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A NEW WAY TO TEACH PHYSICS TO PRIMARY SCHOOL FUTURE TEACHERS

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ABSTRACT

In the University of Aveiro, Portugal, undergraduate teachers formation and training programs include Primary School Teachers Education.The majority of students enrolled in this course reveal weaknesses at the level of their scientific background. Therefore it is a challenge to conceptualize and implement an accurate program taking into account the student's future careers.

A new subject labeled Natural Integrated Science was developed, under the following assumptions: - the students have great difficulties for understanding case scientific concepts; - the students should achieve a holistic view about the scientific issues, rather than a perspective based on traditional areas. A balanced and varied group of science and educational lecturers coming from different departments - Physics, Chemistry, Geoscience, Biology and Didactics and Educational Technology was drawn up for the conceptualization of the program.

The main aim of this paper is to present the different steps developed by this team from the conceptualization to the implementation of this new program. Students' views which have emerged from their answers to a written questionnaire administrated at the end of the course is also put forward.

The physics contribution for this program is addressed. particularly its integration with the other areas.

1. INTRODUCTION

This paper relates to a science subject which is being taught within an undergraduate formation and training program in Primary School Teachers Education carried out at the University of Aveiro (Portugal). The four years long Primary School Teacher's Course started in October 1997. The main aim of this Course is to prepare teachers for their future career (teaching 6-10 year olds) in the context of a framework based on suggestions emerging from educational research, particularly from teachers education [1]. The main areas covered in this Course range from education, science and mathematics, through communication, information and language sciences, social sciences and in-service teaching practice.

For the purpose of enrolling, students have to pass a test on Portuguese language. Learners' scientific background may be relatively different, i.e., there are a few who had science up to 12^{th} level (secondary school) but, the most part of them, finished their learning of science at 9^{th} level (compulsory school). Therefore, it is true to say that the majority of these students reveal weaknesses at the level of their scientific background. This is a very important point, since that the primary school curriculum in Portugal is very demanding as far as science is concerned. All the above sets the background of students' needs within scientific knowledge, owing to the fact that their main formation is in Humanities.

2. SCIENCE IN THE COURSE

There are three main assumptions which underpin the task of designing the science program for this Course.

First of all, if human existence can be expected to be modified throughout the following human life span, and science is taken as a cornerstone, so it will be essential that science plays a relevant role in the education of today's children for tomorrow's world [2].

Second, the common core of learning science has to be centered on science literacy, i.e., the understanding of the links among relevant themes for every day life, rather than on the comprehension of each of the separate disciplines [3].

Third, there is a conceptual basis for the integration in the science curriculum of important themes and concepts about the natural world in the perspective of the planet Earth as a system of sub-systems [4].

It was a challenge to conceptualize, implement and asses an accurate science program taking into account both the context referred to above and the students' future careers as primary school teachers.

3. THE SYLLABUS

A new subject labeled Natural Integrated Sciences, lasting one academic year (two semesters), with three lectures (one hour each) and one laboratory class (two hours) per week, was drawn up. In total 90h of theoretical classes and 60h of practical classes.

A balanced and varied group of science and education lecturers, coming from different university departments – Physics, Chemistry, Geosciences, Biology and Didactics and Educational Technology – was organized for developing the conceptualization of the syllabus; this task took place throughout a considerable number of meetings.

The group members, despite their different background and experience, got common perspective about the relevance of science teaching and the way it should be oriented. Four main aims were defined:

(1) To understand natural world phenomena, on the basis of principles emerging from different areas of scientific knowledge;
(2) To recognize both that the planet Earth is a well structured set of sub-systems in an in-depth and balanced interaction and that human beings are responsible for keeping this balance;
(3) To understand scientific issues in their historical, social and cultural context;
(4) To develop abilities and attitudes that enables an enjoyable science teaching and learning.

The contents of the subject under discussion were articulated in a conceptual map. Three main themes were chosen: Sun, Earth and Life. What one bears in mind is that the Sun, taking into account its nature, characteristics and position, plays a very important role in the maintenance of the features, nature, dynamics and evolution of the Earth. From accurate interactions among a complex set of conditions, the process related to the origin of Life started. Life development and, particularly, its maintenance as well as the maintenance of some important aspects related to the surface of the Earth are strongly related to the attitude of mankind towards nature. All these dimensions were presented and discussed with students, taking into account their needs to achieve a high level of citizenship.

The approach referring to the above mentioned three themes and their relationships was carried out through the analysis of the following eight topics: sun, earth and solar system, the atmosphere, the oceans and the water, the mineral world, history of the earth and development of life, diversity of species, genetic code and mankind and mineral resources.

In laboratory classes several experimental tasks were carried out for the students in order to promote new knowledge, to illustrate the concepts presented in the lectures, and to address some research methods at a level considered appropriated for their scientific formation.

4. STUDENTS' VIEWS

The assessment of this experience is not concluded yet. Nevertheless it started through a written questionnaire administrated to 60 students who have beeen enrolled in the course in 1998/1999 and 1999/2000.

In summary, from the data collected, the following aspects should be emphasised : less than 25% of the students miss the lectures; for 20%, the issues which have been lectured were not difficult; a quite small amount of respondents, less than 10%, didn't understand the logic of the sequence of the topics which have been lectured; less than 10% argue that the topics presented in the lectures are not related to the activities carried out in the laboratory; less than 5% couldn't see the evidence both of the objectives and the topics of the subject ; less than 5% claim that the contents proposed do not provide relevant knowledge to explain the phenomena of the natural world and have not the potential to enjoyable science learning.

From this set of results it seems clear that the overview of the students about the contents and the structure of this new subject is quite positive.

5. PHYSICS IN THE CURRICULUM

As previously stated, the scientific areas do cover the Natural Sciences that are important on the primary school teachers education in sciences. Although we could easily be lead to implement sets of lectures under four distinct topics - Physics, Chemistry, Geology and Biology – i.e. the traditional approach, our aim was to present each theme in an integrated perspective. Therefore, lecturers coming from different scientific areas introduce relevant knowledge in different moments in the syllabus, building a whole containing the contributions from their specific areas.

The first topic to be lectured was the Sun. A lecturer coming from Physics started the classes. A set of classes were carried out to provide main concepts presented in such a context that allowed the approach of other themes from the syllabus later on.

Let us see the Sun example. We begin with common knowledge and move to more complex and comprehensive concepts: the Sun is a star - what is a star? From this discussion we move to the origin of the Universe, and design a strategy that includes fundamental particles, energy and evolution. Now we have a "door" to talk about planetary systems, motion, references to both the sequence of day and night, and of the four seasons. Going back to motion we can study its nature and some dynamics. Relativity is in order. Mass, velocity, therefore, energy – light. Then heat. Then radiation and the electromagnetic spectrum – the UV, and we are in the atmosphere – we make a bridge to chemistry and the mineral world. Getting closer to the Earth sciences we find water and the oceans – solar energy and energy transfer and the motion of the fluids.

The study of the Earth began with the properties of the several materials belonging to the Solar System. Following this issue a question was raised: how does the external part of the Earth works? Plate Tectonics explains the Earth's dynamics based on the concepts of heat, convection currents to understand the process.

Later on a physics lecturer comes to the classroom to talk about an introduction to radioactivity to help students understand radiometric methodologies related to the age of our Planet.

Physics concepts such as energy, heat and equilibrium, play an important role for the understanding the origin and development of Life throughout the geological time. All of these concepts were approached in the beginning of the semester and may be recalled now to present another perspective of dealing with the same subjects.

The embracing theme involves Human Species and the exploitation of resources. Clearly some technological issues can be dealt with that are related to Physics.

As a final comment, we may say that, as can be seen, Physics has a field of work that provides a background knowledge which is very important and relevant in a transversal view of the Integrated Natural Sciences.

6. REFERENCES

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3. National Research Council, National Science Education Standards, Washington, National Academy Press,1996.
4. Mayer, V., Using the Earth Systems for Integrating the Science Curriculum, *Science Education*, 79 (4), 375-391, 1995.

4:50 p.m. - 5:10 p.m.

Parallel Session 4 (Room S213)

A new way to teach physics to primary school future teachers

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In the University of Aveiro, Portugal, initiation undergraduate training programs also include Primary School Teachers Education.The majority of students enrolled in this course reveal weaknesses at the level of their scientific background. Therefore it is a challenge to conceptualize and implement an accurate program taking into account the student's future careers.

A new subject labeled Natural Integrated Science was developed; it lasts one academic year, i.e. two semesters.The assumptions of this new subject are the following:

- the students feel great difficulties for understanding case scientific concepts;
- the students should achieve a holistic view about the scientific issues, rather than a perspective based on traditional areas - Physics, Chemistry, Geology and Biology.

A balanced and varied group of science and education lecturers coming from different university departments - Physics, Chemistry, Geology, Biology and Didactics and Technology of education was drawn up for the conceptualization of the program.

The main aim of this paper is to discuss the different steps, which have been developed by this team from the conceptualization to the implementation of this new program. Students' views which have emerged from their answers to a written questionnaire administrated at the end of the course is also put forward.

The authors also explain the physics contribution for this program, particularly the way it was integrated with the other areas.

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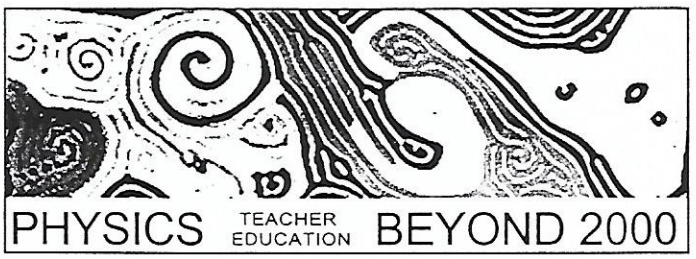

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