

Geoenvironmental Knowledge as Frame Foundation of Environmental Conscience

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Abstract. *In the framework of the present research is attempted to explore the provided geological knowledge in the modern Greek school with emphasis on the use of this knowledge in Environmental Education. The results of the research, come from the content analysis of school handbooks of secondary grade education, that contain elements of geology with base of a check list that was created as well as the analysis list that is proposed by the Greek Pedagogical Institute with the issues of Environmental Education. We state that geology is not related to the sensitive field of environmental education in Greek High School.*

Keywords. Environmental Conscience, Geoenvironmental Knowledge, Geology, Text books.

1. Introduction

We are in a critical transient period, where the rapid growth of Information and Communications Technologies (ICT), causes a real revolution with enormous and unanticipated consequences, in various sectors of human's activities. In these changes, progress and realization of science has contributed considerably.

The above changes influence also the school, which in order to remain an alive and creative institution, should convert in instructive strategies, modern pedagogical perceptions and created needs and requirements of society. More specifically, for

Natural Sciences' course, these changes will be supposed to lead to changes on Curriculum, on instructive strategies that are followed in Natural Sciences' course so that the education in the Natural Sciences will be in harmony with the nature of Natural Sciences as well as with society [1].

In last decades, it was presented in the didactic of Natural Sciences an international tendency, called "scientific literacy". This tendency leads to locomotion of Natural Sciences' didactics, from the clearly academic orientation, to a new prospect that takes into account the usefulness of knowledge in daily life. This new prospect gives accent not so much in this knowledge itself, but in its relation with the individual [2].

The connection of Natural Sciences with the environment and the environmental subjects is particularly important because there are enough common points with the suitable exploitation of which can be beneficial for both fields. For the configuration of systematic proposals, it is required a systematic investigation of questions that concerns so much in the frame of didactics of Natural Sciences and also the Environmental Education (E.E.).

2. The term "Environmental Education"

The Environmental Education emanated from the international environmental movement that was developed in decades of 1960 and 1970 [3]. The term "Environmental Education" was formulated for the first time in 1970 in Nevada of USA during the congress of

IUCN (International Union for Conservation of Nature and Natural Resources) on the subject E.E [4]. There was given also the first definition of E.E, as the process of values' recognition and clarification of significances, in order to develop dexterities and attitudes necessary for the comprehension and estimate interrelation of person, culture and biophysical environment.

The main axis of E.E for citizens and particularly young people is, as it has been determined in most important International Congress that the students apprentice and re-define their relation with the environment and become participants of the efforts for its protection. Nowadays, the E.E aims not only to the acquisition of knowledge and sensitization of citizens towards the environment, but also in the growth of faculties and attitudes and, foremost, in their attendance, so that there will be prevention and confrontation on environmental problems [3].

The E.E constitutes an educational process, which is directed in an environmental problem or subject. It includes case studies, actions and investigates alternative solutions [4].

3. The innovative character of Environmental Education in Greece

The Greek educational system corresponded to the prompts of international community in the dues of 70's, importing E.E, which was applied experimental, up to the end of 80's. The course of E.E in Greece constitutes an example of educational innovation, which began and advanced by the initiative of teachers themselves. Actually it consists for Greek teachers an alternative proposal to give vent to their concerns about the culture of teaching and learning that prevailed at the school. The E.E constitutes, for Greek teachers, an alternative proposal that gives an exit in their reflections, with regard in teaching and learning culture that prevailed in school. The E.E manages to shape a critical mass of teachers familiarized with different instructive approaches, from those that prevail in school [4].

The study of environment has interdisciplinary character and its knowledge is the subject of cultural and product, that has elements of culture from each population and reflects immediately in the action of society in the nature and reversely [5]. As the purpose of

the study of the E.E affecting the daily lives of students, it is obvious that the most appropriate teaching approaches are those that directly involve students in exploring issues to find solutions to them and to implement solutions.

The school programs of environmental education are materialised optionally, to differ completely from the school courses as for the planning, the issues, the educational methodology, the evaluation, and because of this these are characterized as innovative actions, because also their objectives and their methodology differ from the traditional education. These programs include various activities outside of the teaching rooms and after the school program.

The main axes of the cognitive content of E.E's programs are summarized in following: atmosphere - climatic changes, air, water, soil, forests, energy, biodiversity - disappearance of types, management of litter and outcast, human activities, human relations and values. Basic principles of E.E's programs constitute the interdisciplinary regard, the experiential approach, the opening of school in the society, the common work, the growth of the democratic dialogue and the culture of critical thought [6].

The E.E shapes a rich aspect for the growth of action and the culture of attitudes and values are related with those of the Natural Sciences [7]. As supported [8], it is an important ask, in now days, that the pedagogical core of the E.E., impregnates the course but also the teaching of Natural Sciences.

4. Methodological frame

Main source of data for our research constituted the written texts, which is material that has written form and official character, as the Curriculum and the school handbooks of High School and Lyceum, drawing different information of this document [9] and creating various categories. The categories should be exclusive and exhaustive, in regard to the plenitude representation of the subjects that examine [10].

The above elements constitute main inquiring material also for our previous studies [11]. In present research we studied also the proposed list from the Pedagogical Institute with issues and main axes of the E.E. Afterwards we categorized the proposed subjects of the Pedagogical Institute's list

depending on the content of their object in 3 basic categories that are presented in the table 1:

Table 1: Categories of E.E's subjects

Subjects of the E.E. that their study		
1	presupposes	geological and geoenvironmental knowledge
2	requires	
3	does not require	

5. The Inquiring method

According to the current Curriculum, in Greece autonomous Geology course does not exist in High School and Lyceum, thus it was selected for analysis, the school handbooks that contain elements of Geology. These books are: "Geology-Geography" and the exercise book of A' class [12] and "Geology-geography" and the exercise book of B' class [13] for high school, and "Beginnings Environmental Sciences" [14] and "Management of Natural Resources" [15] for B' class of Lyceum. For the content analysis of these books, is only fixed an aspect, which is the investigation of presence of Geology in these school handbooks in order to be connected with the E.E.

The analysis of the present research's content is limited, due to the level of Geological and Geoenvironmental provided knowledge. The page is considered as unit of analysis. Due to the categorization, the pages that contain or do not contain information are recorded, with regard to the content that each category examines. The content of school handbooks was examined separately by two specialists with the aide of an appropriate control list that constitutes the main methodological tool of our analysis.

6. The control list

Due to the above methodological frame, there was developed a tool for the analysis of

four school handbooks of Natural Sciences that we reported in the previous department of our article. This tool concerns in the creation of a control list and criteria for the classification of the information, in its subclasses. There are determined four main categories of the proposed list of control (Table 2).

Table 2: Main categories of the control list of the research

I.	Clearly Geological content
II.	Exist certain elements of Geology (immediately or indirectly) and could be much more
III.	Do not exist elements of Geology but could exist (immediately or indirectly)
IV.	There is not possibility to exist, elements of Geology

The final form of the control list resulted after overall research from colleagues, teachers that teach in High school and Lyceum and have enough instructive experience in corresponding rungs of education as well as in Environmental Education.

7. Results - Perspectives for the Environmental Education

From the elements of table 3, about subjects of the E.E. with clearly, geological content as well as table 4 about subjects the E.E, in which is required geoenvironmental knowledge, in Pedagogic Institute's list becomes explicit that Geology can be promoted considerably through the E.E, but also reverse. However, by our previous researches, the absence of geological and geoenvironmental knowledge from the current educational system [11], [16], can mean also, failure of the E.E, because of the applying without the geological element of environment.

Table 3: Aspects of the E.E with clearly geological content, in Pedagogical Institute's list

	Thematic axis	Aspects of the E.E with clearly geological content
1	Protection of atmosphere and climatic changes	Cross-correlation of climatic conditions with the production, the layout, the erosion, the floods, the natural and anthropologic traits.
2	Water	Operation of circle of water. Factors that disturb him. Surface and aquatic resources.

3	Ground	Study local, national, world bas-relief (natural, geological and historical).
		Management of bas-relief, cultures, layout, tunnels, drainage work, dams, piscicultures.
		Types of soil and rocks - Excavation of rocks, mining
		Erosion of ground
4	Forests	Dangers of forests and their protection Erosion of grounds
5	Management of wastes	Management of solid waste, watery sewages, chemists toxic, radioactive waste etc.

Table 4: E.E.'s subjects, for which is required geoenvironmental knowledge, in Pedagogical Institute's list

a/a	Thematic Axis	E.E.'s subjects, for which is required Geoenvironmental knowledge
1	Protection of atmosphere and climatic changes	Clarification of significance Climate- Contractions of simple meteorological bodies - Experiments - Recording and treatment of measurements.
		Relation meteorological and climatic with the movement of ground, changes of conditions of as resulting from human interventions.
		Imminent climatic changes because of the alleviation of layer of ozone, his appearance phenomenon of greenhouse.
		Exploitation of texts and semeiology of nature.
2	Water	The water as vital component of life.
		The water as biotope.
		Protection of rivers, lakes, seas, oceans and rational use and growth of living resources.
		The priceless value of water and his inopportunity.
		The water shortage.
3	Ground	Consequences from the bad management of ground
4	Energy	Energy production - consumption – Economy.
		Energy and Natural Resources.
		Exploitation of natural energy resources.
		Pumping, treatment, transport of first matters of combustion of raw material.
		The natural reserves are not inexhaustible.
		Nuclear Energy of use – Dangers.
		Renewable sources of energy - Soft forms of energy.
		Exhaustion of not renewable sources of energy.
		Overexploitation of natural resources.
5	Forests	The statement of beginnings on the protection and growth of forests.
		Forest- Growth – Environment
6	Biodiversity - Disappearance of species	Trophic chains of factors abiotic-biotic
		Consequences of human activities in the perturbation of diversity of nature.
		Respect in each form of life.
7	Management of litter	Recycling of paper, glass, aluminium.
8	Human activities	History of urban departments and manufactures.
		History of geographic places.

		Study of structured spaces and operations that are carried out in them
		Planning of buildings, cities, big work concerning the environment.
		Safety and functionalism in combination with the environmental and aesthetic perception for the manufactures and the transports.
		Relations of used materials of - pollution - economy.
		Relations between the layouts - pollution economy of quality of life.
		Cross-correlation of structured/technical environment with the natural destructions.

Afterwards we mention a qualitative analysis of E.E's subjects' content of the table 4, with the aspects of the E.E that are included in Pedagogic Institute's list, based on two categories of table 1; aspects that their study presupposes geological knowledge and aspects that their study requires geological and geoenvironmental knowledge.

Beginning with the subjects of the table 4 that their study presupposes geoenvironmental knowledge, this category has enough big frequency of appearance in five of ten main axes of E.E. These are:

- (a) protection of the atmosphere and climatic changes,
- (b) water,
- (c) soil,
- (d) forests and
- (e) management of litter.

We consider that the clarification of significances and the comprehension of environmental problems that is related with the erosion of coasts-ground, layout, floods, protection of aquatic and mining resources and their management as well as the management of solid or radioactive outcast, aquatic sewages and chemists toxic, is impossible to be achieved unless students know basic geological knowledge. This knowledge is not provided in students, according to the current Curriculum of High schools and Lyceum and is difficult to be covered through the optional programs of E.E, because in this case, E.E is in danger substantially and loses its innovative character and is changed in one still teaching course.

Since the interpretation of many environmental problems was reported more, as well as the processes that cause them, escape from the direct observation and often require increased faculty of abstract thought and combination of data; it is considered necessary, that students who will deal with some of these subjects, should already have acquired the pre-

requisite knowledge in daily program's courses. Thus, possessing the cognitive background of environmental problem, through the E.E's program, might practice themselves in the process of decision-making, in the configuration of the code of values and behaviors that are also the final objective of the E.E.

For the subjects of the table 4 that their study requires geoenvironmental knowledge, it will be supposed to be marked that the category has the biggest frequency of appearance in eight per ten main thematic axes of the E.E. Thus, in the five main axes of the previous category are added also other three, which are:

- (a) energy,
- (b) biodiversity - disappearance of species and
- (c) human activities.

It must be noted that for the approach of all proposed aspects of these axes, is required basic geological knowledge. If this becomes easily perceptible for the aspects of the unit "Energy", after being connected immediately with raw material that we take from the subsoil (mining coals, oil, geothermics etc.), we will examine the connection with the two other axes.

Geodiversity is expressed by the number or the crowd of types of landscapes that are presented in a region or in a country. Greece is a country that besides its small extent has big geodiversity and because of this, allocates big genetic diversity of species and ecosystems. It is recognized that the geological history, the multifarious topography and the bioclimatic variety of our country constitute the main reasons, for the wealth of Greek flora [17]. Biodiversity of Greece in the level of plant species, as it is expressed by the relation of the species' number and the extent of the country, is between the highest of Europe and Mediterranean [17].

It is obvious that despite the discrimination of biodiversity in different levels, protection should be faced as united, because the protection of each level depends from the protection of the previous or the next level. Meaning that the students should have basic geological significances so that “they see” the environment also geological, which means that there is not only alive plants and animal organisms, but also abiotic factors that are found in permanent interaction and interdependence with each other, rejecting thus, the isolation of cognitive fields and one-track causalities [17].

We examine also the main axis of E.E, “Human activities”, which according to the results of our research, all the proposed under review subjects presume basic geological knowledge and mentioning certain from the reasons, why we support this.

In Table 5, we present quantified, the results as have been registered in the three categories of the list, for the subjects of each fundamental axis of E.E, as they are reported

in Pedagogic Institute’s list and in which they entirety are 58. In the first category of table 5, there are registered subjects with clearly geological content and there have been recorded 9 subjects (15,5%), of which 4 correspond in the axis “Ground”, 2 correspond in the axis “Water” and by 1 the axes “Climatic changes”, “Forests” and “Management of litter”. In the second category, there are registered 36 total subjects that require, for their approach, basic geological and geoenvironmental knowledge (62%), which correspond in the main axes “Energy”, “Biodiversity” and “Human activities”. In the third category, for which geological knowledge is not essential, there are found 13 subjects (22,5%). Concisely, only 2 axes by 10, contain subjects that does not require geological elements, which are “Human relations” and “Air” and in the remainder 8, 45 subjects by 58 (77,5%), require knowledge of Geology and Geoenvironment.

Table 5: Quantitative elements for the categories of subjects of [P].[E] in the list the pedagogical Institute

a/a	Thematic axes of the E.E. in the list of P.I.	Subjects of Environmental Education		
		with clearly geological content	that require geological knowledge	that does not require geological knowledge
1	Protection of atmosphere and climatic changes	1	4	-
2	Air	-	-	3
3	Water	2	6	-
4	Ground	4	2	-
5	Energy	-	9	-
6	Forests	1	2	4
7	Biodiversity - Disappearance of Species	-	4	-
8	Management of litter	1	1	-
9	Human relations	-	-	6
10	Human activities	-	8	-
TOTAL		9/58 (15,5%)	36/58 (62%)	13/58 (22,5%)

8. Conclusions - Perspectives

Teaching of geology, as independent cognitive object in Analytic Programs of High School has progressively been disappeared over the recent years in Greece and has been fixed as additional department of other courses [11], [18].

Moreover, it has been decreased considerably its content in these courses, acquiring thus a fragmentary completely marginalized role in school. The disappearance of Geology, the abridgment of matter and its fusion with other courses, deprive students from important knowledge that is related with Geoenvironment,

undermining simultaneously and the E.E, which as central axis has the integrated viewing of the environment. It should also be marked, of course, that according to the improvement of the program of study (OFFICIAL JOURNAL OF THE HELLENIC REPUBLIC 304t. the b'/13-3-2003) [19], the title of the course Geography A' and B' grade of High school, changed in "Geology-geography" and so be it, with some delay, it has been circulated in the schools of our country, the new materials of teaching in September 2009. We consider important that with the new instructive parcels of courses (book of students, exercise book of student, book of professor and the material in digital form (CD) by the Pedagogical Institute), there is the will, from the State's side, for renewal of the school's role and the upgrade of concrete school objects.

This is also strengthened with the presence of the "Geology-Geography", as one of the four training objects in the attempted integrated application of teaching in the digital class of the A' grade of High school. Thus, it is recognized the particular character of objects and the need for their teaching, via modern optical means that can represent changes that become in big spaces and years. An effort that gives the opportunity to teachers, to teach Geology-geography with modern digital material (projection of training material via CD, internet and more) and use of PC with students in the classroom. Also, student has the possibility for further research in the house, so that he is initiated in the inquiring learning with effortless and pleasant way. The aim is that the modern class is corresponding in the requirements and the visions of now days for an education of open horizons, which "equips" suitably current student and prepares him respectively, so that he is included as citizen in a small world but simultaneously big.

Even if the intention of new handbooks' writing was to change the philosophy of teaching geology-geography, the writers of school book of A' class declare that their aim is the upgrade of geographic education and, always accordingly with the writers, they try to strengthen the geological knowledge that has direct relation with Geography. They explain their decision, with the argument, that the causes of geological phenomena are not in direct observation and consequently they require important faculty of abstract thought, which the students of the two first classes of High school do not allocate. That is why geological knowledge was added, with base the new curriculum, were limited in

phenomena, which influence immediately the form of the Ground surface.

For the upgrade of school geology, the structure of the lesson should follow a continuous flow in all rungs of education, in order that student becomes capable to shape perceptions for the life and the environment and to evaluate new knowledge under the light of his new perceptions.

We argue that current school, in order to be modern, should include in obligatory knowledge's subjects that are related with natural destructions and their management, the management of aquatic resources and mining materials, the activities in the surface of ground that influenced the development of life until the appearance of human and subjects of nature's monuments' maintenance. Our country, in all its extent, has places that are suitable to explain natural processes, and also history of the ground with real way. However, it is needed regulation on the hours of teaching in such a way, that the united time spared in classroom, ensures not only the quantity offered knowledge, but mainly the quality. The enrichment of school laboratories of Natural Sciences with material suitable for laboratorial exercises of Geology is essential in combination with possibilities which the ICT offers. Today such thing is feasible because most of schools in our country allocate laboratories of computers and access in the internet.

From the total regard of the results of this study, it is realized, that today, in High School of our country, Geology is not useful in nothing and is not related with the sensitive sector of E.E. Geology as environmental and intersectorial science should acquire in school, the place that deserves in order to contribute in E.E.'s upgrade. We appreciate that the conclusions of present research could constitute starting line for reflection subjects that concern in the place that Geology has in Greek school, and its presence in E.E. Also it can be taken into account at planning and concretization of proportional researches and generally, enriches the inquiring data in the space of education.

9. Epilogue

Summarizing what it was mentioned before, it is judged advisable to say that it is essential, the E.E. maintains its basic characteristics traits, which, although, lend its particularity in the modern educational reality. Most important, however, is to include itself in each curriculum

as an additional course. A such prospect, knowing the incomplete briefing on one side but also the already over-loaded program on the other, will change E.E in a formal course of traditional form - if it is neglected completely - reversing thus, each news to environment's dynamics, that is possible via E.E to exist. However, it will be supposed, that we remain optimistic for the expected results of E.E, because E.E alone cannot constitute "panacea" for the resolution of environmental problems. Problems that are characterized by complexity, because of the large quantity of factors (finances of - policies - social etc.) that contributes in their appearance.

Due to the above elements, our analysis lead to the conclusion that there is required training of teachers, of all specialties on geological subjects, so that they will be capable to import also geological component in the intersectorial work of Environmental Education's programs. Geology today in Greek Curriculum and school handbooks remain a marginalized object that is fragmentarily faced. We consider that Geology as environmental and intersectorial science should acquire in school, the place that deserves in order that teaching of geology, in the frames of environmental education, does not constitute other one lost occasion.

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