals breathe out, plants produce oxygen; It is a compound of oxygen and carbon; gas important for plants and photosynthesis, in atmosphere 0.03%; breathed out by lungs; Mistake: chemical elements in photosynthesis	3.75	3.83	3.54
35	Cancerous substances	Cause cancer;	0	4.50	2.25
36	Nuclear power	Energy given off in nuclear decay; positive helian particles are given off	0	3.66	1.83
37	Sustainable development				
38	Salination				
39	Industrial technologies				
40	Healthy way of life	Right way of life, healthy organism, good physical state, personal hygiene, healthy nutrition, no smoking and drinking, contraceptives; no venereal diseases, nutrition without harmful substances; food with vitamins, vitamins and soup; vitamins, proteins, mineral substances; sport, food, clean air	3.57	3.14	3.35

A small percentage of the students had given full explanations with clear definitions and examples. This applies to the concepts population, photosynthesis, proteins, ozone layer problems, endemic species, nuclear energy, healthy way of life. The majority of the given definitions are incomplete and not precise: natural environment, hydrosphere, plants, anthropo-

genic environment, oxygen cycle, acid rains and others. Most of the students gave only examples instead of definitions in order to explain the terms animals, chemical fertilizers, food chain, natural disaster, nature conservation, parasite, water cycle etc. Most of the concepts were explained on empirical level, based on everyday observations and the media: lithosphere, green house effect, national park, ozone layer problems etc. Knowledge was not conceptualized theoretically and was mainly schematic. Students had ideas about corresponding concepts (green house effect, endemic species, cancer causing substances), expressed themselves generally, not having in mind a particular situation, (endemic species). To a number of concepts they did not provide scientific explanations (atmosphere, environmental problem, chemical fertilizers, natural resources, carbohydrates, erosion, etc.) or gave explanation from their life experiences. Students made some serious mistakes, as illustrated by several examples. Lithosphere was explained using the words "stone layers of the Earth globe" or "the solid sphere in the interior of the Earth globe" and in this way it was mixed with the core of the Earth or with the branch of science, "studying soils and rocks". Some students understood the concept animals as "all organisms on the Earth" and forgot about plants and other living kingdoms", although they had already studied them in the fifth and the seventh grades. Biotope was mixed with ecosystem "living organisms and the environment they live in". The concept environmental equilibrium was not understood – neither empirically no theoretically, wrong explanation was given to photosynthesis – „independent nutrition of animals" or „from organic substances are built inorganic". The concept national park was not distinguished from reservation and examples were not given. The concept carbon dioxide was wrongly explained by some students as "a chemical element in photosynthesis". Methods of science were not understood – observation was explained with the words investigation, studying as associations.

In respect to evaluation and self-evaluation students from T1 had overestimated themselves with the exception of one student, who had underestimated their achievement. In T2 group three students estimated their achievements objectively, 10 students underestimated themselves and the rest of them (33 students) – overestimated themselves. In B1 objective self-evaluation was done by 14 students, 23 overestimated themselves and 3 underestimated themselves. In B2 objective self-evaluation was achieved by 23 students, overestimation by 17 and underestimation by 12. Very few students can evaluate themselves objectively. The higher the students` knowledge, the more objective their evaluation was. Students were not taught how to

self-analyze their achievements, how to be self-critical and how to practice self-reflection.

Students` work and behavior in the course of the investigative procedure were very serious. They tried to answer the questions to the best of their abilities.

Conclusions

1. Environmental culture is at the core of modern human culture and a fundamental factor for changing environmental behavior. The students' textbooks in Bulgaria and Turkey explain an adequate set of environmental terms, but that is not enough to insure proper development of environmental culture. The system of terms modifies behavior of students when it is conceptualized at the level of evaluation, when the students have not only heard of them but also know them, understand them, use them in their everyday life.

2. Students have acquired half of the standard requirements for environmental culture. The mean value of the obtained results shows that students have reached the middle level of state environmental standards in environmental education. Few students, especially from B2 and T2 have reached the upper level of environmental culture. Students, who enjoyed high living standards, experienced better learning conditions and reached higher scores of achievements. Students with low social standards learned less effectively and achieved low results.

3. Students that had passed an entrance exam in biology, were better motivated in learning, obtained higher scores and showed higher level of environmental culture. Their achievements were more academic than the achievements of students from ordinary schools. The entrance exams helped students acquire objective ways of self-evaluations and become more self-exacting.

4. Students make some mistakes concerning environmental concept learning: do not formulate right definitions ("air covering of water" or "air environment" for atmosphere), cannot give adequate examples, confuse the meaning of some terms (hydrosphere with hydrology), exchange one concept with another (lithosphere with magma), use wrong terms to explain a key concept ("CO_2 is a chemical element in photosynthesis"). Very often they give childish explanations from their everyday life experiences or from media advertisements which misuse scientific terms ("proteins are food supplements"). Some explanations are merely translations of the scientific

term (usually Greek, Latin, or English) into their mother tongues (Turkish or Bulgarian). Theoretical knowledge is inadequate.

5. The scientific language of students is not systematically developed as most of the assessment is done by multiple choice questions that do not require construction of sentences. The development of students' thinking abilities is not at the centre of teaching and students find difficulties in structuring their answers. Furthermore they do not fully understand the meaning of the terms "know" and "explain".

6. Students have not developed real and objective self-evaluation, which is closely connected with critical thinking and self-reflection. Most of the students did not reflect critically upon their knowledge, did not analyze their achievements against their goals and personal endeavors. Environmental culture of students has been developed on second level, i.e. understanding and requires further development to reach higher levels.

7. Research on environmental culture of eight grade students from the two countries provides the possibility to find out misunderstandings and shortcomings and to correct them before they have become mistaken knowledge.

8. The system of environmental and science concepts in textbooks was well chosen and structured but probably students activities and the allocated time for its conceptualization was not adequate otherwise students should not have made so many mistakes. Besides, modern concepts such as sustainable development do not receive proper explanation and proper practical application. Students could not understand and conceptualize them. In Bulgarian the term stable development is commonly used, which is not synonymous with sustainable development. Besides, there are neither enough adequate examples of sustainable use of natural resources, nor measures against pollution, especially in Bulgaria.

9. Development of environmental culture is a long complex and difficult process, which requires innovative methods of teaching and regular feedback about the level of students' environmental culture. Learning may become successful if concepts are structured using new techniques (intellectual maps for example), innovative methods for increasing students' cognitive activities, introducing theoretical explanations earlier in the elementary school, organizing practical activity in the open for students to care about the environment. Better attention is necessary to key concepts.

Further investigations on this problem are necessary, requiring development of new teaching and learning models, using new methods of studying perception and conceptualization of environmental concepts by students, experimenting with improved and better structured system of environmental

concepts for development of environmental culture, consciousness and behavior.

The results of the current study have identified students' shortcomings and misunderstandings and will be helpful in improving education in science and ecology in the upper classes of secondary school and for improving environmental education of students in elementary school.

Notes

[1] Environmental Literacy for All. Connect (UNESCO), Vol. XIX, No. 2, 1989.

[2] Erdoğan, M., & Marcinkowski, T. (2007). Results of an analysis of K-8 environmental education research in Turkey, 1997-2007. 34th North American Association for Environmental Education Annual Conference and Research Symposium, Virginia Beach, USA, 13–14, November, 2007.

[3] Susuki, K., Futagami, T, Ogura, S., Hara, M., Ohkawa, T., Yasui, I. Change in Environmental Consciousness and Behavior Led by Information http://www.yasuienv.net/CREST/l_list/1128.pdf

[4] Understanding Environmental Literacy in America and Making it a Reality, Three-year Report 2002, 2003, 2004. Environmental Education and Training Foundation (2005) http://www.neefusa.org/pdf/NEETF_2002-04_Report.pdf

[5] National Environmental Literacy Assessment. http://www.naaee.org/programs-and-initiatives/research.htm.

[6] The Earth Summit. Connect (UNESCO), Vol. XVII, No. 2, 1992.

[7] UNESCO and the International Decade of Education for Sustainable Development (2005 – 2015). Connect (UNESCO), Vol. XXVIII, No. 1-2, 2003.

References

Atasoy, E. (2005). Çevre bilinci ve çevre için eğitim, "Kaygı" dergisi, Sayı 5, Bursa, p. 109–131.

Ballontyne, R., Packer, J., Hughes, K. & Dierking, L. (2007) Conservation learning in wild tourism settings: lessons from research in Zoos and Aquariums. Environmental Education Research, 13, 367–383.

Chawla, L., Cushing, D. F. (2007). Education for strategic environmental behavior. Environmental Education Research. 13, 437–452

Claus, G., Ebner, H. (1971) Basic statistics for psychologists, sociologists and pedagogues. Sofia: Nauka i izkustvo [In Bulgarian, translated from German].

David, M. E. (2007) Changing the educational climate: children, citizenship and learning contexts? Environmental Education Research. 13, 425–436.

Erdoğan, M. (2007). An analysis of newly developed fourth and fifth grade science and technology course curriculum; A qualitative study. Gazi Universitesi, Turk Egitim Bilimleri Dergisi. 5, 221–259.

Georgieva, E. (1995). Integration between science, technology and society in students' knowledge. Pedagogika, 3(12), 65–73 [In Bulgarian].

Hart, P., & Nolan, K. (1999). A critical analysis of research in environmental education. Studies in Science Education, 34, 1–70.

Hicks, D. & Holden, C. (2007) Remembering the future: what do children think? Environmental Education Research, 13, 501–512.

Hines, J., Hungerford, H., & Tomera, A. (1986). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. J. Environ. Educ., 18 (2), 1–8.

Jacobson, S. K., McDuff, M.D. & Monroe, M. C. (2006). Conservation Education and Outreach Techniques (Techniques in Ecology and Conservation). Oxford: Oxford University Press.

Kostova, Z., Naidenova, L., & Dodova, M. (1978) A system of nature conservation concepts in education. Sofia: National Institute on Education [In Bulgarian].

Kostova, Z. (1985). Environmental education in the secondary school. Sofia: Narodna Prosveta [In Bulgarian].

Kostova, Z. (1995). Environmental Education in Bulgaria. Pedagogika, 3(12), 53–64.

Kostova, Z. (2003). Conceptualization of environmental education. Veliko Tirnovo: Faber.

Kostova, Z. & Georgieva, E. (1997). Six graders' understandings of science – technology – society integration (a case study in Bulgaria). In: W. Stawinski &. R.M. Janiuk (Eds.) Science and Technology Education for Social and Economic Development (pp. 68–70). Lublin: Maria Curie-Sklodowska University Press.

Katov, A. & Kostova, Z. (Eds.). (1984). Dictionary of Ecology and Environmental Protection. Sofia: Partizdat.

Lundmark, C. The new ecological paradigm revisited: anchoring the NEP scale in environmental ethics. Environmental Education Research, 13, 329–347.

Meyers, R.B., Brody, M., Dillon, J., Hart, P., Krasny, M., Monroe, M., Russell, C. & Wals, A. (2007) Towards creating an inclusive community of researches: the first three years of the North American Association for Environmental Education research symposium. Environmental Education Research, 13, 639–661.

Malone, K. (2007) The bubble-wrap generation: children growing up in walled gardens. Environmental Education Research, 13, 513–527.

Schmieder, A. A. (1977). The nature and philosophy of environmental education: goals and objectives. In: Trends in Environmental Education. New York: UNIPUB.

Stapp, W., Bennett, D., Bryan, W., Fulton. J., MacGregor, J., Nowak, P., Wan, J., Wall, R. & Havlick, S. (1969) The concept of environmental education. J. Environ. Educ., 1, 30–31.

Stawinski, W. (2000) Influence of environmental education and Challenges of environmental conservation on humans daily life. In: M. Golebiowski, M. (Ed). Human Being in Environment (pp. 271–280), Szczecin:Universytet Szczecinski.

Zverev, I. D. (1980). Ecology in school education. Moskwa: Znanie, Pedagogy and Psychology [In Russian].

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