

The Role of Teachers' Competencies in Education For Sustainable Development

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Abstract: The education for sustainable development (ESD) in the curricula claims to foster students' ability to take part in promoting sustainable development. A number of studies show that the implementation of sustainable development is highly demanding for teachers and requires specific knowledge and abilities. Hence, it is important to determine what competencies teachers need in order to develop and implement education for sustainable development and to attain specific educational goals with their students. ESD requires a specific and more constructive focus on teaching, which raises the question of building corresponding competencies in teachers' education. Teachers have to gain the insight through constructivism, that acquiring competencies is a self-steered and active process, which can be fostered but not created. In this paper we present results from a research carried out in primary schools in the Republic of Macedonia aiming to assess the level of teachers' competencies with respect to ESD. The objective of the study is to explore the perceptions and views on teachers' competencies in relation to education for sustainable development. For this purpose as research instrument we have designed and applied an online questionnaire on separate samples of teachers and students. The gained results from the empirical analysis are used to promote the awareness amongst teachers about the development of ESD competencies in order to become more alive and integrated within the existing education curriculum.

Keywords: education for sustainable development (ESD), teachers' competencies.

1. Introduction

This paper focuses on the concept of "competences for sustainable development" as one specific area of competence-based and competence oriented education. Competences for sustainable development are defined, starting from the idea that the complexity of current and future societal problems cannot be addressed using classical education models, which focus on knowledge transfer (Wiek et al., 2011). This paper elaborates one specific link related with integrated ESD content in the science curricula in Macedonian primary education and teachers' competences for ESD. Worldwide societies generally expect educational systems to prepare young people for their future professional life and/or continued studies, the Republic of Macedonia being one of these countries.

The educational system is seen as having a socializing role and is expected to contribute to preparing young people to take up their responsibilities in helping to shape the complex society in which we live. Due to this reason, during the mid-sixties and early seventies, a so-called adjectival education was introduced into the curriculum of many educational systems. The adjectival education comprises several types of education such as: environmental education, health education, citizenship, peace education, etc. In this context the Republic of Macedonia has so far put lot of efforts to follow the examples of good practice from other countries worldwide.

The introduction of sustainable development in the curriculum of both primary and secondary education is therefore strongly recommended by several international organizations such as UNESCO and UNECE. This is the reason why Macedonian educational system is trying to incorporate social, economic and ecological aspects in the curriculum of many different subjects, all together recognized as education for sustainable development. However, this implies that education for sustainable development requires competencies, developed with a more holistic approach, rather than the reductionist approach which is common in traditional educational systems. It is necessary for teachers to increase competencies for ESD

if they want to envisage themselves as individuals who are in a dynamic relationship with their students, colleagues and the wider society.

This means that teachers should no longer be just the communicators of knowledge, but members of an institution, which has a collective focus on the way all its members learn and develop and all of those people are involved in the dynamics of a society that is seeking to confront the issues of sustainability. For all these levels teachers need specific competences for education for sustainable development. Competencies for ESD of teachers concerns real life problems and issues and require creation of learning opportunities for the students in the society. Having in mind these considerations, the paper is structured as follows. In Section 2 we present the origin of the idea for ESD followed by elaboration of competencies for sustainable development in Section 3. The methodology of research and description of the analyzed data is subject of Section 4. Finally, the main conclusions and recommendations are outlined in Section 5.

2. The origin of the idea for ESD

According to the Sustainable Development Education Panel Report in 1998, education for sustainable development (ESD) is about the learning needed to maintain and improve our quality of life and the quality of life of generations to come. ESD enables people to develop the knowledge, values and skills to participate in decisions how we do things individually and collectively, both locally and globally, that will improve the quality of life now without damaging the planet for the future. ESD is essential for the achievement of a sustainable society and is therefore desirable at all levels of formal education and training, as well as in non-formal and informal learning (Council of the European Union, 2010). Therefore, the negotiations for the Fifth Ministerial “Environment for Europe” Conference, which took place in Kiev in 2003, saw the emergence of a UNECE initiative on education for sustainable development. At the Conference, Ministers gave the green light to draw up a regional Strategy on ESD.

In 2005 in the Lithuanian capital Vilnius, less than two years after the Kiev Conference, Ministers and other officials from education and environment Ministries from across the UNECE region adopted the UNECE Strategy for ESD. The Strategy is a flexible framework for implementing ESD and is to be adapted by countries based on their needs and priorities. The UNECE Strategy for ESD's main aim is to encourage countries to integrate ESD into all forms of their education systems and covers all levels from primary to tertiary education, including vocational and adult learning. The report by WCED (1987) recognized that “sustainable development requires changes in values and attitudes towards environment and development” (p. 111) and that education has to play a central role in achieving those changes in values and attitudes. ESD means including key sustainable development issues into teaching and learning, such as poverty alleviation, citizenship, peace, ethics, responsibility in local and global contexts, democracy and governance, justice, security, human rights, health, gender equity, cultural diversity, rural and urban development, economy, production and consumption patterns, corporate responsibility, environmental protection, natural resource management and biological and landscape diversity. It also requires participatory teaching and learning methods that motivate and empower learners to change their behavior and take action for sustainable development. ESD consequently promotes competencies like critical thinking, imagining future scenarios and making decisions in a collaborative way.

The way competences for sustainable development are integrated in education is examined and described in different settings (e.g. Cortes, 2010, Lambrechts et al., 2010, 2012, Segalas et al., 2009). As many authors point out, there should be a strong emphasis on system thinking, future thinking and the ability to deal with uncertainties (De Haan, 2006, Rieckman, 2012, Roorda, 2010, Sleurs, 2008, Wiek et al., 2011). However, these competences remain poorly integrated in our education system (e.g. Lambrechts et al., 2012). Moreover, methods and techniques to acquire these competences for sustainable development are appropriately described. Lambrechts et al. (2012) distinguished three methods: (i) interactive and participative methods, (ii) action oriented methods and, (iii) research based methods. Research competences and research-based education methods could create a relevant contribution to the acquisition of competences for ESD.

3. Competencies for sustainable development

In order to prepare students to cope with complex challenges, take action and achieve sustainable societies, there's a need to rethink the mission of schools. Mochizuki and Fadeeva (2010) and Sleurs (2008) point out that the integration of competences for sustainable development into education, could be a first stepping stone towards sustainable education and serve as a basis for a change in curriculum and education pedagogies.

Competences for sustainable development exist in various forms, definitions, settings and interpretations. Several authors defined these competences as offering a complete set of knowledge, skills, values, and attitudes, necessary to ensure that graduate students are able to cope with the complexity and uncertainty of sustainability issues (e.g. De Haan, 2006; Jucker, 2011; Roorda, 2010; Rieckmann, 2012; Sleurs, 2008; Wiek et al., 2011). De Haan (2006), Rieckmann (2012) and Roorda (2010) defined key competences for SD, applicable for all teaching subjects. Moreover, UNECE (2012) has identified core competences for ESD for educators. In this context, 40 competences in total are divided into four clusters:

- learning to know (refers to understanding the challenges that society faces both locally and globally and the potential role of educators and learners);
- learning to do (refers to developing practical skills and action competence in relation to education for sustainable development);
- learning to be (addresses the development of one's personal attributes and ability to act with greater autonomy, judgment and personal responsibility in relation to sustainable development);
- learning to live together (contributes to the development of partnerships and an appreciation of interdependence, pluralism, mutual understanding and peace).

In line with the UNESCO pillars, formulated by the International Commission on Education for the Twenty-first Century in 1996, the suggested framework of core competencies in ESD for educators identified by the above-mentioned Expert Group intends to serve as a guide to what educators should know, what they should be able to do, how they should live and work with others, and how they should be if they are to contribute to ESD. The competencies are clustered around the following three essential characteristics of ESD: a holistic approach, envisioning change, and achieving transformation.

The acquisition and assessment of competences for ESD require different ways of teaching and learning (Sterling, 2004; Wals en Jickling, 2002), which focus on experiential learning, reflective learning, participative learning, active learning, creativity, collaboration, problem solving, practice based learning, transdisciplinary approach and self-regulation. A multitude of learning methods, techniques and tools are described to teach and assess competences for sustainable development (e.g. Ceulemans and De Prins, 2010; Scoullas and Malotidi, 2004; Steiner and Posch, 2006; McKeown 2002; Lambrechts et al., 2009; Peeters, 2010). Analysis of these methods showed that there are three main characteristics of teaching and learning methods for competences for SD (Lambrechts et al., 2012):

- interactive and participative methods: e.g. Socrates method, group discussion, role play, group or personal diary, brainstorming, peer assessment, etc.;
- action oriented methods: e.g. learning through internships, solving real community problems, outdoor education, etc.;
- research methods: e.g. bibliographic research, problem analysis, value clarification, case studies, concept mapping, etc.

4. Methodology and data analysis

The most common projects in the Republic of Macedonia's educational process are related to the fields of interethnic integration, computerization, decentralization and integration of environmental education, and many more. On the other hand, the education for sustainable development encompasses environmental education as only one of the three components and stands on the margins of interest of

both, professionals in the educational sector and policymakers. There is no involvement of public attention or institutional readiness in order to help incorporating this field into the educational system as a very important principle that must be integrated into existing curricula throughout the compulsory education starting from an early age.

Having in mind the above considerations, we have conducted a survey with an aim to scan the state of primary education and to determine the level and awareness of teachers in the field of natural sciences with respect to the competences for ESD.

Questionnaires for teachers and students were designed and sent to all primary schools throughout Macedonia. The sample of teachers consists of 306 respondents teachers in the field of natural sciences and related subjects (biology, chemistry and physics) from 179 schools. The sample of students consists of 310 respondents students from 91 schools in the country. The sample is representative and geographically well distributed, so it is correct to generalize the conclusions about the degree of incorporation of ESD in teaching in the Republic of Macedonia.

Answers from teachers, both male and female, from different age groups and with different experience in education, were received. The student questionnaire was largely completed by students belonging in higher grades of elementary education. The surveys were created and posted online by using Google forms. The direct link was sent to schools and science teachers in the entire country allowing teachers to easily connect and respond to the survey.

In order to explore the teachers' competences in ESD, we outlined the hypotheses based on the theoretical background about integrating the education for sustainable development in the process of natural science studies, as well as the level of competences in education for sustainable development among teachers who teach natural sciences in elementary schools. The hypotheses were formulated in the manner of comparing attitudes between two populations: teachers and students by using the *t-test* which was processed by using the software package SPSS. In addition, the goal was to identify potential significant differences in attitudes between teachers and students that would help us confirm or reject the research hypotheses. In order to create a distinguishing parallel between the answers given to same questions received from both, teachers and students, we stated a "null hypothesis" which in this case would mean that there are no statistically significant differences in the answers between students and teachers.

Whilst comparing teachers' and students' answers to the question "How many teachers who teach natural sciences in primary education have knowledge about the importance of education for sustainable development in the teaching-learning process", the *t-test* shows that at level of significance 0.05 there is a statistical difference between teachers and the pupils' opinions. In this case the *p-value* is less than the critical level, hence we can reject the null hypothesis since the risk of making an error when rejecting the null hypothesis is lower than the maximum allowed. The results from the performed *t-test* are presented in Table 1,

In this case, it can be noticed that teachers on average are more familiar with the significance of education for sustainable development in the teaching process in the field of natural sciences than the students. This could be interpreted that some teachers recognize ESD content in curricula, according to which the integration of appropriate content in the field of ESD has a significant impact on the implementation of this type of education in the process of natural science studies in the primary education. (Figure 1)

However, judging by the students' answers on the same question, it can be ascertained that the number of students who stated that they are not aware of the significance of this type of education in the teaching-learning process in the field of natural sciences is greater than the teachers, which leads to the conclusion that some of the teachers who stated that they recognize ESD do not transfer the same to their students, hence those teachers do not possess the necessary competences for ESD.

Figure 1

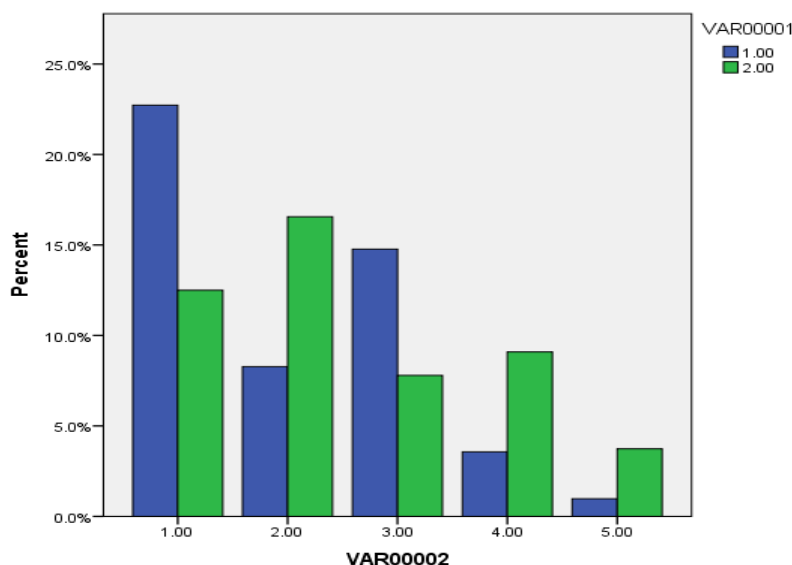


Table 1

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
VAR00002	Equal variances assumed	7.536	.006	-4.788	614	.000	-.45480	.09498	-.64132	-.26827
	Equal variances not assumed			-4.784	601.191	.000	-.45480	.09506	-.64149	-.26810

Regarding the second hypothesis which is stated as follows: "While teaching natural sciences teachers introduce elements of education for sustainable development wherever necessary" we came to a very interesting situation, because we received diametrically opposite answers from teachers and students. The obtained results from the t-test showed that at level of significance 0.05 the null hypothesis is rejected, hence there are statistically significant differences in attitudes between the teachers and the students. The results from the performed t-test are presented in Table 2,

The results show that the two target groups have conflicting views. Namely, teachers, to a large extent, consider that they incorporate elements of education for sustainable development wherever necessary, while students largely disagree with this view. These results confirm the hypothesis which states that the ESD competences of the teaching staff are extremely important for the implementation of this type of education in the process of studying natural sciences in primary education. In this case, there is a clear indication of the lack of teachers' competences in the field of ESD, which has been revealed by students' general perception that they do not recognize ESD content throughout the teaching process. (Figure 2).

Figure 2

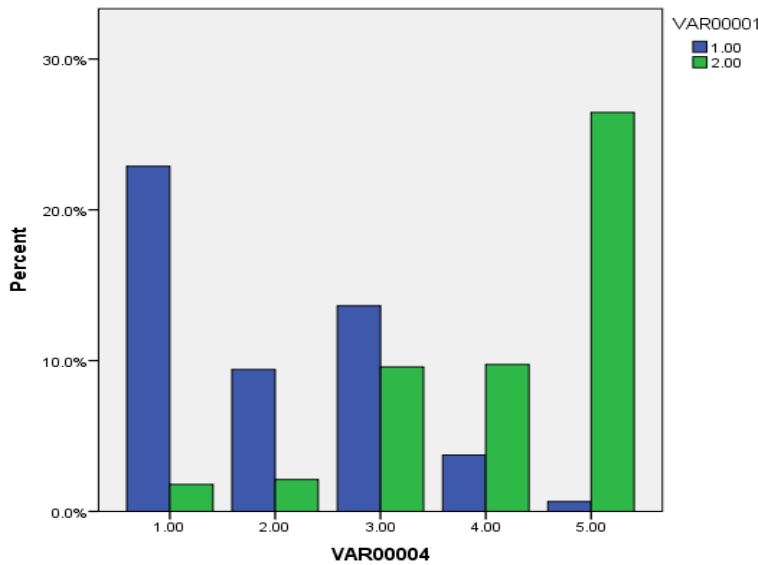


Table 2

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
VAR 00004	Equal variances assumed	.012	.913	-24.578	614	.000	-2.14383	.08723	2.31513	1.97254
	Equal variances not assumed			-24.574	613.109	.000	-2.14383	.08724	2.31516	1.97251

One of the key hypotheses that show how students and teachers identify environmental education as sustainable development education is stated as follows *"I know how to make a difference between education for sustainable development and environmental education"*. The statistical data, processed by using a t-test showed that at level of significance 0.05 there is not enough evidence to reject the null hypothesis, i.e. there is no statistically significant difference among teachers and students' responses. Most of the respondents stated that they do not recognize difference between education for sustainable development and environmental education, which is one of the three main ESD components along with the economic and social one. The results from the performed t-test are presented in Table 3, while the graphical depiction is shown on Figure 3.

Figure 3

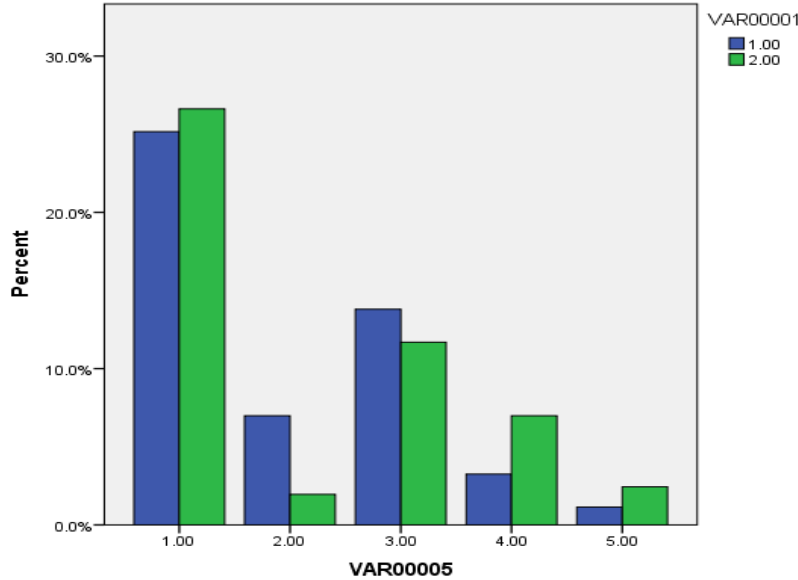


Table 3

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	T	Df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
VAR 00005	Equal variances assumed	33.264	.000	- 1.586	614	.113	-.15648	.09868	-.35028	.03731
	Equal variances not assumed			- 1.584	593.087	.114	-.15648	.09879	-.35051	.03755

The fact that teachers and students identify ESD as environmental education is confirmed testin the hypothesis that *classes related to sustainable development education are actually ones that teach ecological content*. The results from the t-test at level of significance 0.05 lead to the acceptance of the null hypothesis which suggests that there is no statistically significant difference in the attitudes between the teachers and students with respect to the above hypothesis.

These results confirm the hypothesis that *"Teachers' knowledge and skills in relation to the education for sustainable development are identified as ones belonging to the field of ecological education"*, as well as the hypothesis stating that *"Students identify education for sustainable development as ecological education"*. Such results point out to the fact that teachers in natural sciences do not consider as multidisciplinary issue when processing certain contents, or otherwise said, they do not integrate different scientific disciplines throughout the realization of content that could be related to a specific ESD goal. For example, a teacher should be prepared to teach a topic, not only from the environmental, but also from the economic, cultural, historical, social and ethical perspective if he/she wants to incorporate education for sustainable development in teaching processes. The results from the performed t-test are presented in Table 4, while the graphical depiction is shown on Figure 4.

Figure 4

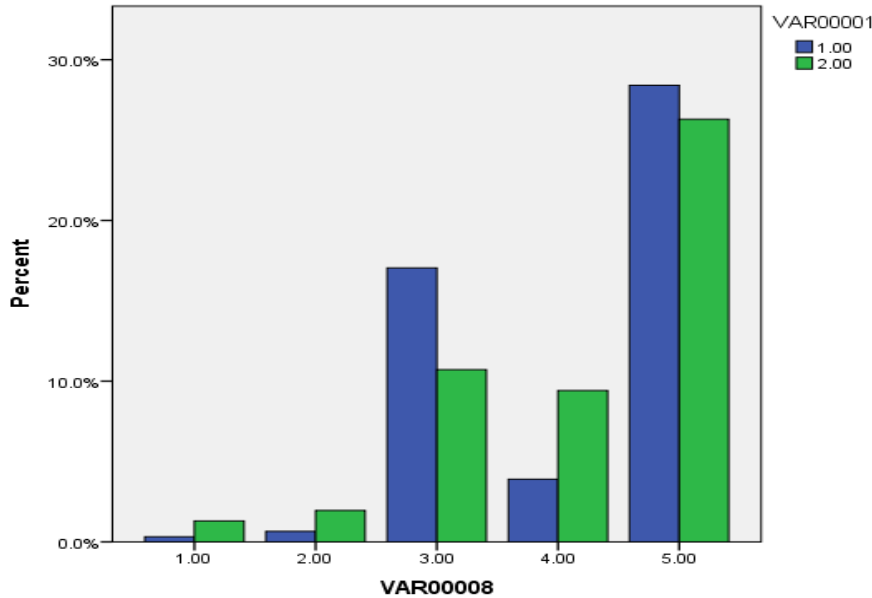


Table 4

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	T	df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
VAR 00008	Equal variances assumed	.732	.393	.288	614	.773	.02378	.08255	-.13834	.18590
	Equal variances not assumed			.288	610.451	.773	.02378	.08259	-.13840	.18597

Furthermore, we analyze the hypothesis stated as follows: "The field of sustainable development is a continuously explained and mentioned topic throughout the regular education of natural sciences". The obtained results from the t-test show that at level of significance 0.05 we reject the null hypothesis, i.e. there are statistically significant differences in the attitudes of teachers and students with respect to the above hypothesis. The results from the performed t-test are presented in Table 5, while the graphical depiction is shown on Figure 5.

In this case, teachers increasingly agree that education for sustainable development is a continuous process that constantly accentuates and explains to its students, while students largely disagree with this statement. These results emphasise that while teachers are aware of the incorporation of certain content from OER in natural science curricula, however, they do not skillfully direct the way of similar thinking among their students.

It is very important to nurture an interdisciplinary approach throughout the educational process which involves thinking and raising awareness about the strategic responsibility of each individual, including all necessary competences that in turn will enable students to work effectively towards a sustainable future.

If we look at the answers on this claim, it is of concern that the necessary competences among the surveyed teachers are not at an enviable level, which confirms the hypothesis that "The competences of the teaching staff responsible for ESD are of exceptional importance for the implementation of this kind of education in the process of studying natural sciences throughout primary education". In this case, we believe that the lack of competences for ESD among the teaching staff is inversely proportional to the process of successful implementation of this type of education in the process of studying the natural sciences.

Figure 5

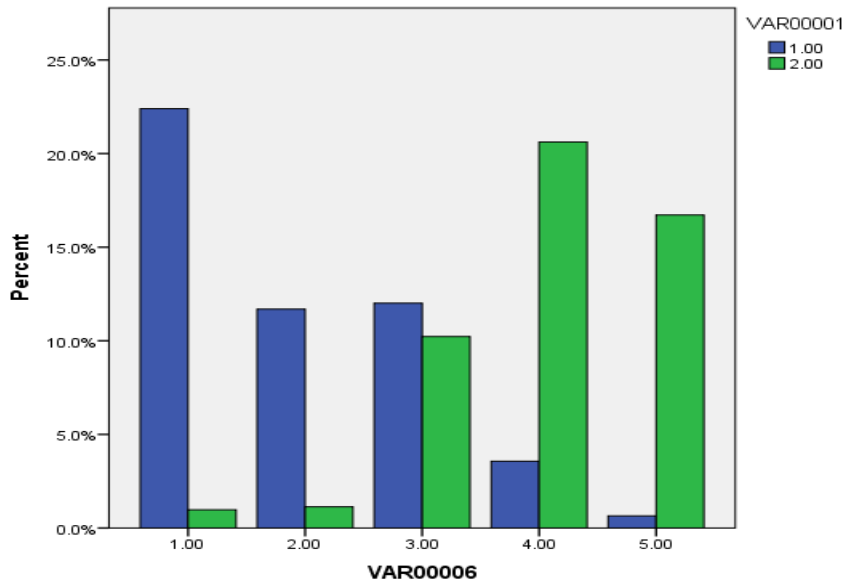


Table 5

	Levene's Test for Equality of Variances		t-test for Equality of Means							
	F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
								Lower	Upper	
VAR00006	Equal variances assumed	19.371	.000	26.119	614	.000	-2.05195	.07856	2.20623	1.89767
	Equal variances not assumed			26.143	603.556	.000	-2.05195	.07849	2.20609	1.89781

In addition we compared differences in response between the statement formulated in the student questionnaire, stated as "Teachers in the field of natural sciences often share the goals of ESD during our classes with us" with the statement from the teacher questionnaire, "I often use the opportunity to talk to my students about ESD's goals during regular teaching processes". By using a t-test we obtain that at level of significance 0.05 we reject the null hypothesis, i.e. there are statistically significant differences in attitudes between teachers and students with respect to the above hypothesis. The results indicate that teachers, unlike students, think that they share ESD goals during the process of teaching. The results from the performed t-test are presented in Table 6, while the graphical depiction is shown on Figure 6.

Again this finding confirms the differences in perceptions among teachers and students. It is very important that teachers form a new teaching approach that will largely differ from their current one.

Sharing learning objectives is an essential part of that process, and if teachers incorporate ESD goals since the beginning of the class, their students will accordingly change their way of thinking over time. Namely, they would develop the awareness of connecting knowledge with everyday life experiences, through critical and analytical thinking in terms of ESD. Teachers, and through them students as well, need to become aware that education for sustainable development is not simply the acquisition of knowledge and skills, but an overall approach that provides motivation and a desire for sustainable actions that lead to a sustainable future.

Figure 6

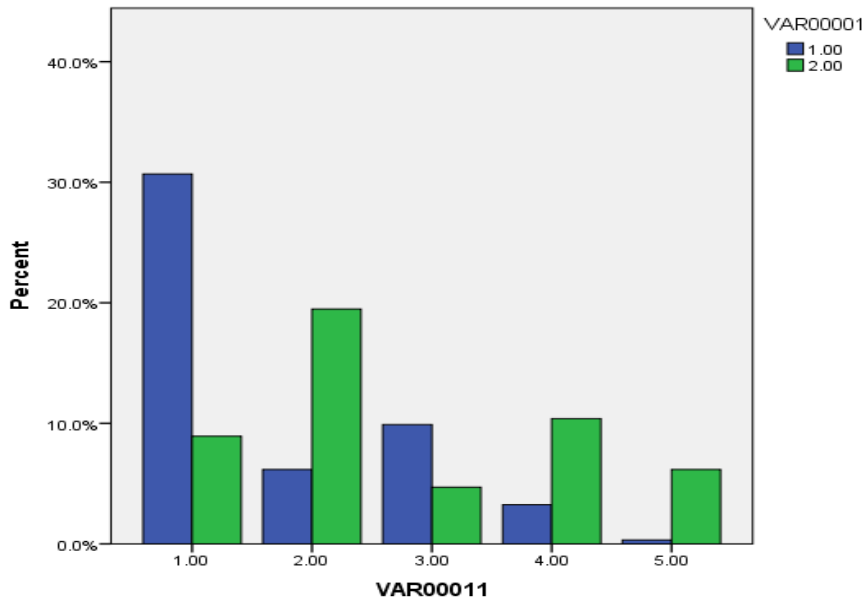


Table 6

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower		Upper
VAR00011	Equal variances assumed	36.313	.000	-10.200	614	.000	-.97040	.09514	1.15724	-.78356
	Equal variances not assumed			-10.184	576.178	.000	-.97040	.09529	1.15756	-.78324

Finally, we analyze worldwide political developments associated to sustainable development by paying particular attention to the UN Agenda 2030, which was adopted in September 2015. By comparing the attitudes of students and teachers related to the statement "*I am familiar with the Agenda 2030's sustainable development goals*" we obtain results that showing that at level of significance 0.05 we reject the null hypothesis. This shows statistically significant differences in attitudes between teachers and students regarding the above hypothesis. The results from the performed t-test are presented in Table 7, while the graphical depiction is shown on Figure 7.

According to our findings teachers are more familiar with the sustainable development goals for the period 2015-2030, formulated in the Agenda 2030, as opposed to students. This is an additional confirmation of the previous insights obtained from the statistical assessment of attitudes, which suggests that teachers do not use a sufficiently holistic and integrated approach in terms of implementation of ESD in the teaching-learning process.

Figure 7

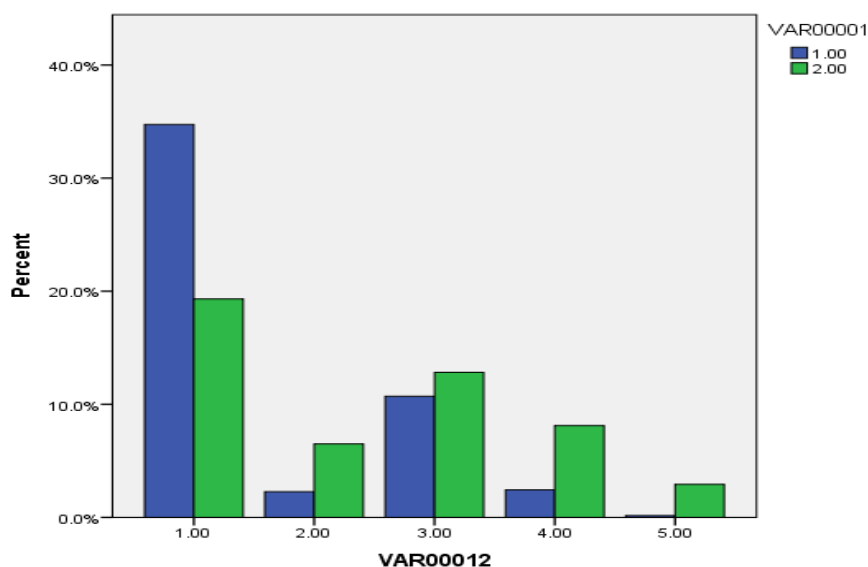


Table 7

		Independent Samples Test									
		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
										Lower	Upper
VAR00012	Equal variances assumed	47.546	.000	-7.965	614	.000	-.74352	.09335	-.92683	-.56020	
	Equal variances not assumed			-7.952	570.839	.000	-.74352	.09350	-.92717	-.55986	

5. Conclusion

Education for sustainable development is not only a topic in the curriculum that remains at the theory-level, while it requires acquisition of skills through action. When it comes to promoting ESD, the most intensive role is played by teachers in natural sciences, because of their connection to teaching topics that encompass one of the three segments of sustainable development, and that is the environment. Although the past performance of most teachers in natural sciences is recognizable, it is still necessary for them to find a way for a more intensive involvement in providing education for sustainable development through personal changes, mutual cooperation, dialogue, research and exchange of experiences, communication with other educational programs, as well as continuous improvement of their competences in terms of education for sustainable development.

According to our analyses, there is a lack of key competences for ESD among the science teachers in the Republic of the Macedonia. Traditional teaching methods based on rather passive lecturing and focused on transmission of knowledge are insufficient to acquire key competences for ESD. There's no evidence of a clear preference for active, student-centered and real-world learning methods. The outcome of recognizing the ESD competencies is a reflective teacher with pedagogical thinking who is able to develop as a practicing teacher in changing circumstances.

The teachers' and students' attitudes show that knowledge and subject competencies approaches for ESD in the science curricula in primary education in Republic Macedonia tend to focus on the environment. They may refer to broad sustainable development concepts and skills (e.g. values, citizenship) but, not generally to specific sustainable development subject matter or knowledge. Curricula guidance is needed for formal education systems which go beyond environmental education to teach students about sustainable development. This includes the more complex concepts and thinking related to sustainable development, including systems and measurement approaches. Subject competencies for ESD can be linked to other competencies such as social and personal and, to sustainable school practices.

OECD proposed ESD curricula approach for ESD competencies. Here, teaching progresses from giving students a solid understanding of basic economic, environmental and social concepts (primary level), to explaining interdisciplinary concepts and the need for integrated approaches (secondary level), to studying the state-of-the-art in sustainable development governance, measurement, assessments and practices (tertiary level). This approach could be adapted by countries to suit their own educational systems and culture, as generally based on the following elements: courses, concepts, systems, measurement and practices.

Namely, sustainable development should be part of core curricula at all school levels, which will differ in the degree of course integration. At primary level, the basic concepts associated with each pillar should be taught broadly as part of existing lessons or courses. Curricula should progress in complexity in terms of integrating the three sustainable development pillars. In primary school, a foundation in economic, environmental and social concepts should be established. The sustainable development concepts can be illustrated by placing them in the context of relevant systems. At primary level, economic markets (supply and demand), ecosystems (environmental diversity), and social systems (society and its actors) should be explained. Quantitative and qualitative approaches to measuring the three pillars and their integration should be taught together with basic concepts and systems. At primary level, these could relate to wealth (GDP per capita), ecological and carbon footprints, and participatory processes such as voting. Developing subject competencies should be accompanied by practical experiences to develop social and personal competencies. Starting from the earliest years, participatory learning strategies can produce the attitudinal and behavioral changes and values (tolerance, solidarity) needed for sustainable development. In addition, it is worth to mention that there exist a wealth of Internet tools and other materials for applying learning in a variety of real life contexts. For example, at primary level these include many environmental activities of eco-schools.

This simple analysis is an incentive for a larger research that could encompass the genesis, history and policy development for ESD worldwide including the Republic of Macedonia. The main goal is to raise the level of teachers' competences in education for sustainable development. In this context, we should mention the Einstein's quote: "We cannot solve a problem that we have created ourselves, in the same manner of thinking that was previously initiated." Accordingly, in order to achieve the goals when protecting the environment by using ESD principles, the basic precondition is personal change of each individual.

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