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Comparative Study of Knowledge and Attitudes of Secondary Students on Water Issues

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Abstract

Water resources perform important functions for the biosphere and for all life forms. However development, overconsumption, and pollution endanger safe access to clean water in many areas of our planet. Are knowledge and attitudes of gymnasium students (age 14-15) on water pollution and water scarcity differentiated in relation to their counterparts of lyceum (age 16-17). The aim of the survey is to investigate and record the knowledge and attitudes of gymnasium and lyceum students on issues related to water pollution, scarcity and management, and the comparison of data from these two groups. The case study was chosen as the basic method, and the questionnaire as the research tool, because the questionnaire is the main technique used in social sciences. The sample consisted of 289 gymnasium students and 292 lyceum students. The questionnaire included 19 questions, and was administered 3-29 March 2014. In the sample, significant lack of knowledge is observed concerning the problems of pollution, the ways to tackle them, and the issues related to the management of water resources. Regarding the attitudes, the students seem to adopt a certain degree of environmental friendliness. Similar results, as far as environmental attitudes are concerned, were recorded in recent years in international literature. Concerning the knowledge of students on water pollution, scarcity, and management, lyceum students excel their counterparts of gymnasium. On addressing pollution and water scarcity, the lyceum students present a more positive attitude. This perhaps is due to the fact that lyceum students have stricter judgment than their gymnasium counterparts.

Keywords: Environmental education; pollution; water scarcity.

1. Introduction

In the modern world of mass production and over consumption the influence of industrial growth and technological progress on the environment is evident. Every human action involving the excessive

use of mineral and natural resources coupled with their by products, has serious consequences including irreparable damage to entire ecosystems (UNEP, 2011). These problems include climate change, pollution by toxic chemicals (Diamond, 2006: 20-21· Larrère, 2011: 43), change of use for natural ecosystems (Green et al., 2005), reduction of biodiversity at a threatening rate (Thomas et al., 2004· Dunn, 2005), social disorder (Georgopoulos et al., 2014), expansion of poverty (Dahl, 2009· Royal Society, 2012), environmental refugees (Petrakou, 2012) etc. Considering these issues, many researchers note that the worsening of environmental problems threatens the survival of all life on earth (Suzuki, 2010· Koroneos & Rokos, 2012· Griggs et al., 2013· IPCC, 2014).

The qualitative and quantitative environmental degradation increasingly exposes terrestrial and underground freshwater stocks and planet's aquatic ecosystems to significant risks (Corcoran et al., 2010). Water, although it is a primary asset for all life, and especially for humans, as it offers food, health, entertainment, culture, and improves the standard of living, it gets littered, polluted and eventually turned into waste mainly through industrial activity and energy production (Tzaberis et al., 2010).

It cannot be denied that the combination of continuous degradation of water quality, the growing demand for water, and the scarcity of water limits the economic and social development of a region (Singh, 2007). Worldwide, it is estimated that in the last century water demand increased tenfold due to the rising needs in agriculture, industry, and modern lifestyle (Psilovikos, 2006). Solving the water problem appears tragically compelling when one considers that the world population is expected to reach 9 billion by 2050 (UNFPA, 2009), while official estimates indicate that 7 billion people will be facing water scarcity by that time (Vesterager, 2009).

Seeking solutions, attention turns towards Integrated Water Resources Management with the objective to balance supply and demand based on three categories of action (Thomas & Durham, 2003): protection through the development of local water resources, reduction of demand and finding alternative resources. The last action includes water reuse of treated wastewater and rainwater (Bakir, 2001· Zhou & Tol, 2005· Gikas & Tchobanoglous, 2009· Alfarra et al., 2011). The integrated management of water resources is considered a system of analysis and action planning that is part of the environmental, economic, institutional, social and technological context of the area (Davis, 2007). In recent years, in particular, it is gaining importance as its political and social character becomes increasingly recognized (Davis, 2007· Mollinga et al., 2007· Saravanan et al., 2009). However, a management plan to be successful and timely, it should include a self-evaluation and improvement mechanism (Georgakakos, 2006).

In order to implement essential solutions, knowledge, awareness and a positive attitude is required that is based on a code of ethics for all organisms and ecosystems (Kaila et al., 2005: 11). A prerequisite for dealing effectively with environmental problems is the development of ethical values (Jickling et al., 2006), and it can be established through appropriate education (Stevenson, 2007). Education for the environment and its sustainability with appropriate methods and teaching techniques (Sauvé, 2002· Mogias, 2011) constitutes an important medium that can bring profound changes in human society by enhancing its connection to nature on a consistently sustainable basis (Dahl, 2012· Huckle, 2010: 136). The challenge in this educational process is to understand the concept of

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sustainability (Flogaiti & Liarakou, 2012). Furthermore the principal agent for implementing environmental education programmes, in order to accelerate reaching the goal of global sustainability is the school (Arbuthnott, 2010).

In view that every research in environmental education can contribute to improving the efficiency of the programmes, the aim of this survey is to investigate and record the knowledge and attitudes of gymnasium (14-15 year olds) and lyceum (16-17 year olds) students on issues related to water pollution, scarcity and management, and the comparison of data from these two sample groups.

2. Research methodology

The sample consists of 581 students with a participation rate of 49.7% gymnasium and 50.3% lyceum school students. The research population was selected from Rhodes northern triangle; this choice was dictated by the fact that this urban complex concentrates the largest population of the island leading to the greatest water consumption, more drilling, a large production waste, and six wastewater treatment plants.

The case study is the research's basic methodology and the questionnaire was chosen as the most appropriate tool for data collection. The questionnaire consists of 19 main questions, prepared in accordance with specific instructions from the literature (Papanastasiou & Papanastasiou, 2014: 64-67), in order to cover the research topics. It aims to gather insight on three types of information: knowledge, values and preferences, attitudes and beliefs. The final questionnaire was administered during the period 3-29 March 2014 through researchers personally visiting gymnasiums and lyceums of Rhodes.

The statistical data processing was performed using the SPSS application. In terms of statistical inference and relevance test between two categorical variables statistical criterion χ^2 was used (Andreadakis & Vamvoukas, 2005: 72-73). To test the relationship between a categorical variable with two levels and one variable at a five-point Likert measurement scale the t-test for independent samples was used after meeting the required conditions. For correlating two variables at the five-point Likert scale the correlation index ρ of Spearman was calculated.

3. Description and analysis of the results

Table 1 presents the selections of the respondents according to their school grade and in total at the research question regarding local issues related to water. From this table it is observed that half of the students (49.9%) state incorrectly that there is good management of water in Rhodes and 41.7%, also incorrectly reply that there is water sufficiency. Only 35.3% of the respondents know correctly that local water quality is good, while 52% declare that water in Rhodes is polluted. Only 12.6% declare the Lake of "Nanon" exists, a big percentage (67%) replies incorrectly that there is a Lake of Butterflies (instead of «the Valley of Butterflies»), and also they claim there are healing waters at the commonly known area called the Seven Sources (70.7%).

The differences among gymnasium and lyceum students were found statistically significant in several cases. In particular, the good quality of water was recognised well, according to official data of the Water Company by 42.8% of lyceum students in relation to 27.7% of gymnasium students ($\chi^2(1) =$

14.55, $p< 0,001$). Likewise, water sufficiency, according to official data, was chosen incorrectly by 37,4% of gymnasium students, in relation to 45,9% of lyceum students ($\chi^2(1) = 4.34$, $p = 0.04$). Equally, as far as the good management of water is concerned, it was chosen incorrectly by 54.3% of gymnasium students in connection to the lyceum students who also replied incorrectly but with a smaller percentage, 45.5% ($\chi^2(1) = 4.48$, $p = 0.04$). Finally, water contamination was incorrectly chosen by 54.3% of gymnasium in relation to 45.5% of lyceum students ($\chi^2(1) = 4.12$, $p = 0.04$).

Table 1. Frequency allocation of responses of the students research sample regarding local issues related to water.

Which of the following exist or are valid for Rhodes?	Gymnasium				Lyceum				Total				test of statistical significance	
	YES		NO		YES		NO		YES		NO			
	f	%	f	%	f	%	χ^2	*p*	f	%	f	%	χ^2	*p*
1. The lake of Nanon	31	10.7	258	89.3	42	14.4	250	85.6	73	12.6	508	87.4	3.01	n.s.
2. Good water quality	80	27.7	209	72.3	125	42.8	167	57.2	205	35.3	376	64.7	14.55	0.001
3. The healing waters of Seven Sources	201	69.6	88	30.4	210	71.9	82	28.1	411	70.7	170	29.3	2.12	n.s.
4. Water efficiency	108	37.4	181	62.6	134	45.9	158	54.1	242	41.7	339	58.3	4.34	0.04
5. The lake of Butterflies	183	63.3	106	36.7	206	70.5	86	29.5	389	67.0	192	33.0	3.71	n.s.
6. Water contamination	138	47.8	151	52.2	164	56.2	128	43.8	302	52.0	279	48.0	4.12	0.04
7. Good water management	157	54.3	132	45.7	133	45.5	159	54.5	290	49.9	291	50.1	4.48	0.03

n.s. = non significant

The results to the open sub-question "*Write briefly some evidence for any of the above you know better*" which aim to investigate and document the knowledge of the sample in relation to the main questionnaire described in Table 2.

It is observed that the highest percentage (64.2%) of the sample refrain from documenting the knowledge they claim to have. Of those who respond to the question 21.5% have a wrong approach and 14.3% a correct one. The differences between the two groups were found to be statistically significant (χ^2 (2) = 8,97, $p = 0,017$). Specifically, the wrong answer was chosen by a larger percentage of gymnasium students (26.6%), compared with 16.4% of lyceum students.

Table 2. Frequency allocation of responses of students of the research sample on the knowledge of local environmental issues.

Knowledge of local environmental issues	Gymnasium		Lyceum		Total		test of statistical significance	
	f	%	f	%	f	%	χ^2	*p*
Correct	39	13.5	44	15.1	83	14.3	8.97	0.017
Wrong	77	26.6	48	16.4	125	21.5		
No responses	173	59.9	200	68.5	373	64.2		
Total	289	100.0	292	100.0	581	100.0		

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The question "They say that in the future there will be many conflicts mainly about..." attempts to explore the sample's knowledge on water scarcity. Students are allowed to choose more than one answer among the proposed, as indicated in Table 3. The table's data suggest that the largest percentage of all students (53.9%) incorrectly stated "petroleum" as the source of conflict as compared to the 47.0 % who choose the correct answer, "water".

The differences shown in Table 3 between gymnasium and lyceum students were found in this question in both cases statistically significant. In particular, the choice of wealth was incorrectly chosen by a larger proportion of gymnasium students (20.1%) compared to lyceum students (13.0%) ($\chi^2(1) = 4.99$, $p = 0,02$) . Furthermore, a greater percentage (60.6%) of lyceum students correctly chose water as compared with the corresponding percentage of gymnasium students, which was significantly lower (33.2%) ($\chi^2(1) = 45.53$, $p<0,001$).

Table 3. Frequency allocation of responses on water scarcity as a potential cause of future wars.

They say in the future there will be many conflicts mainly about:	Gymnasium				Lyceum				Total				test of statistical significance	
	YES		NO		YES		NO		YES		NO			
	f	%	f	%	f	%	N	%	N	%	N	%	χ^2	*p*
Petroleum	146	50.5	143	49.5	167	57.2	122	42.8	313	53.9	268	46.1	3.21	n.s.
Food	36	12.5	253	87.5	46	15.8	243	84.2	82	14.1	499	85.9	2.19	n.s.
Wealth	58	20.1	231	79.9	38	13.0	251	87.0	96	16.5	485	83.5	4.99	0.02
Water	96	33.2	193	66.8	177	60.6	112	39.4	273	47.0	308	53.0	45.53	0.001
Energy	39	13.5	250	86.5	54	18.5	235	81.5	93	16.0	488	84.0	2.84	n.s.

n.s. = non significant

Table 4. Frequency allocation of responses on the knowledge of water scarcity causes in a region.

Knowledge for water scarcity	Gymnasium		Lyceum		Total		test of statistical significance	
	f	%	f	%	f	%	χ^2	*p*
Political dimension- Mass media	6	2.1	15	5.1	21	3.6	2.91	n.s.
Economical dimension	2	0.7	10	3.4	12	2.1		
Citizen's behavior	118	40.8	137	46.9	255	43.9		
Other	7	2.4	3	1.1	10	1.7		
Politics / Citizen's behavior	6	2.1	7	2.4	13	2.2		
Economics / Citizen's behavior	5	1.7	9	3.1	14	2.4		
No responses	145	50.2	111	38.0	256	44.1		
Total	289	100.0	292	100.0	581	100.0		

n.s. = non significant

The respondents are facing a dilemma: "The Judge Aristides D. is concerned whether he should impose a higher fine to the responsible of the small industry for polluting the lake or to the offender who cuts trees in the protected Natura area.»

This question seeks to detect the attitudes of the sample groups regarding the seriousness of water pollution. Students are asked to adopt the role of a judge assessing the gravity of the offense and impose the appropriate fine. The decisions of the sampled students are presented in the following tables.

Based on the results of Table 5 in relation to the person in charge of the small industry, from the statistical analysis of the survey data it is observed that the sample in total allocates responsibility with an average of 1.64. Specifically, the majority of gymnasium and lyceum students with rates of 43.6% and 58.6% respectively agrees that the small industry has very big responsibility for water pollution. The degree "enough" is supported by 36.0% and 29.8% and "moderate" by 12.1% and 6.5% respectively for the two groups. These differences among gymnasium and lyceum students were found statistically significant ($\chi^2 = 11,72$, $p<0.001$).

Table 5. Frequency allocation of responses on the attitudes towards water pollution in relation to the small industry.

To the small industry	Gymnasium (avg. 1.76 – s.d. 0.9)		Lyceum (avg. 1.52 – s.d.0.8)		Total (avg.1.64 – s.d.0.8)		test of statistical significance	
	f	%	f	%	f	%	χ^2	*p*
Very much	126	43.6	171	58.6	297	51.1		
Enough	104	36.0	87	29.8	191	32.9		
Moderately	35	12.1	19	6.5	54	9.3		
Slightly	6	2.1	5	1.7	11	1.9	11.72	0.001
None	4	1.4	2	0.7	6	1.0		
No responses	14	4.8	8	2.7	22	3.8		
Total	289	100.0	292	100.0	581	100.0		

In regards to illegal logging, from the results of Table 6 it is observed that the sample in total assesses this practice with an average of 1.86. The majority of both gymnasium students (36%) and lyceum students (46.6%) argues that the logger brings very big responsibility for this activity. As seen from the frequencies of responses between students of these two grades the difference recorded is not statistically significant with $\chi^2 = 3.10$ and $p> 0.05$.

Table 6. Frequency allocation of responses on the attitudes towards water pollution in relation to illegal logging.

To the illegal logger	Gymnasium (avg. 1.94 - s.d. 0.9)		Lyceum (avg. 1.80 - s.d. 0.9)		Total (avg. 1.86 - sd.0.9)		test of statistical significance	
	F	%	f	%	f	%	χ^2	*p*
Very much	104	36.0	136	46.6	240	41.3		
Enough	98	33.9	88	30.1	186	32.0		
Moderately	43	14.9	46	15.8	89	15.3		
Slightly	16	5.5	10	3.4	26	4.5	3.10	n.s.
None	4	1.4	4	1.4	8	1.4		
No responses	24	8.3	8	2.7	32	5.5		
Total	289	100.0	292	100.0	581	100.0		

n.s. = non significant

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The question "Which of the following enrages you more?" attempts to trace the attitudes of the sampled students on water scarcity and the importance of water efficiency. Respondents are asked to score their degree of indignation on each of the listed issues counting from 1 to 5, with 1 being the most important. For the purposes of the research question five topics for evaluation are proposed: the garbage on the beaches, the lack of recycling bins in a city, water running uncontrollably from a pipe on the sidewalk, the lack of infrastructure for people with disabilities and the stench of sewers.

In Table 7 the analysis of the results presents that the issue which enrages the students most is the stench of sewers with a means of 2.90, while the water running uncontrollably from a pipe at the pavement is stated with enough deviation as a second choice with a means of 3.20. Furthermore the students state the lack of recycling bins in a city with a means of 3.24, the lack of infrastructure for people with disabilities with a means of 3.20, and the garbage on the beaches with a means of 3.33. Statistical significant difference is presented in one case only: the gymnasium students reply that they are more enraged that their lyceum counterparts for the garbage on the beaches to a statistical significant degree ($t(453) = 2.52$, $p = 0.012$).

Table 7. Means and standard deviations of responses on the attitudes towards water scarcity.

Which of the following enrages you more?	Gymnasium		Lyceum		Total		test of statistical significance	
	avg.	sd.	avg.	sd.	avg.	sd.	t	*p*
Garbage on the beaches	3.54*	1.544	3.17*	1.565	3.33	1.565	2.52	0.012
Lack of recycling bins in a city	3.31	1.384	3.19	1.251	3.24	1.309	1.52	n.s.
Water running uncontrollably from a pipe on the sidewalk	3.34	1.346	3.09	1.392	3.20	1.377	1.86	n.s.
The lack of infrastructure for people with disabilities	3.45	1.390	3.16	1.332	3.29	1.363	1.81	n.s.
Stench of sewers	2.87	1.569	2.92	1.635	2.90	1.605	1.01	n.s.

Asterisk (*) stands for cases of statistical significance at level $p < 0.05$
n.s. = non significant

4. Conclusions

From the survey results analysis, in terms of the students' knowledge, it is observed that the majority of students have considerable shortcomings and misunderstandings in their knowledge on local ecosystems and the issues related to water quality and water sufficiency on the island of Rhodes. Students seem to know that urban waste water is an important factor that significantly pollutes the planet. Also, students recognize the impact of dumping municipal sewage directly into the sea without treatment, i.e the disturbance of marine biodiversity and the negative effects on human health from infectious diseases. Furthermore, results indicate that students have knowledge on water scarcity, which concerns water efficiency, saving, and recovery. Fewer than half of the sampled students know that future conflicts will be about water, and that the citizen's behavior may cause water shortage in an area. Additionally, few know about the possibility of recycling waste water. Concerning the sources for acquiring knowledge about environmental issues, students primarily mention school and family. Results indicate that the lyceum school students appear to possess more knowledge regarding water as compared to their younger, gymnasium counterparts.

Regarding attitudes towards the environment, the survey indicates that students are in general terms positive. In particular, the attitudes of lyceum students present them as more sensitized than gymnasium students towards almost all the issues related to water pollution, water scarcity and integrated water management. In many cases lyceum students appear to be harsher critics in comparison to gymnasium students as to the attribution of responsibility for environmental problems, the measures to be taken, and penalties to be imposed. However, students do not justify their choices often.

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