Macedonian students' ecological knowledge and level of information about the environment

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Abstract

The aim of this study was to investigate the cognitive domain of students' environmental education (EE) in the Republic of North Macedonia. The main tasks of the study was (1) to compare the ecological knowledge and level of information between primary and secondary school students in the Macedonian context, and (2) to provide an analytical review of the findings. Two instruments were used to collect data from a sample of 1003 students from 37 primary and secondary schools in the Republic of North Macedonia. The results of the study suggested that the students in the sample have a low level of both ecological knowledge and ecological information. Students of secondary schools have a statistically higher level of ecological information. It is critical to a certain extent for empirical studies on environmental knowledge to be carried out in developing countries in order to incorporate the findings into the environmental policy development process. We need to develop curricula and programs that are suitable to the individual differences, needs, viewpoints, and abilities of the students. Curricula for environmental learning should contain all environmental components: natural systems, resources, and human resources. We must look at students' EE achievements in the context of the overall socio-economic conditions in which we carry out the education process. In order to increase students' knowledge and level of information about the environment, activities should be arranged by various stakeholders, and not only by schools. Environmental education should be extended by using mass communication channels, especially the internet and media.

Keywords: ecological knowledge, ecological information, Republic of North Macedonia, schools, students.

Introduction

"Education and training play a crucial role in helping individuals and societies to adapt to the profound social, economic and cultural change, and thus foster the development of the human capital needed for economic growth. The ability of education and training systems to fulfill these roles depends on whether educational institutions, themselves respond

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to change, and whether teachers develop and deliver educational content in ways that meet the needs of today's and tomorrow's citizens" (OECD & UIS, 2001, p. 9).

Environmental education (EE) is one of the most popular educational trends to come along in recent memory. EE has become an important and growing area for educational research. EE is rooted in the belief that humans can live compatibly with nature and act equitably toward each other. Due to that, over the past 50 years, the core field of EE has developed into one of the most effective paradigms of learning available today.

According to the Tbilisi Declaration, the goals of EE are: (1) to foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas; (2) to provide every person with opportunities to acquire knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment and (3) to create new patterns of behavior of individuals, groups, and society as a whole towards the environment (UNESCO, 1980).

The term "environmental education" is widely used; however, it has no single, indisputable meaning. Lucas (1972) classified the usage of this term into the categories "education *about* the environment", "education *for* the environment" and "education *in* the environment" and mixed categories. Education *about* the environment is concerned with providing a cognitive understanding of issues. Education *for* the environment is directed toward environmental preservation and is characterized by particular purposes or aims. Education *in* the environment is characterized by the technique of instruction stressing direct contact in physical and social environments outside of the classroom (Europa-Universität Flensburg, 2019, p. 5-6). Too often, we are concentrated on learning about the environment and put too little emphasis on learning through and for the environment.

Based on the qualitative and quantitative analysis of 36 documents related to environmental education, Srbinovski (2005a) defined the term environmental education in the following way: 'Environmental education is a developing process of active learning in which individuals and groups acquire the necessary knowledge, understanding, attitudes and skills for a determined, motivated, responsible, and above all, joint action towards obtaining and maintaining a dynamic balance in the environment'. This definition includes all the essential components (attitudes, awareness, knowledge, skills and action) of environmental literacy as the ultimate goal of environmental education (Srbinovski, 2005a, p. 26). The proposed definition has neither the ambition nor the intention to give a complete and final answer to this question. Users should be sensitive to the fact that this definition is not exhaustive and should be modified. The debate on the best ways of achieving the goals and the most effective ways of applying it in practice continues.

Schools as one of the social systems responsible for the development of citizenry should be charged with developing cognitive, affective and psycho-motor skills to equip students with the ability to make environmentally responsible decisions. The cognitive variable involves knowledge and understanding of concepts and facts as well as the ability to apply abstractions, analyze, synthesize and evaluate. The cognitive domain deals with remembering or understanding of concepts, ideas, and facts. Today there is a large amount of cognitive information related to EE. The affective variable involves feelings or emotions. It consists of attitudes and values towards objects. The cognitive and affective

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domains function cooperatively. The psychomotor variable involves skills in carrying out physical and mentally coordinated activities.

The assessment of cognitive, affective and skill variables, and particularly the latter, has not received equal attention. The affective and cognitive EE domains of students in the Republic of North Macedonia have been studied by Srbinovski (2005a, 2006, 2016), Idrizi, Srbinovski, & Jonuzi (2014), Idrizi, Srbinovski, Jonuzi, & Murati-Sherifi (2015), Jonuzi, Ismaili, Srbinovski, & Zenki (2009), etc.

This research is part of a complex study on environmental education in the Republic of North Macedonia conducted in the period 1995-2015. The main aims of the study were (1) to compare the ecological knowledge and level of information of primary and secondary school students in the Macedonian context, and (2) to provide an analytical review of the findings.

Materials and methods

There is a good basis for assuming that students of secondary schools have a higher EE cognitive domain level in comparison to students of primary schools. The t-test was used to test this hypothesis.

We examined the cognitive domain with regard to knowledge of ecology and environmental problems and issues; and students' level of information about the environment. In order to assess the students' level of environmental knowledge, we asked students what they had learned about the main environmental components (Ballard & Pandya, 1990): natural systems (general, abiotic components, biotic components, processes, and biological systems), resources (natural resources, biotic resources, abiotic resources, degradation of resources), and human resources (humans and the environment, technological systems, and environmental awareness and protection). The questions were designed according to the curriculum content in biology textbooks. We used the best-known type of knowledge test - multiple-choice questions. The number of response options was five.

The level of environmental information that a student possesses is the degree to which the student is informed about pollution of the environment, pollution control etc., thanks to information spontaneously acquired from their surroundings, but at the same time it is based to a limited degree on formal education. The questions from the environmental information test referred to the same environmental components, as well. The number of response options was five.

Two instruments were used to collect data: the Knowledge of Ecology Test (KET) and the Test of the Level of Environmental Information (TEI). The procedure of the preparation and validity of the instruments that were used went through the most important phases according to the methodology of empirical research. These instruments were tested before they were used on a sample of 435 students.

The participants in this research were 1003 students from 37 primary and secondary schools in the Republic of North Macedonia. We decided to include only final-year students, because the students learn environmental issues in all grades. As a result of this choice of sample, we can conclude that it is intentional and systematic. It is intentional because we included final-year students, and systematic because we chose each n-th year.

As a range of coincidental factors determined which students would be present in these classes, we can consider our sample to be coincidental and sufficiently representative. The research was anonymous. It was conducted during the regular 90-minute classes.

Results and discussion

Environmental education in schools actually represents the adult generation's effort to invite the young generation to share a moral concern for succeeding generations. Sometimes the process of EE can be seen as a series of stages starting with awareness and working towards action. But surely this is a simplification since all the elements are inter-related and it is possible to start at any point.

Table 1 shows the achievement on ecological knowledge and information in percentages, and differences between students of primary and secondary schools in the Republic of North Macedonia are shown.

Table 1

Ecological knowledge and level of information by educational level (%).

	Elementary School (N = 515)	Secondary School (N = 488)	Difference	t-test
Knowledge	40.03	39.97	-0.06	0.143
Information	38.12	50.19	12.07	10.386

In terms of ecological knowledge, both groups achieved similar results (40.03% and 39.97%). On the other hand, the primary school students have a lower level of ecological information than the secondary school students. In terms of this component, there is a significant difference ($t = 10.39$) between the two subgroups. If we assume that the two components have the same meaning, the average level of the cognitive domain is about 39.07% and 45.18% for students in elementary and secondary schools, respectively.

Similar results for the two subgroups were obtained on the questions regarding the main environmental components. On the questions in the field of natural systems, the students scored around 42.43%. A slightly higher score was achieved by the students in secondary education compared to the students in primary education (46.41% and 38.44%, respectively). We got almost identical results on the questions about human resources (elementary school students - 42.62%, and high school students - 40.81%). On the Test for the level of environmental information students achieved nearly identical results on the questions related to resources and human resources (42.10% and 44.89%, respectively).

Student's level of ecological knowledge

As one of three commonly recognized areas of learning, the cognitive domain deals with remembering or understanding of concepts, ideas, facts etc. Unfortunately, classroom-based environmental studies often concentrate on the knowledge and skills and do not give enough attention to personal response and personal responsibility. Knowledge

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is more than information; it involves dialogue and process. It is not enough for people just to know what to do. The problem therefore is not in knowing, but rather in the action undertaken. In order to perform that action, obviously they need to know (Silveira, 2001, as cited in Srbinovski, 2005a). If people do not know what things are harmful to the environment, how can they treat them with the seriousness they deserve?

Accordingly, we wanted to explore the students' level of ecological knowledge. Results show both subgroups have a low level of environmental knowledge, both in general, and regarding environmental components.

Jonuzi et al. (2009) reported lower results, while Erhabor & Don (2016), Jamilah et al. (2015), Zarrintaj et al. (2013) reported higher results, Sadik & Sadik (2014) reported a moderate level of environmental knowledge. The results of the Third International Mathematics and Science Study (TIMSS, 1999) confirmed the relatively low level of students' knowledge. Macedonian students had a significantly higher average only compared to students in Morocco, the Philippines and South Africa (The International Study Center and The International Association for the Evaluation of Educational Achievement, 2000). According to The Program for International Student Assessment (PISA), a worldwide study by OECD in 70 nations, North Macedonia ranks 67th in science (OECD, 2018).

In order to check if there is a significant difference in the basic population, we tested the hypothesis on the significant level of 0.05. The low value of the t-test (0.143) shows that there is not enough justification for the assertion that there would be a difference if all students from primary and secondary schools had been examined.

The most important questions are why our students have a low level of environmental knowledge, and why they are similar in terms of this cognitive component?

The Republic of North Macedonia is a country going through a transitional period. Since the beginning of the 21st century, the people in our country have experienced a great number of radical changes in all spheres of life. All of these social changes, of course, have influenced the education system. According to some previous researches, the key problem, very likely, is the fact that EE is not consistently anticipated in the curricula and in didactic materials (Srbinovski, 2003, 2005a, 2013). Environmental themes are not widely integrated into formal education courses. They are not sufficiently connected with environmental protection. The environment is mainly considered through its natural aspect. This is in contradiction with one of the primary aims of EE: to enable human beings to understand the complex nature of the environment resulting from the interaction of its biological, physical, social, economic and cultural aspects.

In the absence of laboratories and specialized classrooms, the teaching process usually takes place in traditional classrooms (Srbinovski, 2004a). The same author reported that the topic of instruction affects students' level of environmental education, as well.

A high-quality curriculum and syllabus are not a sufficient guarantee for effective and efficacious EE. A very important factor in its implementation are teachers. They are not only implementers, but also initiators and organizers of teaching activities. Srbinovski (2004b) reported that about 67% of students think that their teachers are interested in implementing environmental content. This component is significantly linked to the level of environmental knowledge of the students (Srbinovski, 2004b).

It is not sufficient to "tell" students about the environment. Students must experience a curriculum which allows them to discover how they interact with the environment

themselves. Only in this way will citizens be able to make responsible decisions concerning ecology. Active learning is more effective than traditional methods. For example, studies have shown that whilst you are likely to remember only 20% of what you hear, if you are involved actively through talking and doing, you remember 90%.

In general, our schools take an old-fashioned approach to developing students' knowledge, attitudes and values in the field of EE. In the traditional school, the child is considered to be only a child. Without respecting students' different characteristics, needs and interests in accordance with the requirements and conditions of contemporary living, we cannot comprehensively accomplish the goals of EE. Also, we cannot separate the emotions from the cognitive domain and volition, because the processes of cognition are emotional and cognitively motivated, from perception to conclusion.

A number of socio-economic, demographic, and personal factors influence the level of students' ecological knowledge. Cruz Lasso de la Vega (2004) reported statistically significant differences in ecological knowledge depending on ethnicity ($F(5, 457) = 4.951$, $p < .05$) and entertainment activities and knowledge ($F(5, 457) = 3.286$, $p < .05$). On the other hand, there are no statistically significant differences in knowledge based on gender, income, and urbanity. It would be very interesting to determine the impact of these factors on ecological knowledge in the Macedonian context. Srbinovski (2004a, 2004c) reported statistically significant differences between ecological knowledge and ecological atmosphere in the school ($C = 0.11$), object of teaching ($C = 0.11$), students' motivation for learning environmental issues ($C = 0.19$), students' interest in studying environmental content ($C = 0.18$), students' activity during class ($C = 0.16$), students' personal responsibility about the environment ($C = 0.12$), and teachers' interest in implementing environmental content ($C = 0.20$).

Over the last two decades, traditional ecological knowledge (TEK) has gained increasing attention as a source of information for environmental science, policy, and management (Hernández et al., 2014). Although TEK is different from scientific knowledge, both bodies of knowledge are believed to be largely complementary, having great potential to enrich one another in informing decision-making processes and improving understanding of ecosystems and their dynamics (Huntington, 2000). In order to better mainstream this knowledge into environmental policy processes Hernández et al. (2014) suggest the establishment of an interdisciplinary knowledge network to build a collaborative TEK concept in Europe.

Students' level of ecological information

In more recent years, alongside world-wide acceptance of the need for sustainable development, and education for sustainability, there has been an ever-increasing focus in the environmental education literature on the crucial importance of education for the environment in particular (Palmer, 2003, p. 137). Environmental education is more than information about the environment. Environmental education increases public awareness and knowledge of environmental issues, does teach individuals critical thinking, does enhance individuals' problem-solving and decision-making skills, and does not advocate a particular viewpoint (National Academy of Engineering, 2001).

With the Test for students' level of environmental information (TEI) we explored how much students are informed about ecology, environmental problems and issues. Students of secondary schools have a higher level of ecological information than students from primary schools (50.19% and 38.12%, respectively).

We must look at students' level of environmental information in the context of the overall socio-economic conditions in which we carry out the education process. In order to increase this component, various stakeholders should arrange activities, not only in schools. Srbinovski (2004a, 2004c) reported statistically significant differences between this component and the object of teaching ($M = 0.11$), students' interest in studying environmental content ($M = 0.23$), students' activity during classes ($M = 0.15$), students' personal responsibility about the environment ($M = 0.18$), students' motivation for learning environmental issues ($M = 0.25$), teachers' interest in the implementation of environmental contents ($M = 0.9$), methods of classroom instruction ($M = 0.11$), and forms of working ($C = 0.15$).

The high value of the t-test (10.386) shows that there is enough justification for the assertion that there would be a difference if all students from primary and secondary schools were examined. We consider that the difference between the levels of students' environmental information is a result of their own personality, and the areas where they live. In terms of age, older students have greater opportunities to participate in various activities outside the school. This is very important because this cognitive component is the result of spontaneous information within the surroundings, rather than being based on formal education. Middle schools are located mainly in urban areas which are more polluted than rural areas. In these areas people are more worried and talk about the environment and various activities aimed at protecting and promoting the environment, as well.

It is very important to note that the students' cognitive component is on a lower level than their affective and conative components. In addition, there are studies which show the trend of this component decreasing in recent years (Jonuzi, 2009). It should be emphasized that there is a statistically significant correlation between the cognitive component and attitudes in the Macedonian context (Srbinovski, 2005b).

With the last educational reform in our country, we expected that almost all the presented disadvantages and weaknesses in our education system would be overcome. However, the results of following research will show to what extent this intention will be accomplished in practice.

We must be aware of all factors that affect the ability of individuals to learn. The quality of environmental education will depend on the degree to which the designer has been able to incorporate the learning situations into the student's experience. We need to think about problem-solving, hands-on learning approaches, scientific method, complex thinking strategies, co-operative learning, relevant subject matter and topics that engage students in the educational process (Hoody, 1995). A balanced EE program should address all three key dimensions - "about", "in" and "for" the environment. Environmental education seeks to encourage pupils to look at their surroundings and their own place within them with a more practiced eye, a more responsible mind, and a more involved heart.

In order to develop effective environmental education, some models and constructs have been proposed. Palmer J. (2003) presented an integrated model for teaching and learning in environmental education: towards progress and promise in the twenty-first

century. This model reflects the relationship between education about the environment, in/from the environment, and for the environment. At the center of this model are the learning processes and curriculum elements driven by knowledge, concepts, skills, attitudes, and understanding. Planning for such a curriculum model requires the interaction of concern, experience, and action. The "core" of this model contains the powerful base of formative influences upon which all further learning depends, and which most educational programs and practice seem to ignore (Palmer, 2003, p. 270).

Curriculum objectives, such as environmental attitude, knowledge, and awareness (AKA), have been investigated in the literature as ways to improve the overall behavior of future citizens toward the environment. An area of learning in education for sustainable development is knowledge, as well. This component includes: knowledge and understanding, learning new knowledge, viewing prior knowledge in new ways, applying knowledge to new contexts, enabling deeper understanding, acquiring new insights, appreciating inter-connectedness (Council for Environmental Education, 2004)

Conclusion

The most effective way to solve environmental problems is the education of societies. Although there is a growing effort among educators to develop a citizenry that both behaves responsibly and is actively working to protect the environment, it is difficult to realize it in practice. Knowledge of ecology should be construed to encompass all the cognitive understandings about the working of the natural world and human interactions and interrelations with it.

The results of the study suggested that the students in the sample have a low level of both ecological knowledge and ecological information. The students of secondary schools have a higher level of ecological information. There were statistically significant differences between students from primary and secondary schools, in regard to the level of environmental information. Thus, we have partially confirmed our working hypothesis.

We need to develop curricula and programs that are suited to the individual differences, needs, viewpoints, and abilities of the students. Curricula for environmental learning should contain all environmental components. These issues would be local in nature in the early years, and expand into more regional, national, and international concerns at succeeding grade levels. In addition, as learners grow older, their information about issues should increase in quality and depth.

We must look at student EE achievement in the context of the overall socio-economic conditions in which we carry out the education process. In order to increase students' knowledge and level of information about the environment, not only schools but also various stakeholders should arrange activities. Environmental education should be extended by using mass communication channels, especially the internet and media. Developing a model that tries to incorporate all factors might neither be feasible nor useful, but we feel that it can help to illuminate this complex field.

It is important to emphasize the limitations of this study that should be considered before any generalization of the results. Firstly, the sample was not completely represen-

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tative. So, we cannot generalize our results until we and other researchers have conducted further studies with children from other backgrounds and in other locations. Secondly, the results presented and analysed in this research date from the period 1995-2015, which somewhat diminishes their relevance.

In the light of this study, some suggestions can be offered for future studies. Firstly, we believe that future researchers will use samples from different social and ethnic backgrounds. Secondly, to improve the quality of the data, and to reduce bias, more than one method of collecting data should be used. Finally, in order to get a clear picture of students' achievement in the field of EE, it is important to include all basic categories of outcomes in EE: knowledge, skills, attitudes, and environmental behaviour. Despite these constraints, these results give an intriguing insight into students' knowledge and level of information about ecology, environmental problems and issues in the Republic of North Macedonia.

Implications for practice

The results of this study can help in shaping education policy in terms of common facets of educational programs, stages of development and/or decisions regarding whole print, instructional programs etc. As a highly experienced teacher, I believe that this study has some important implications for practice: to improve, clarify, and modify curriculum goals and instructional materials; to improve instructions; to determine what students should learn about the environment; and to determine how students have been influenced by their experiences.

Finally, the most important thing is that the results of this research show the cognitive ecological component of our students is on a lower level than the affective and conative ones. Therefore, improving the quality and quantity of students' knowledge and information about the environment should be the priority in the field of environmental education in our country. It would increase Macedonian students' level of positive attitudes towards the environment.

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Еколошка знања и информисаност македонских студената

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Тетово, Република Северна Македонија

Апстракт Сврха ове студије је истражити коинтезивни домен еколошког образовања ученика у Републици Северној Македонији. Главни задаци студије су (1) упоредити еколошко знање и информисаност ученика основних и средњих школа у Републици Северној Македонији и (2) анализирати добијене податке. Два инструмента коришћена су за прикупљање података на узорку од 1.003 ученика из 37 основних и средњих школа Републике Северне Македоније. Резултати студије сугеришу да ученици обухваћени узорком имају низак ниво еколошког знања и познавања еколошких информација. Ученици средњих школа имају статистички виши ниво еколошке информисаности. Врло је значајно да се у земљама у развоју спроводе емпијска истраживања знања о животној средини, како би се резултати могли користити у процесу креирања политике заштите животне средине. Потребно је да развијемо насловне планове и програме који су у складу с индивидуалним разликама, потребама, интересима и способностима ученика. Програми еколошког образовања треба да обухватају све компоненти животне средине:

природне сисџеме, маџеријалне и људске ресурсе. На џосџиинуџа ученика морамо џледаџи у конџексџу свеобухваџних социоекономских услова у којима сџроводимо образовни џроцес. Како бисмо џовеџали ученичка знаџа и информисаносџи о окружеџу, џоџребно је да буду укључене не само школе неџо и друџи акџиери. Образоваџе за брџу о живоџној средини џреба да буде унаџреџено коришџеџем средсџава масовних комуникаџја, џосебно инџернеџа.

Кључне речи: еколошко знаџе, еколошке информације, Република Северна Македонија, школе, ученици.

Экологические знания и осведомленность македонских учеников

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Резюме

Целью данного исследования является изучение когнитивной области экологического образования учеников в Республике Северная Македония. Основными целями исследования являются (1) сравнение экологических знаний и информации учащихся начальных и средних школ в Республике Северная Македония и (2) анализ полученных данных. Два инструмента были использованы для сбора данных, на примере 1003 учеников из 37 начальных и средних школ в Северной Македонии. Результаты исследования показывают, что анкетированные учащиеся имеют низкий уровень экологических знаний об окружающей среде и экологической информации. Ученики средних школ обладают статистически более высоким уровнем экологической осведомленности. Считается крайне важным проводить эмпирические исследования экологических знаний в развивающихся странах и затем, полученные результаты использовать в процессе разработки экологической политики в защите окружающей среды. Необходимо разработать учебные планы и программы, соответствующие индивидуальным различиям, потребностям, взглядам и способностям учащихся. Программы экологического образования должны охватывать все компоненты окружающей среды: природные системы, ресурсы и людские ресурсы. Достижения учащихся необходимо рассматривать в контексте общих социально-экономических условий, в которых осуществляется образовательный процесс. Для того, чтобы повысить знания учащихся и осведомленность об окружающей среде, необходимо привлекать не только школы, но и других участников. Экологическое образование должно поощряться с помощью средств массовой информации, особенно Интернета.

Ключевые слова: экологические знания, экологическая информация, Республика Северная Македония, школа, ученик.