

Components of Environmental Literacy in Elementary Science Education Curriculum in Bulgaria and Turkey

Mehmet Erdoğan

University of Akdeniz, Antalya, TURKIYE

Zdravka Kostova

Kliment Ohridski University, Sofia, BULGARIA

Thomas Marcinkowski

Florida Institute of Technology, Melbourne, FL, USA

Received 05 December 2007; accepted 17 August 2008

The purpose of this study was to analyze the extent to which science education objectives in elementary schools addressed to the six basic components of environmental literacy (EL), and how this attention differed from Bulgaria to Turkey. The main method in the study involved comparative content analysis of these objectives. The courses sampled for Bulgaria include “The Human Being and Nature”, “Biology and Health Education”, “Chemistry and Environmental Protection” and “Physics and Astronomy”. The course sampled for Turkey is “Science and Technology Education”. Content analysis of these objectives reveals that all components of environmental literacy did not receive the same attention. For example in both countries most attention was given to knowledge, less to skills and attitudes, and little to environmentally responsible behavior (ERB).

Keywords: Bulgaria, Turkey, Environmental Literacy, Environmental Education, Science Education Objectives

INTRODUCTION

One of the priorities of the European Union is to ensure the sustainability of the environment by taking the necessary precautions and raising public awareness (UNECE Strategy, 2005). Efforts to overcome continuous environmental degradation and establish sustainable development around Europe and other continents can be advanced by providing citizens of all

ages with opportunities to become more environmentally informed, committed and active, and thus more environmentally literate. Implementation of environmental education in elementary school depends on both school curricula and teachers' environmental competencies. It can be argued that the foundations of consistent environmental literacy are emphasized in elementary schools mainly through science education.

Components of Environmental Literacy (EL)

Environmental literacy (EL) is an evolving concept in the developing world literature. Even though this concept was dealt with by many scholars (e.g. Hungerford, Volk, Tomera, Marcinkowski, McBeth, and Simmons) in the area of environmental education (EE),

*Correspondence to: Mehmet Erdoğan,
PhD in Curriculum & Instruction,
Akdeniz Üniversitesi, Eğitim Fakültesi, 07058
Antalya, TURKEY
E-mail: mehmederdogan@yahoo.com*

this concept still has been conceived as wrong by some others and needs to be conceptualized and even contextualized. This concept and its components are apparent in definitions and frameworks (Stapp et al., 1969; Harvey, 1977; Schmeider, 1977; Disinger, 1983; Hungerford & Volk, 1990; Simmons, 1995), sets of goals and objectives (Unesco, 1977, 1978; Hungerford, Peyton, & Wilke, 1980; United Nations, 1992), other reviews of the professional literature (Hart, 1981), and collections and reviews of research (Iozzi, 1981, 1984; Hines, Hungerford, & Tomera, 1986/87; Marcinkowski & Mrazek, 1996; Volk & McBeth, 1997; Hart & Nolan, 1999; Erdogan & Marcinkowski, 2007a, 2007b). Some authors think EL marginal in EE (Staples & Bishop, 2001) and discuss it as functional, cultural and critical (Stables, 1998), others regard it as a predictor to environmentally responsible behavior (ERB) (Hsu & Roth, 1998). Still others think its implementation in primary school problematic because of inadequate EL of teachers (Makenzie & Smith, 2003). Recent publications show a great interest in EL and EE. Some authors point out their inseparable relations with environmental ethics (Lundmark, 2007) and stress the importance of action competence (Lundegard & Wickman, 2007), or a personal sense of competence and a sense of collective competence (Chawla & Cushing, 2007). Others notice the growing interest of children in exploring alternative futures and see the need for a future perspective in education (Hicks & Holden, 2007) or engaging students emotionally in non-captive wildlife tourism and suggestions for future research (Ballontyne et al., 2007). The brief analysis shows that EL is at the center of environmental education research and that it can be used in assessing school curricula.

Some of the difficulties in the analysis are due to the different terms and understandings about one and the same thing in EE. The term EL is seldom used in Bulgaria and other East European countries where scientists prefer to use the concepts of environmental education and environmental culture, consciousness and behavior as its outcomes (Kostova, 1978, 2003; Kutov & Kostova, 1984). Likewise, this term was not used in Turkish professional literature until recent days. Instead, EE, environmental consciousness, behavior, knowledge and attitudes were preferred. Parallel to growing EE and EL literature in USA and also in Europe, the concept of EL has appeared recently in some research studies (e.g. Erdogan & Erentay, 2007; Erdogan & Marcinkowski, 2007a, 2007b) done in the context of Turkey.

Literacy means basic knowledge in a given area (Andreichin, 1976), ability to read and write (The Concise Oxford Dictionary, 1964, p. 709), having the necessary knowledge and information in a certain field or any deeds, fulfilled without mistakes (Ojegov, 1981, p.128). Consequently, EL is defined as “basic functional education for all people, which provides them with the

elementary knowledge, skills and motives to cope with environmental needs and contribute to sustainable development. Environmental literacy is conceived as “functional literacy” (UNESCO, 1989). Roth (1992) believed that EL is beyond the certain cognitive skills and the basic definition of literacy – ability to read and write. He claimed that “*Environmental literacy builds on an ecological paradigm. Environmental literacy is the capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems* (p. 17)”. EL in its totality seems to comprise the same elements as environmental culture, consciousness and behavior taken together.

Based upon an evolving understanding of EL, we assume that EL includes six main components; *namely*, Ecological knowledge, Socio-Political knowledge, Knowledge of environmental issues, Affect, Cognitive skills and Environmentally responsible behaviors (Simmons, 1995; Volk & McBeth, 1997). On the bases of these authors' contributions the components of EL can be described as following:

Ecological knowledge refers to the knowledge and understanding of major ecological concepts, principles and theories as well as knowledge and understanding of how natural systems work and how they interact with social systems.

Socio-Political knowledge includes an understanding of the relationship between beliefs, political systems, and environmental values of various cultures. Socio-political knowledge also includes an understanding of how human cultural activities (e.g. religious, economic, political, social and other) influence the environment from an ecological perspective. Also included within this category is knowledge related to citizen participation in issue resolution. It is often referred to as cultural literacy comprising knowledge of environmental action strategies.

Knowledge of environmental issues includes an understanding of environmental problems/issues caused as a result of human interaction with the environment. Also included within this category is knowledge and understanding, related to alternative solutions to issues and to major sources of environmental information.

Affect refers to factors within individuals which allow them to reflect on the environmental problems/issues at the interpersonal level and to act on them if they judge the issue/problem warrants action. It is expressed in the intention to act.

Additional determinants of environmentally responsible behavior include locus of control and the assumption of personal responsibility.

Cognitive skills are those abilities required to analyze, synthesize and evaluate information about environmental problems/issues and to evaluate a selected problem/issue on the basis of evidence and

personal values. This category also includes those abilities necessary for selecting appropriate environmental action strategies, and for creating, evaluating and implementing an action plan. It is the action competence as a major constituent of functional EL.

Environmentally responsible behaviors include active and considered participation aimed at solving problems and resolving issues. Categories of environmentally responsible actions are persuasion, economic and consumer action, eco-management, political and legal action (Volk & McBeth, 1997, pp. 8-9) accompanied by strong conviction of personal commitment and responsibility.

For the purpose of this analysis, we broke these six components into forty sub-components (Babulski, Gannett, Myers, Peppel, & Williams, 1999; Erdogan & Marcinkowski, 2007a, 2007b) which were used as criteria in the analysis of the status of EL in the elementary schools of Bulgaria and Turkey.

Bulgarian Context / Case

Environmental Literacy (as an outcome of EE) was introduced into the science education curriculum and textbooks for the 9th grade of the Secondary school in Bulgaria in 1967 through a new topic “The organism and its environment,” and since then it has always been a part of the compulsory education (Kostova, 1995). Ecological and nature conservation concepts were introduced in the school subjects “Knowledge of the Fatherland” (1st to 3rd grade) and “Nature study” (4th grade) in 1972. EE topics are present in the programs and science textbooks from 1st to 12th grades nowadays. One key goal in the grades from 5th to 8th is “to develop attitudes towards the living place, the role and the responsibility of everyone towards society, nature and its protection” (Revised school programs, 2003). From 1972 to 1992 the development of theory and practice of EE, including curricula, textbooks and teachers’ guides, was under the guidance of a specialized research team. At present with the development of State Educational Standards and the implementation of new curricula, the EL is receiving a greater attention in the so called Cultural educational area (KOO in Bulgarian) “Natural sciences and ecology” from 3rd to 12th grades of the Secondary education.

Turkish Context / Case

Environmental Literacy, which is assumed to be the major outcome of environmental education (Stapp et al., 1969; Harvey, 1977), seems to have been somehow neglected in Turkey for several years. Environmental and nature-related concepts were not sufficiently incorporated in the natural studies, agriculture, and life

sciences until 1960s. In line with the trends and developments in the USA and Europe, topics pertaining to environmental education were more introduced into school curricula. For example, elementary school science curricula that paid much greater emphases on environmental related concepts/topics were developed in 1992 and 2000 respectively. It merits due recognition and appreciation that this has been receiving greater attention with the initiation of a new Science and Technology Curriculum for elementary schools in 2004-2005 academic year. This curriculum is different from the previous ones in that the dimensions of technology and environment have been added to and integrated with the science dimension. One of the key goals of this curriculum is to develop environmental awareness and consciousness (Erdogan, 2007), and increase scientific process skills of students (Ozgelen & Yilmaz-Tuzun, 2007).

Rationale and Purpose of the Study

Bulgaria has just become a member of the European Union (EU). One of the hot topic and requirements of EU is to develop understanding for sustainable development as well as to develop responsible citizens for the quality of the environment. The main topic of environment is like an umbrella covering other related topics such as sustainable development, environmental education, environmental literacy and ... so on. On the other hand, Turkey is a candidate country for EU and still in the adaptation process to EU. Considering this priority of EU, both countries have been undertaking protection measures and steps to take care of this broad concept. This can be observed in national policy, school curricula, and vision of NGOs in both countries. This study only focuses on one part of this umbrella; *environmental literacy and its components and how they are represented in the implemented school curricula from 4th to 8th grades*. In this study, only science education curriculum was considered, because it was believed that the subjects of the science curriculum give much more scientific bases of EL than the other curriculum (e.g. social sciences, math...etc).

The purpose of this study was to analyze the extent to which science education objectives in elementary schools include attention to the six basic components of environmental literacy (EL) in both Bulgaria and Turkey, to compare how this level of attention may differ from Bulgaria to Turkey and how the results can be used in improving the contemporary situation.

METHOD

The design of study was content analysis, one of the common methods of qualitative research. This study covers the comparative analysis of four curriculum

Table 1. Text books selected from both countries for the study and their characteristics

Country	Name of the courses selected	Characteristics of the selected curriculum / textbooks
Bulgaria	The Human Being and Nature 3 rd to 6 th grade.	Up to now the course is developed and introduced in 3 rd to 6 th grades. Three different versions of textbooks for each grade were approved and implemented in schools by the Ministry of Education and science. 6 th grade textbooks are under first year trial.
	Biology and Health Education 7 th to 8 th grade	The program is ready, but the textbooks (three versions) are under preparation and will be introduced successively in the next two school years. The current textbooks are named biology.
	Chemistry and Environmental Protection 7 th to 8 th grade	The program is ready, but the textbooks (also three versions) are under preparation and will be introduced the next two school years. The current textbooks use the name chemistry.
	Physics and Astronomy 7 th to 8 th grade	The program is ready, but the textbooks (three versions) are under preparation and will be introduced the next two school years. The current textbooks are physics.
Turkey	Science and Technology Education 4 th to 8 th	The program was developed and piloted with elementary schools in 2004, disseminated in following years gradually. It is for the students who are in 4 th to 8 th grade. The name of this course was science education before 2004. Three different versions of textbooks for each grade were approved and implemented in schools by the Ministry of Education. The name of the text books are Science and Technology – 4, - 5, - 6, - 7 and - 8.

guide books for 3rd to 8th grade in Bulgaria and one curriculum guide book for 4th to 8th grade in Turkey.

Selected Textbooks

Five curriculum guide-books used in obligatory science courses in elementary schools in both countries were selected for this analysis. Of these, four were from Bulgarian elementary schools, integrated in the Cultural Education Area (CEA) “Natural Sciences and Ecology” and the other one was from Turkish elementary schools. In Turkey, there are some others course in which EL components are implicitly stated, such as life science course for 1st to 3rd grade, social science course for 4th to 8th grades, and agriculture course (elective course), although only a science education course was selected because of its meeting the purpose of the study. The name and characteristics of the selected books are illustrated in table 1.

Whereas the courses selected from Bulgaria cover 3rd to 8th grades, the course from Turkey covers 4th to 8th grades. Lower level courses were not considered because of their irrelevance to the study.

In Bulgaria, the course “*The Human Being and Nature*” is only introduced to 3rd and 6th grade students and comprises three parts: 1st part Physical phenomena, 2nd part Substances and their properties and 3rd part Structure and life processes of organisms. The other three science-related courses (biology, chemistry and physics) are introduced from 7th to 8th grades. The new

curriculum guide books and the corresponding textbooks from 3rd to 6th grades are already prepared and introduced, but from 7th to 8th grades students use old textbooks and guides introduced in 1998-2000 school years. On the other hand, there is only one obligatory course related to science education in elementary level in Turkey. The course titled “*Science and Technology Education*” was designed in 2004, piloted in 120 elementary schools in 2004-2005 academic year and then disseminated to all Turkish schools in following years (Erdoğan, 2007). The course for 4th to 8th grades includes several topics pertaining to chemistry, biology, physics and the natural environment. The units in this course are categorized under four learning domains; (1) Living Organism and Life, (2) Matter and Change, (3) Physical Events and (4) Earth and Universe.

Content Analysis of the Textbooks

The selected curriculum guide books were subjected to content analysis. First, the objectives, which are called attainments in 2004 Turkish elementary school curriculum, and standards and expected results in the Bulgarian curriculum, were retrieved from the selected guides. A table including six components of EL (affect and additional determinants of ERB were combined for this analysis since their nature seems to be similar) and forty sub-components of EL was constructed for comparative analysis.

Table 2. Environmental Related Concepts – Topics in Selected Courses in *Bulgaria*

Grade	Name of the Course	Grade	Name of the Courses		
	The Human being and Nature		Biology and Health Education	Chemistry and Environmental Protection	Physics and Astronomy
4 th grade	Substances (properties), bodies and organisms, movement and energy, earth (natural resources, soil, ores, minerals, fuels) , moon, sun, solar energy, natural phenomena and processes, life processes of plants and animals, adaptation, biodiversity, health, hygiene, contagious diseases, harmful substances, environmental damage and protection (air, water and soil protection from pollution)	7 th grade	Biodiversity, classification and protection of organisms (e.g. prokaryota, protoktista, plants, fungi and invertebrate animals), extinct and threatened species from each taxa, the relationship among organisms, environment and human beings and their activity.	Classification, structure, properties and application of substances, chemical processes in nature, everyday life and in production (technology), useful and harmful chemical processes for man and nature, solving pollution problems, security in the chemical laboratory, harmful effects of chlorus, acids, freons, thermal effect, corrosion.	Electrical energy, light, sound, noise pollution and its negative effects, movement and forces, from the atom to the Cosmos, biological effects of ionizing radiation, cognitive interest, environmental consciousness.
5 th grade	Energy, classification of substances, purification of water, purifying stations, clean and polluted air, chemical processes, structure, living processes and classification of organisms, cellular structure, biodiversity, nutrition, respiration and excretion in plants and animals comparatively and in the human being, interdependence and hygiene of those three processes.	8 th grade	Classification of organisms continues with vertebrate animals, extinct and threatened species from the different taxa, structure and functions of the human body, health and hygiene, interaction of organism and environment, unity of organisms and environment, the human being in nature	Structure, properties and application of substances, organic and inorganic substances, chemical elements, water purification, first aid, sources of acid rains and its effects, environmental problems, pollution with gaseous emissions, heavy metals, fuels, acid rains, fertilizers etc.; recycling, decomposition, environmentally friendly technology	Movement and forces, mechanical movement, work and energy, equilibrium, energy, heat energy and movement, heat equilibrium, heat pollution of the environment. Safety rules in the laboratory and in working with electrical appliances, apparatus and different substances.
6 th grade	Movement of solar bodies, research in Cosmos, temperature and heat, heat pollution, chemical and physical properties of substances, chemical reactions and substances in nature, and in practice, conservation of environment, reproduction, growth and development, movement and irritability of plants and animals, same processes in human beings, health and hygiene, human and environment relationships	Notes: Topics, connected with Earth and Universe (Earth, evolution of the Earth and life on it, natural resources, continents and oceans, ocean, land and soil pollution, technologies, population, depletion of resources, anthropogenic influence on Earth, environmental problems of Europe, Balkan peninsula and Bulgaria) are dealt with in geography and economics from 5 th to 8 th grades.			

Table 3. Environmental related concepts – topics in Science and Technology Course in Turkey

Grade	Name of the Learning Domains in Science and Technology Curriculum			
	Living Organism and Life	Matter and Change	Physical Events	Earth and Universe
4 th grade	Human health, Ecosystems, environmental pollutions, and environmental protection, environmental responsibility,	Matter, status of matter (liquid, solid and gas), types of matter (natural, artificial and processed), natural events (snow, wind, rain...etc)	Noise pollution, hearing and eyes health, energy Disposal of the battery	Layers of the earth, a-biotic factors (stone, soil, water, air...etc), universe, underground recourses (minerals), pollution
5 th grade	Human health, balanced diet, ecosystems, food chain, environmental problems, prey-predator relationship, biodiversity [plants, animals, fungus]	Energy [sun], Matter, Water cycle	Noise pollution, lunar eclipse, solar eclipse	Universe, earth, moon, sun
6 th grade	Organic agriculture, pesticide usage	Matter, status of matter (liquid, solid and gas),	—	Natural monuments, soil, erosion, fossils, water, underground and surface-water, mine, types of rock
7 th grade	Ecosystem, environmental protection, a-biotic factors (humidity, light, and temperature), biodiversity, environmental problems in local and global area (forest fire, avalanche, landslide, flooding,)	—	—	Universe, earth, sun and moon, natural satellite, sun system, universe pollution
8 th grade	Adaptation, evolution, biodiversity, energy flow, food chain, matter cycle, recycling, energy sources (renewable and un-renewable), photosynthesis, respiration	Matter, types of matter, Water purification, acid rains, water, air and soil pollution	Noise pollution	Earthquake, air humidity, air temperature, climate, air pressure, meteorology, mountain, continent, volcanoes, ocean, seasons

This table included one column for Turkey and one column for Bulgaria across to grade level (4th grade to 8th grade). The objectives in the selected guides were analyzed against the forty sub-components of EL selected for use in this study.

Charting of the Results

For the comparative analysis, three different, but related tables were developed. These visualize the results emerged from the content analysis of the guide-books and make the results more comparable. The concepts associated with EE from analyzed books were included in the first two tables (table 2 for Bulgaria and table 3

for Turkey). The concepts in Bulgarian guide-books were categorized under selected courses and grade levels. On the other hand, the concepts in Turkish guide-books were grouped under four main learning domains. The last table (Table 4) was designed for comparative analysis of the objectives according to country and forty sub-components of EL.

RESULTS AND DISCUSSIONS

The comparative analysis of the objectives and content of the selected science education guide books indicated that environmental education in both countries is not considered as a separate subject, but is

Table 4. Comparative Analysis of Environmental Literacy in Selected Science Education Curricula in Bulgaria and Turkey

	Components and Sub-Components of EL	Country	
		Bulgaria	Turkey
KNOWLEDGE	1. <i>Knowledge of Natural History and Ecology</i>	(1) The sub-components of 1.2 and 1.4 are relatively more emphasized in all grades.	(1) All sub-components are emphasized in the curriculum.
	1.1. Species & Population		(2) The sub-component of 1.3 in 4 th to 6 th grades is ignored.
	1.2. Environments & Habitats	(2) The sub-components of 1.1, 1.3, 1.5, 1.6 receive less attention	(3) The sub-component of 1.7 is not very much emphasized.
	1.3. Communities & Interactions		
	1.4. Abiotics & Material Cycles		
	1.5. Ecosystem & Biomes	(3) The sub-component of 1.7. is not adequately considered	
	1.6. Natural & Social System		
	1.7. Physical & Biological History		
	2. <i>Knowledge of environmental issues and problems</i>	(1) Almost all the sub-components in all grades are emphasized.	(1) Almost all the sub-components in all grades are emphasized.
	2.1. Risk, Toxicology and Human health	(2) Not enough attention is paid to 2.4, 2.7 and 2.8	(2) The sub-components pertaining to the socio-political issues, cause and effects of the issues in all grades except 7 th grade, and the sub-component of natural disaster in all grades except 8 th grade are somewhat ignored
2.2. Bio-Physical Problems			
2.3. Causes of Problems			
2.4. Socio-Political Issues			
2.5. Causes of Issues			
2.6. Effects of Problems and Issues			
2.7. Natural Disasters			
2.8. Alternative Solutions and Actions			
3. <i>Socio-Political-Economic knowledge</i>	(1) All the sub-components are emphasized in all grades to certain extend.	(1) This component is not dominantly stated (note: this is more dominant in social sciences course)	
3.1. Cultural Values & Activities	(2) Exceptionally, the sub-components of 3.2, 3.3, 3.4, and 3.5 are dealt with in social subjects not in science courses	(2) Except 3.5 and 3.6, none of the components is very much considered.	
3.2. Economic Values & Activities	(3) Component 3.6 is not apparent.		
3.3. Societies & Social Systems			
3.4. Government & Political System			
3.5. Geographic Patterns			
3.6. Citizenship Participation			
4. <i>Cognitive skills</i>	(1) Almost all of the sub-components are well integrated	(1) Almost all of the sub-components are relatively well integrated	
4.1. Problem and Issue Identification Skills	(2) Not enough emphasis is exhibit to 4.3, 4.4 and 4.5. These are recommended for development in project work which is more or less not obligatory yet.		
4.2. Issue Analysis Skills			
4.3. Variable and Research Question Skills			
4.4. Data Collection Skills			
4.5. Data Analysis Skills			
4.6. Action Skills			
5. <i>Affect and Additional determinants of ERB</i>	(1) Almost all the sub-components are integrated.	(1) This component is not dominantly observed	
5.1. Environmental Appreciation and Sensitivity	(2) The sub-component of 5.5 is not observed. It is essential in class work and in implementation of action environmental strategies. The explanation notes of the curricula stress the point of skills for team work, good communication and tolerance in all grades.	(2) Only the objectives pertaining to environmental appreciation and sensitivity are more apparent.	
5.2. Environmental Attitudes			
5.3. Environmental Values			
5.4. Ethical & Moral Reasoning			
5.5. Efficacy / Locus of Control			
5.6. Personal Responsibility			
5.7. Willingness/ Motivation / Intention to Act			
6. <i>Environmentally responsible behaviors (ERB)</i>	(1) The implications of action strategies pertaining to conservation and eco-management behaviors are well observed.	(1) The sub-components of 6.1 is observed in 4 th , 7 th and 8 th grades	
6.1. Conservation and Eco-management	(2) Sub-components 6.4 and 6.5 are mentioned, but 6.2, 6.3 and 6.6 are more or less ignored.	(2) The sub-component of 6.2 is apparent in 5 th and 8 th grades and of 6.3 and 6.6 are observed in only 5 th grade.	
6.2. Consumer and Economic Action			
6.3. Interpersonal and Public Persuasion			
6.4. Governmental and Political Action			
6.5. Legal Action and Law Enforcement			
6.6. Other Forms of Citizen Participation			

mainly infused in the science education curricula. Different numbers of courses for science education are used in both countries. In Bulgaria, environmental education (EE) is realized mainly in science courses, united in the cultural educational area (CEA) “Natural sciences and ecology”, but some subjects (e.g. Geography and economics) from the CEA “Social sciences, civics and religion” are also involved. The topics associated with EE are more observable in four courses selected for the study. The concepts and topics emerged from these selected guide books are summarized in table 2. This table was designed according to grade (4th to 8th) in the column and selected courses in the row. It is clear to say that these all courses are complementary to each other and designed by considering the understanding of spiral curriculum. Advanced topics are introduced to the students based on the fundamental topics. There is a vertical connection among the courses as well as a horizontal connection (especially for 7th and 8th grade courses). Secondary school curriculum in Bulgarian is split into many subjects, and many textbooks make the comparison very difficult.

On the other hand, in Turkey, EE is realized under the curriculum of Science and Technology Course. The several concepts related to EE are emerged from this curriculum. These concepts are illustrated in table 3. Same as selected guide books from Bulgaria, vertical and horizontal connection among the learning domains and among the courses (e.g. with social sciences, interdisciplinary topics...etc) are also apparent in Science and Technology curriculum in Turkey.

The fundamental scientific concepts, needed for EL, are dealt with in the science curricula of both countries. Basic ecological and nature conservation concepts are accordingly developed. These all topics are for developing students’ understanding of ecological processes in nature, the relationships among living organisms, non-living matter, human and natural environment, physical, biological and chemical aspects of the environment (nature). Furthermore, the topics related to causes and effects of and solutions to environmental problems, hygiene and health are also introduced to the students in both countries in various grades. Knowledge is a fundamental predictor of EL, especially of ERB and is perfectly dealt with in textbooks, though Bulgarian textbooks seem to be overburden with it.

Table 4 presents the results of the comparative analysis. These results indicated that all components of environmental literacy do not receive the same attention. For example, greater attention was paid to the environmental knowledge, relatively little attention to skill, and little attention to affective and behavior sub-components in Turkey. On the other hand, within Bulgaria, much greater attention was given to knowledge

sub-components, less attention to skill and affective sub-components, and little attention to behavior.

Components of EL

Knowledge of Natural History and Ecology

This component of EL includes seven sub-components. Compared to the other components, it is apparent that this component is highly emphasized and incorporated in selected courses in both countries. In Bulgaria, the sub-components of Environments & Habitats and Abiotics & Material Cycles are relatively more introduced. However, the sub-components of Physical and Biological History (natural history) are not adequately considered. The reasons for that are several; (1) These subcomponents are mainly dealt with in geography, which is not analyzed. (2) They are thoroughly exhausted in higher grades from 9th to 12th. (3) Children may not possess the necessary background for understanding them. (4) The development of the biological scientific knowledge in 7th and 8th grades obeys the evolutionary process from simple unicellular organism to complex multicellular ones. On the other hand, all sub-components are very much observable in Science and Technology Course in Turkey. However, the sub-components of Communities & Interaction and Physical & Biological History (natural history) are somehow overlooked. The latter sub-component is still the only one which is rather less emphasized in both countries. Same as Bulgarian guide books, this sub-component seems to be more observable in Social Studies curriculum.

Knowledge of Environmental Issues and Problems

This component includes eight sub-components each pertaining to environmental problems and issues, their causes and effects, alternative solutions, natural disasters (earthquake...etc) and risk, toxicology, and human health. In Bulgaria, almost all of these sub-components are well integrated into the selected courses. But, socio-political issues, and causes of issues, natural disasters and alternative solutions and actions are underestimated and in some grades (e.g. 6th grade) merely not apparent. It is not necessary to prove their importance as environmental situation in both countries speaks for itself. Those topics in Bulgaria are included in civics. Knowledge of environmental action strategies is somewhat vague and marginal. Besides behavior of business corporations set a very bad example of environmental treatment. On the other hand, even though this component and its sub-components are well observable in Turkish science curriculum, the concepts associated with socio-political issues and causes of these

issues are not integrated in 4th, 5th, 6th and 8th grade. Likewise, the concepts related to natural disaster are not observable in 4th to 7th grades, except 8th grade curriculum.

Socio-Political-Economic Knowledge

This component consists of six sub-components. This component puts more emphasis on socio-political and economic aspects of the environment. Since this dimension is more related to social sciences, it is expected to observe this component more in Social Studies. Surprisingly, in Bulgaria, all the sub-components are well integrated in science curriculum. However, economic values and activities, societies and social systems, government and political system, and geographic pattern are not apparent in 4th grade. Those are more observable in Social Studies Curriculum in Turkey.

Cognitive Skills

This component includes six sub-components, each regarding as problem investigation and problem solving abilities. Considering the theoretical structure of this dimension, it is clear to say that these skills are in line with science process skills. In Bulgaria, almost all components are well integrated into the science curriculum, but not enough attention is given to variables and research question skills, data collection and data analysis skills. They are dealt with merely verbally but not as action skills. One reason for that is that school laboratories in Bulgaria are in a poor state because of the low economic development. No financial resources are allocated to school equipment. The overburden with information textbooks do not allow enough school periods for experiments. Therefore EL in respect to action skills is problematic and doomed to experience limited success. That in its turn narrows the boundaries of functional EL. Action skills are left for development as homework, teamwork in class or individual and group development of projects. Because of their ultimate importance, it is not surprising that authors put strong emphasis on this component (Stables, 1998) and suggest the use of zoos and aquariums in promoting conservation learning, values and skills development (Ballontyne, 2007). In Turkey, one of the most important innovations in new developed curriculum is the integration of science process skills. This is an evidence to say that cognitive skills are integrated into the curriculum in Turkey. Cognitive skills involve interest in environmental knowledge, which is best developed by solving real environmental problems. aspects are priority to geography, technology and civics curricula and textbooks. This situation in Bulgarian Science curriculum is

not as much observed as in Turkey's. That may be due to the more integrated subject in Turkey. Sub-components are not very much observable in the science curriculum. Only, the topics related to geographic patterns and citizenship participation is relatively well integrated in all grades (4th to 8th) in Turkish science curriculum. These components

Affect

Included seven sub-components, this component is a combination of two other main components of EL – Affect and Additional Determinants of Environmentally Responsible Behavior. In Bulgaria, except the sub-component of efficacy/locus of control, almost all the sub-components are integrated in all grades. Additional determinants (loci of control) are hard to apply to school curricula and that may be the cause for the obtained results. The explanation notes of the curricula stress the necessity of skills for team work, good communication and tolerance in all grades. The discussion of environmental problems and issues is done using reasons from within society and from within nature, i. e. natural and social causes. Externals (extroverts) deal with objective world and are more comfortable by being with others, while internals (introverts) deal with the subjective world and are more comfortable by being alone. Internals attribute their outcomes to ability, but externals to chance. The curricula give priority to social causes of environmental education but put less emphasis on greediness of people for material wealth. The value orientations and environmental ethics, though very insufficient, receive their attention through emphasis on the need of caring about nature. That is why ethical issues and moral reasoning are not observable in 4th and 5th grade science curriculum or sound very artificially. Ethical position on human-nature relationships shows signs of anthropocentrism and misses the crucial elements of the contemporary environmental ethics debate. Affect is simply overlooked. No criteria are developed for measurement of the outcomes. Nevertheless affect can be seen in the intention to act in order to solve environmental problems, in the desire to develop environmental skills and make the school environment cozy and clean. Besides, to overlook knowledge for the sake of affect is equally inadequate (Makenzie, 2003)

Comparing to the other components of EL, affect component is relatively less integrated into science curriculum in Turkey. Only the objectives pertaining to environmental appreciation and sensitivity are apparent in all grades. “Environmental attitudes”, “personal responsibility” and “willingness to act” are rather less observable in the curriculum. Other sub-components are somehow ignored and never considered.

Environmentally Responsible Behavior

This component includes six sub-components. Comparing to the other main components, this component and its sub-components receive very little attention in science education curriculum in both countries. Conservation and eco-management behaviors sub-component, so-called physical actions, is relatively more observable in both curricula. Government and political action, Legal action and law enforcement are left for social sciences and mentioned very occasionally in science curriculum. The implications of physical action strategies are more dominant in 4th, 7th and 8th grades in Turkey. In Bulgaria, other types of behavior are extremely rarely apparent in the studied grades. On the other hand, only very few attainments in Turkish science curriculum pertains to “Consumer and Economic Action” in 5th and 8th grades and “Interpersonal and Public Persuasion” in 5th grade.

Little attention is given to action competence, involving the ability to take into consideration human conflicts of interest, which lies behind sustainable development and preserving the quality of the environment. Action is not very much concerned with future perspective and if it does it, the accent is on negative outcomes and dark predictions. Bad future perspective is despairing. The science school curricula raise questions that can be investigated by students in their out of school activities when making projects, using observations and experiments and analyzing the results as well as taking part in environmental organizations. These activities are not compulsory and teachers may decide not to organize them. They are more or less personal choices of teachers. At least that is the case in Bulgaria.

The six components of EL can be used as criteria for critical evaluation of the local, national and global environmental education (Singh, 1998). They help researchers and teachers to obtain more reliable results.

CONCLUSION

The comparative analysis of five science education textbooks taken from Bulgaria (n=4) and Turkey (n=1) with regard to components of environmental literacy revealed that all the components are not considered equally in both countries. While the components pertaining to environmental knowledge are highly emphasized, the other components are paid partially less attention both countries.

For example, even though relatively little attention is given to skills, this component is well integrated. But, the components of affect and behavior (action) receive little attention in new Science and Technology curriculum in Turkey. However, in Bulgaria, it was found that skill and affective sub-components are

relatively well integrated, although the component of behavior is somewhat ignored and not well integrated in the obligatory curriculum.

In both countries, participation of students in nature conservation activities is limited in textbooks and, from all appearances, in school practices. Such kinds of activities are mainly voluntary in non-formal education (Revised school programs, 2003). This may be one of the primary reasons for low levels of responsible behavior of students to their surrounding environment (Kostova, 2003, p. 207 – 234). Another reason may be the bad example set by adults, expressed in their consumerism and other forms of irresponsible environmental behavior.

Considering that one of the important aims of environmental education in schools is to help students develop the abilities and capacities needed for civic participation, service, and action (Hungerford & Volk, 1984, 1990), it is clear to say that in both countries, this aim of EE may not be easily realized because the action component of EL is given little attention and some of its sub-components are even ignored in these textbooks. Fortunately, we have still a chance to integrate this component of EL because in Turkey science education curriculum is being under development and in Bulgaria the new textbooks are in the process of being prepared (considered the revisions returned back from the piloted schools and findings of the research studies). For that reason, the findings of this study serve as an in-depth source of information for (these) national curriculum revisions, particularly on the integration of all the components of EL. The value and action components require a new approach to teaching incorporating inquiry methods and field studies, ensuring the integration of knowledge, emotion and action, i.e., “heads, hearts and hands”. This means that revision of curricula and text-books is not enough. Teachers’ guides and teachers’ qualification should also be updated in order to create stimulating learning environments.

Curricula are not the only predictors of environmentally responsible behavior and other factors should also be investigated, such as:

1. The state of environmental literacy as a possession of schoolchildren at the end of each grade.
2. The diversification of learning environments and the efficacy of their use.
3. Teachers’ professional competencies to involve students in successful environmental learning.

Acknowledgement

The authors thank to PhD candidate Murat Aydemir at METU for his initial revision of the article.

REFERENCES

- Andreichin, L. & others. (1976). A Dictionary of the Bulgarian Language (explanatory). [In Bulgarian]. (3rd ed.) Sofia, Nauka i izkustvo.
- Babulski, K., Gannett, C., Myers, K., Peppel, K., & Williams, R. (1999). *A white paper on the relationship between school reform and environmental education in Florida: Correlating Florida's Sunshine State Standards and an Environmental Literacy Framework*. Melbourne, FL: Unpublished research paper, Science Education Department, Florida Institute of Technology.
- Ballontyne, R et all. (2007) Conservation Learning in Wild Tourism Settings: Lessons from Research in Zoos and Aquariums. *Environmental Education Research*, 13(3), 367-383.
- Chawla, L., Cushing, D. F. (2007). Education for strategic Environmental Behavior. *Environmental Education Research*, 13(4), 437-452.
- Disinger, J. (2005). Environmental educations' definitional problems. In H. Hungerford, B. Bluhm, T. Volk and J. Ramsey (Eds.) *Essential Readings in Environmental Education* (pp. 17-32). Champaign, IL: Stipes Publication (Original article: 1983, ERIC, Information Bulletin # 2)
- Erdogan, M. (2007). Yeni geliştirilen dördüncü ve beşinci sınıf fen ve teknoloji dersi öğretim programının analizi: Nitel bir çalışma. (An analysis of newly developed fourth and fifth grade science and technology course curriculum; A qualitative study). *Türk Eğitim Bilimleri Dergisi*, 5(1), 221-259.
- Erdogan, M., & Erentay, M. (2007). *Children's perceptions on endangered species and threatened environments: results from Unique and Universal Project*. Proceedings of the 4th International Conference on Hands-on Science. Costa MF, Dorrio BV, Reis R (Eds.); 2007, July 23-27; University of Azores; Ponta Delgada, Portugal. 2007. 141-148.
- Erdogan, M., & Marcinkowski, T. (2007a). *Results of an analysis of K-8 environmental education research in Turkey, 1997-2007*. (Research Symposium) 34th North American Association for Environmental Education (NAAEE) Annual Conference and Research Symposium, Virginia Beach, USA, 13-14, November, 2007.
- Erdogan, M., & Marcinkowski, T. (2007b). *An analysis of K-8 environmental education research in Turkey, 1997-2007*. (Main Conference) 34th North American Association for Environmental Education (NAAEE) Annual Conference and Research Symposium, Virginia Beach, The USA, 14-17, November, 2007.
- Hart, P., & Nolan, K. (1999). A critical analysis of research in environmental education. *Studies in Science Education*, 34, 1-69.
- Harvey, G. (1977). A conceptualization of environmental education. In J. Aldrich, A. Blackburn, and G. Abel (Eds.), *The Report of the North American Regional Seminar on Environmental Education* (pp. 67-72). Columbus, OH: ERIC SMEAC.
- Hines, J., Hungerford, H., & Tomera, A. (1986/87). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *The Journal of Environmental Education*, 18(2), 1-8.
- Hicks, D., Holden, C. (2007). Remembering the future: What do Children Think? *Environmental Education Research*, 13(4), 501-512.
- Honeyman, B. (1998) Non-formal and Formal Learning Interactions: New Directions for Scientific and Technological Literacy. UNESCO, *Connect*, 23(1), 1.
- Hsu. Sh. J., Roth, R. E (1998) An Assessment of Responsible Environmental Behaviour Held by Secondary Teachers in the Hualien Area of Taiwan. *Environmental Education Research*, 4(3), 229-249
- Hungerford, H., Peyton, R., & Wile, R. (1980). Goal for curriculum development in environmental education. *The Journal of Environmental Education*, 11(3), 42-47.
- Hungerford, H. & Volk, T. (1984). The challenges of K-12 environmental education. In Arthur B. Sacks (Ed.) *Monographs in environmental education and environmental studies*, Volume 1 (pp. 3-30). Troy, OH: NAAEE.
- Hungerford, H. & Volk, T. (1990). Changing learner behavior through environmental education. *The Journal of Environmental Education*, 21(3), 8-22.
- Kostova, Z., L. Naidenova and M. Dodova (1978) A system of nature conservation concepts in education. [In Bulgarian]. Sofia, Ministry of Education.
- Kostova, Z. (1995). Environmental Education in Bulgaria. *Pedagogika*, 3 (12), 53 – 65
- Kostova, Z. (2003) Conceptualization of Environmental Education. [In Bulgarian]. Veliko Turnovo, Faber
- Kutov, A. & Z. Kostova (eds) and others. (1984) A Dictionary of ecology and environment conservation. [In Bulgarian]. Sofia, Partizdat
- Iozzi, L. (ed.) (1981). Research in environmental education, 1971-1980. Columbus, OH: ERIC/SMEAC. (ERIC Document No. ED 214 762)
- Iozzi, L. (ed.) (1984). A summary of research in environmental education, 1971-1982. The second report of the national commission on environmental education research. (Monographs in Environmental Education and Environmental Studies, Vol. #2). Columbus, OH: ERIC/SMEAC. (ERIC Document No ED. 259 879).
- Lundmark, C. (2007). The New Ecological Paradigm Revisited: Anchoring the NEP Scale in Environmental Ethics. *Environmental Education Research*, 13(3), 329-347
- Lundegard, I. & Wickman, P.O. (2007) Conflicts of Interest: An Indispensable Element of Education for Sustainable Development. *Environmental Education Research*, 13(1), 1-15
- Makenzie, A.C., Smith, R. (2003). Ecological Literacy: the "missing paradigm" in Environmental Education. *Environmental Education Research*, 9(4), 497-524.
- Marcinkowski, T., & Mrazek, R. (Eds.) (1996). *Research in environmental education research, 1981-1990*. Troy, OH, NAAEE.
- McBeth, W. (Primary investigator – PI) (2006). National Environmental Literacy Assessment of Middle School Students in the U.S. (A Special Project Award to the North American Association for Environmental Education [Award no NAO6SEC4690009] by the National Oceanic and Atmospheric Administration, U.S. Department Commerce). Washington, D.C.: NAAEE.

- Ogegov, S.I. (1981) Dictionary of Russian Language. Moscow, Russian Language (57000 words). In Russian (Slovar Ruskava Yazika, M., Ruskii Yazik)
- Ozgelten, S., & Yilmaz-Tuzun, O. (2007, April). *Pre-service science teachers' perceptions about science process skills and their practices*. Paper presented at the 84th Annual American Educational Research Association, Chicago, USA.
- Revised School Programs (2003). "The Human Being and Nature" and "Biology and Health Education". *Journal of Biology, Ecology and Biotechnology*, 12 (3-4), 6 – 76 [In Bulgarian].
- Roth, C. (1992). *Environmental literacy: Its roots, evolution and directions in the 1990s*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics and Environmental Education.
- Schmieder, A.A. (1977). *The nature and philosophy of environmental education: Goals and objectives*. In UNESCO, Trends in environmental education (pp. 23-34). Paris, France: UNESCO.
- Simmons, D. (1995). *Working paper # 2: Developing a framework for national environmental education standards*. In papers on the Development of Environmental Education Standards (pp. 53-58). Troy, OH: NAAEE.
- Singh, M. (1998). Critical Literacy Strategies for Environmental Educators. *Environmental Education Research*, 4(3), 341-354.
- Stables, A. & Bishop, K. (2001). Weak and strong conceptions of Environmental Literacy: Implementations for Environmental Education. *Environmental Education Research*, 7(1), 89-97
- Stables, A. (1998) Environmental Literacy: Functional, Cultural and Critical. The Case of the SCAA guidelines. *Environmental Education Research*, 4 (2), 155-164.
- Stapp, W. B. et. al. (1969). The concept of environmental education. *The Journal of Environmental Education*, 1(1), 30-31.
- UNECE Strategy for Education for Sustainable Development, Vilnius, 17-18 March 2005. CEP/AC.13/2005/3/Rev.1
- UNESCO (1989). Environmental literacy for all. *Connect*, 14 (2), 1.
- UNESCO (1978). Intergovernmental conference on environmental education: Final report. Paris, France: UNESCO.
- UNESCO (1977). Trends in environmental education. Paris, France: UNESCO.
- Volk, T. & McBeth, W. (1997). *Environmental literacy in the Unites States: What should be...What is...Getting from here to there*. A report funded by the U.S. Environmental Protection Agency and submitted to the Environmental Education and Training Partnership, NAAEE. Washington, DC: U.S. EPA.
- Wilke, R. (1995). Environmental education literacy/needs assessment project: Assessing environmental literacy of students and environmental education needs of teachers; Final report for 1993-1995. (Report to NCEET/University of Michigan under U.S. EPA Grant #NT901935-01-2). Stevens Point, Wisconsin: University of Wisconsin – Stevens Point.

