PISA & Greek Curriculum of science for last two classes of primary school: comparative analysis and assessment

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ABSTRACT
The analysis of PISA, in the context of the analysis implement we used, seems to designate important suggestions for writing science curriculum in compulsory education. These proposals aim at the obtainment of basic knowledge and at the culture of abilities (abilities-keywords) for everyday life: communication, collection and processing of information (data), cooperation and collectivity, problem solving, critical thinking and reflection, creativity and culture of citizenship. In the same context the analysis of (a) general part of Greek Curriculum, (b) the Greek Curriculum of Science for all levels of compulsory education, and (c) the Curriculum "Explore the natural world" for the two last classes of primary school are attempted, which apply today in the obligatory education of our country. The results showed that the general part of the Greek Curriculum and the Greek Curriculum of science for compulsory education, theoretically talking, coincide with the PISA proposals. However, it seems that the curriculum "Explore the natural world" of the two last classes of primary school deviates from the philosophy and the suggestions of PISA, having characteristics of traditional knowledge-based curricula.

KEYWORDS
Literacy in Science, knowledge-based approach, abilities, daily life

RÉSUMÉ
L'analyse de PISA dans le cadre de l'outil d'analyse utilisé, apparaît de mettre en évidence des propositions importantes pour la rédaction du Curriculum pour les Sciences à l'enseignement obligatoire. Ces propositions visent à l'acquisition des connaissances fondamentales et le développement des connaissances nécessaires pour la vie quotidienne: communication, recueil et traitement des informations (données), coopération et collectivité, solution des problèmes, esprit critique et réflexion, créativité et développement de la qualité de citoyen. Dans ce cadre, on a essayé de faire l'analyse (a) de la partie générale du Curriculum, (b) du Curriculum grec pour les Sciences pour tous les degrés de l'enseignement obligatoire, et (c) le Curriculum «Explorer le monde naturel» pour les deux dernières classes du primaire, qui sont actuellement en vigueur dans notre pays. Les résultats ont démontré que la Partie Générale du Curriculum grec et le Curriculum grec pour les Sciences pour tous les degrés de l'éducation, coïncident avec les propositions de PISA. Cependant, il apparaît que le Curriculum «Explorer le monde naturel» pour les deux dernières classes du primaire,

s'écarte de la philosophie et les propositions de PISA, en présentant des caractéristiques des curricula qui se basent sur les connaissances.

MOTS-CLÉS
Alphabétisation en science, approche cognitive, habilités, vie quotidienne

INTRODUCTION

PISA is a current program of assessment of 15th year old students of member-countries of OECD, which is carried every three years. It began in 2000 and assesses students with the completion of compulsory education in reading, maths and science. The philosophy of PISA is impressed upon the following question: "are the students capable of applying the knowledge and abilities they acquired at school to solve problems they will face in adult life?". In this case the term literacy is used in order to handle the abilities the students need in today rapidly changing societies.

Studying the publications of OECD about PISA (OECD, 1999, 2000, 2001, 2003, 2004, 2005, 2006, 2007), as well as relevant articles (Harlen, 2001; Lokan et al., 2001; Arffman et al., 2002; Mulford, 2002; Schleicher & Tamassia, 2002; Hatzinikita, 2008; Hatzinikita et al., 2008), the analysis of it was attempted in order to designate suggestions about writing science curriculum. Even though PISA is not a Curriculum, we believed that an effort of its analysis in the context of the implement we chose, can designate important suggestions in this case.

In the same context there has been an analysis of the general, all subject curriculum and the analytical curricula "Explore the natural world" of the fifth and sixth grade of primary school). Specifically the (a) the general part of the Greek Curriculum, (b) the Greek Curriculum of Science for all levels of compulsory education, and (c) the Curriculum "Explore the natural world" for the two last classes of primary school were analyzed. As an implement of analysis we used ICMAS (Intentions, Content, Modification, Assessment, Support) which is expanded in five discrete levels (A) Educational intentions, (B) Content of teaching, (C) Planning and organization of teaching, (D) Student evaluation, and (E) Requirements of completion and mechanisms of reinforcement of educational work (Karidas & Koumaras, 2002). The last level of analysis will not be discussed at all, provided that the general part of Greek Curriculum, the Greek Curriculum of Science for all levels of compulsory education and the Curriculum "Explore the natural world" for the two last classes of primary school do not seems to designate complete suggestions of supporting educational work.

AN ANALYSIS OF PISA

Educational intentions

As far as teaching goals are concerned in science education, the results of the analysis showed that PISA designates the following suggestions:

- Scientific literacy for all students. For instance, it is stated that *"the meaning of the word "literate" shows that somebody has the knowledge and abilities which are necessary for everyone, not only for those who will become experts or will have a career in one of the fields of science*" (Harlen, 2001).
- Knowledge and abilities for adult life. It is explicitly stated that PISA aims at the assessment of the degree that the students have acquired the general knowledge and

abilities in science, which they will need in adult life. Namely, it is focused on the estimation of how young people get ready to face the challenges of modern society of knowledge (OECD, 1999, p. 11). In the same context it is stated that "*the main characteristic of the expanded definition of literacy in science, is a main focus on knowledge for an effective function in everyday life. The meanings and procedures suggested by PISA, mention real or everyday situations which include problems that may have impact on us as individuals (for example use of food and energy) or as members of a local society (for example water safe to drink, building a power station) or as global citizens (for example overheating, reduction in biodiversity*)" (OECD, 2000, p. 16).

- Abilities for lifelong education. The PISA program reflects a dynamic model of lifelong learning about knowledge and abilities that are necessary to be acquired in lifelong process for the individual's successful fitting in a continuously changing world. Students cannot learn at school everything they should know about adult life. What they must acquire is the requirements for a successful learning in their future life. They must be capable of organising and modifying their learning, to learn either separately or in groups and to overcome the difficulties in the learning procedure. It is prerequisite to know the strategies of learning and thinking procedures.
- Abilities for effective participation in society. In the definition of PISA about literacy in science, it is mentioned that "*students must develop specific abilities "in order to comprehend and to take decisions concerning the natural world and its changes due to human activities*" (OECD, 1999, p. 60, 2003, p. 134). Likewise, the theoretical framework of PISA 2006 defines the literacy in science as "*the understanding and application of scientific knowledge in order for the individual to be willing to approach matters (social and personal), which are relevant to science"* (OECD, 2006, p. 12).

In the same logic with PISA, the general part of the Greek Curriculum and the specific aims of the Greek Curriculum of science, include a variety of same suggestions, (for example "the assurance that everybody has access to information and knowledge", "the conditions which provide the possibilities for life-long renewal of knowledge and skills" , " the student to have an opinion and to live as a responsible and active citizen") which if we decide to integrate and interpret in the context of the teaching aims science, three important perspectives are designated: (α) Literacy in science for all students, (b) Exhibiting the relation of "Science – Technology – Society – Life – Environment" which refers to the creation of active citizens, and (c) Life – long learning.

However, proceeding in the analysis of the educational aims of the Curriculum "Explore the natural world" for the two last classes of primary school, we realise that unlike the previous ones, most of them are cognitive goals provided that they promote detailed denotations of Science. For example in the module "Atoms – Elements – Chemical compounds" the following goals are stated: *"The students aim at: – To mention that the chemical compounds unite and form particles – To differentiate elements from chemical compounds depending on the kind of the atoms they are constituted, – To connect the chemical compounds with the change in creation of the particle – To attribute the huge variety of the material they see around them to the different combinations of not many different kinds of atoms, – To name the more common elements (hydrogen, oxygen, nitrogen and carbon) and to recognize their symbols – To identify the chemical compounds water and carbon dioxide from their symbolism – To picture with simulations the particles of the above elements and the chemical compounds*" (Curriculum "Explore the natural world", p. 507-508).

Moreover, several goals exceed the mental abilities of the students (Koumaras, 2007) and it seems they are addressed mostly to students of secondary education, for example *"the students: to describe the way of the particle's movement in the 3 conditions of material and to interpret the behavior of solid, liquid and gas*" or "*to describe the changes of the conditions of the material conditions using the term: energy (warmth) is carried and to connect these with the change in the way particles move ...*" (Curriculum "Explore the natural world", p. 507, 508, 511).

Content of teaching Science

As far as principles or procedures of the science that are chosen to be taught PISA suggests:

- Fundamental meanings and subjects of science which can be related with everyday life *"To have specific knowledge in science, as the names of specific plants and animals has a minor meaning in comparison with understanding broader matters and denotations such as the consumption of energy, biodiversity and human health which constitute important discussion matters and research for science and the adult world*" (OECD, 1999, p. 65). Matters which are offered for teaching: *"refer to issues of practice in Science, through which affairs are emerged that the citizens must worry about and make a decision. The issues of practice that influence the choice of content: Science in life and health: health, illness and nutrition – persistence and viable use of species – interrelationship of natural/biological systems. Science in Earth and environment: pollution – production and loss of land – weather and climate. Science in technology: biotechnology-use of material and disposition of waste-use of energy-transport*" (OECD, 2003, p. 139).
- Refinement of abilities, mentioned in specific research procedures: (a) the acknowledgement of questions answered by Science, (b) the specification of elements /data in a troublesome situation, (c) the scheduling and carrying out of research, (d) the collection of data and deduction, (e) the announcement /interaction of conclusions, (f) the proof of comprehending scientific meanings with their application in real situations. The extrapolation of conclusions through evidence and specific information is given to young people as well as their ability to criticize the assertions defined by others, based on specific evidence constitute nodal abilities for them – to differentiate the subjective opinion from the statements based on particular proof, (OECD, 2003).
- Knowledge about the nature of Science and Technology. The school graduates have to be equipped with understanding the nature of science, its procedures, its capabilities, as well as its restrictions and the kind of questions that they can or cannot be answered (Harlen, 2001).
- Issues from the history of science: *"The historian is another type of situation appropriate for some subjects, in whose limits understanding the progress of scientific knowledge can be evaluated. In the context of PISA the assessment works refer to personal, social and worldwide matters, as well as to issues that specify how scientific knowledge is evolved and has consequences to the social decisions related to science (historical relativity)"* (OECD, 2000, p. 78).

In the same direction with PISA, the general part of Greek Curriculum suggests:

- Teaching basic topics and significations of science "*No emphasis is given to specialized and detailed knowledge, but the essential is promoted, the important and edifying, so as too much syllabus to be avoided*" (General Part, p. 7)

- Culture of abilities for gradual and creative incorporation of someone in social life: *"the skill of communication, the skill of cooperation, the utilization of knowledge, the formation of opinions in decision making, etc"* (General Part, p. 9).

Though in the Curriculum "Explore the natural world", emphasis is given on learning detailed significations, many of which seem to be extremely incomprehensible for the mental development of children, for example "Elements, chemical compounds, Quark, movement of molecules …". The emphasis of its editor is signified in the teaching of detailed implications of Science, in grooming of children for the next levels of education and the creation of future scientists (Koumaras, 2002a). How is the connection with everyday life accomplished when in the second to last class of primary school the teaching of molecules is scheduled to be taught in the second week of teaching, charged atoms and symbols of chemical elements? Is the microcosm daily life? (Kokkotas, 2002; Koumaras, 2002b).

Planning and organization of teaching

PISA analysis designates everyday life and the concerns of children as a jumping off point and development of teaching. The attention of teaching is focused closely on denotations, used in everyday life and technology, as well in the discussions about environmental and energy issues, as well as in health issues.

In Greek curriculum of science everyday life is recommended as a context of applicating teaching issues and not as a jumping off point and development context of teaching (Curriculum "Explore the natural world", p. 52). Though we have a traditional organization of the teaching content, where teaching issues have as a baseline science, for example molecules, atoms, quarks, elements, chemical compounds, particles movement, etc. ("Explore the natural world", p. 507-512). What is mentioned above restricts application suggestions (where it is appropriate) in everyday life. As regards teaching approaches, in PISA and the Curriculum "Explore the natural world" active participation of children is chosen in teaching process with the application of collaborative and enquiring processes.

Teaching assessment

From PISA analysis it is designated that the assessment aim of the student is the evaluation of his skills for everyday life and lifelong learning. PISA contributes in comprehending the extent to which educational systems in participant countries warm up their students to become lifelong students (lifelong learning) and to set constructive parts as citizens in the society (OECD, 1999). In the question what is assessed, what is valued, is obvious: (a) The comprehension of fundamental denotations and the wider issues of science, (b) The acquirement of skills referred to specific scientific procedures, (c) The application of both in situation of everyday life. The Curriculum "Explore the natural world" moves in the context of a knowledge based approach, where mainly it is suggested: (i) the assessment of the students' ability to define the denotations of science, (ii) the assessment of the students' ability to describe natural events and procedures, (iii) the assessment of the students' ability to relate terms and denotations of science in the description and analysis of natural events (p. 522).

CONCLUSIONS

The results of PISA analysis seem to designate important suggestions for an innovative curricular and hence for teaching science in compulsory education. The meaning of the word innovative aims to equip students with knowledge and abilities for everyday life, in order to

intercede efficiently in natural and convivial world. Something similar happens with transformation/reframe of scientific knowledge which sets definite axes of basic denotations, scientific procedures and extensive issues proposed to be taught. Finally the context development of content (situations and problems of everyday life) is defined, as well as application fields of Science (Science in life and health – Science in earth and environment, etc.) which pertain to interests and self-examinations of students, and generally of man who lives in the context of today society.

The analysis of (a) general part of Greek Curriculum, (b) the Greek Curriculum of Science for all levels of compulsory education, and (c) the Curriculum "Explore the natural world" for the two last classes of primary school shows that the generators are either possessed by different perspectives or vacillate among approaches "Science for everybody", which designates the philosophy of the "scientifically literate citizen" who is caring and intervenes in society and the academic teaching approach which advances the philosophy of future scientist student. The first approach in accordance with PISA is promoted by general part of Greek Curriculum and Curriculum of Science with emphasis in the development of students' abilities and in the reframe of scientific content with topics of everyday life. The second approach is promoted by Curriculum "Explore the natural world" for the two last classes of primary school presenting a traditional knowledge based Studies program where the change/reframe of scientific content is limited in its traditional simplification. Emphasis is given on acquisition/memorization of scientific denotations of science, while the cultivation of abilities seems to be ignored.

To sum up we regard that the philosophy of cultivating "Knowledge and abilities for everyday life," as it arises from the PISA suggestions, can support the reconsideration of detailed Curriculum of science in our country. The main purpose of teaching in science could not be the preparation for the next grade of education or the creation of future scientists but how to warm up the student better for active participation in the world in which he will live and will be asked to come to a serious decision. The aim of the teaching in science education, at least of even value with the knowledge of the content, can and must be the development of abilities/skills which will be useful in citizens' everyday life.

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