Educational Support to Prospective Physics Teachers at the field of Green Energy; First Assumptions

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Abstract. *This qualitive research studies the context we should form in order to guideline future science teachers to create and introduce their original teaching material in their daily teaching experience. More precisely, in this case we cope with the subject of renewable energy approaching it through an interdisciplinary view.*

The tool that was chosen to build the main part of the teaching material was Excel, using those functions that help to create interactive relationships between figures and comprehensive depiction of those relationships.

First results show that we should insistently support students so that they become familiarized with educational methodology and meaningful use of technology.

Keywords. Excel, Future science teachers**,** Interdisciplinary, Renewable energy.

1. Introduction – Framework - Purpose

Teacher learning has emerged as an important area for research in education [1]. There are a large number of studies on the content of teacher learning, mainly focusing on the knowledge base of teachers (e.g. [2]; [4]; [7], [8]).

The American educationalist Lee Shulman introduced the term 'pedagogical content knowledge' (PCK) when he investigated the knowledge base of teachers. He defined it as "a special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding" [8]. He stated that effective teachers need PCK rather than just knowledge of a particular subject matter.

Taking into account that "no innovation will be sustained unless systematic and ongoing professional development is provided to support the changes required in the pedagogy of science teachers" [6], our research team studies the ways the means and methodology in general affect Science teaching practice. Complementary, we study the context we should form in order to instruct future science teachers to create and introduce their original teaching material in their daily teaching experience.

Nevertheless the fact that "… studies confirm that teacher beliefs about the nature of knowledge, teaching science, and the mandated curriculum impede and ''filter'' innovative practice suggested by professional development...", [9] showing the great importance for systematic support for prospective Physics Teachers, in order to become more efficient and to promote insightful learning.

At this point the issue of technology arises, providing a new, very promising, outlet but which also demands a lot of attention in order to be meaningful and not just decorative.

More precisely, we study the pathway followed by two future teachers when they were called to present a proposal for teaching green energy-energy conservation through an interdisciplinary view, using as an educational tool the widely known Microsoft Excel (or analogous programs).

We describe the issues raised, the decisions we had to make and the supportive guidance through the entire attempt in order to help the under-testing teachers introduce technically and methodologically the innovative ideas in teaching practice.

2. Rationale-Research Questions

Former research efforts [3], [5] which conducted in previews years, have provided us with useful experience. Concisely, the general assumptions were that students do follow a methological approach in their teaching but they don't attain the deeper philosophy of it. They just follow the provided steps, oblivious of any further extensions.

It has been also shown that students usually don't manage to use technology in the most beneficial

Vassilios Grigoriou, Eleni Vithopoulou & George Kalkanis (2010). Educational Support to Prospective Physics Teachers at the field of Green Energy; First Assumptions M. Kalogiannakis, D. Stavrou & P. Michaelidis (Eds.) *Proceedings of the 7th International Conference on Hands-on Science.* 25-31 July 2010, Rethymno-Crete, pp. 351 – 354
http://www.clab.edc.uoc.gr/HSci2010

rate, as it is common to be induced by the glamour of technology and finally to become slaves of their own material.

At this paper we are investigating how two students at the University of Athens do manage to materialize an educational proposal for the topic of the green energy-energy conservation, following an interdisciplinary approach and by using Microsoft Excel as a tool. Was the developed material consistent with the educational methodology that they were provided? Did the developed material meet the prerequisite criteria that had been put at the design of the effort?

3. Methods

This is a qualitive research, based on two students of the University of Athens who were studying physics and they were voluntary offered to participate. They were at the fourth year of their studies and they had already attended several classes which involve teaching methods.

The two students were asked to present a proposal for teaching the aforesaid topic. Some barriers were that they had to approach the issue through an interdisciplinary approach, as it was a question to study the physical phenomena that describe the procedures embedded, but simultaneously approach and present the interactive relationships between the phenomena and elements of everyday life, social organization, civilization, history, natural environment and unliving and living matter in general. They also had to develop an educational material in Microsoft Excel 2007 (or similar program) using those functions that would help to create interactive relationships between figures and comprehensive depiction of those relationships. In this way, we consider an experimental approach of figures with crucial social extensions possible, such as the quantity of pollutant emitted compared to society's economical structure e.t.c.

4. The educational material

The educational material that was produced was a set of worksheets accompanied by two files in Microsoft Excel 2007 platform. The scientific fields that there were under review were aeolian energy and biomass (Fig. 1, Fig. 2).

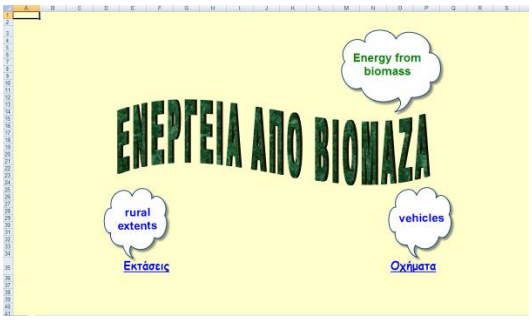

Figure 1. Screenshot of 1st file: "Energy and biomass"

Figure 2. Screenshot of 2nd file: "Aeolian Energy"

Alternatively to Microsoft Excel it could have been used an open source program such Open Office Spreadsheet with no remarkable difference.

The worksheets implement an inquiry educational methodology that it is described as scientific / educational by inquiry model. The methodology consists of five steps: a. Triggering of interest, b. Hypotheses' formulation, c. Experimentation, d. Conclusions' draw, e. Application in similar situations/explanation with the microcosm (Fig.3).

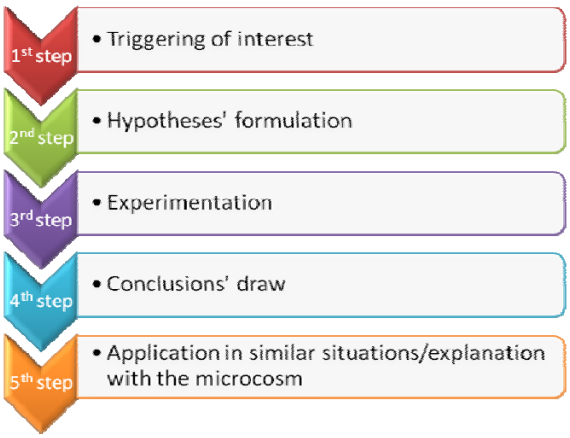

Figure 3. Educational Methodology

The flowchart of the two Excel files is presented bellow (Fig. 4, Fig.5). The first file (Energy and biomass) consists of two dimensions: rural extents and vehicles. At the field of rural extents it is presented a set of possible choices for the user, such as different kind of crops, yield per square kilometer, requisite land, requisite water and the equivalent graphical pies. At the field of vehicles, user has a great variety of possible choices, such as type of economic growth of the region, number of vehicles, type of fuel, price per litre, type of vehicles, estimation of fuel consumption, estimation of fuel cost, estimation of CO_2 emission, estimation of losses and benefits in the case of substitution of fossil fuels with biomass which are accompanied with the appropriate charts.

The second file (Aeolian Energy) also consists of two major components: domestic appliances and economic growth. At the field of domestic appliances one can select to deal with the cost per kwh of production of electric energy via wind generator or via electric power station, the cost of usage for major electric appliances and the analogous CO_2 emission. At the field of economic growth, there are several choices which show the relevance between the economic growth of a region, the population, energy demands and the necessary number of wind generators.

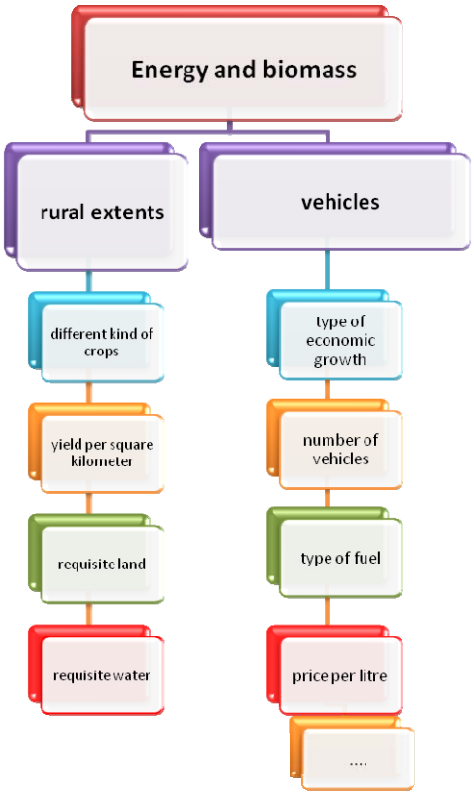

Figure 4. Flowchart of "Energy and biomass"

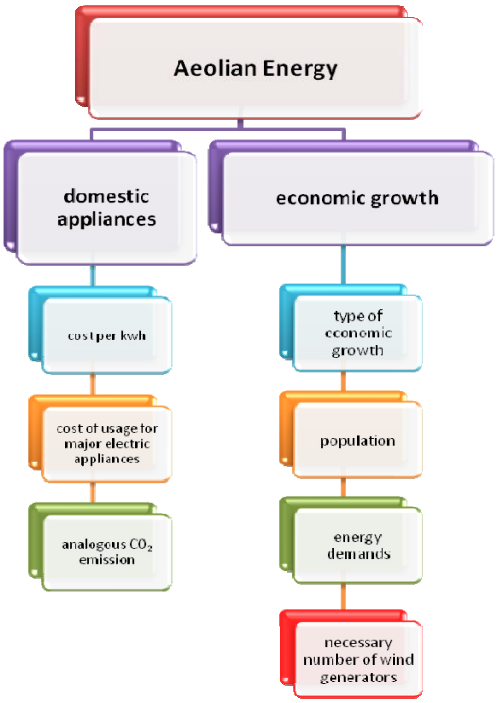

Figure 5. Flowchart of "Aeolian Energy"

These files had been proposed by the two students to play the role of a virtual experiment, as it has been mentioned above experimentation is one of the steps of the followed educational methodology.

5. Results

The findings show that the two students managed to develop teaching material, transforming this new technology into teaching practice. They produced a Microsoft Excel file which incorporated many options which provided the potential to visualize correlations between different figures (fig. 6). It also met with the criteria of functionality and aesthetic that have been put at the beginning of the effort.

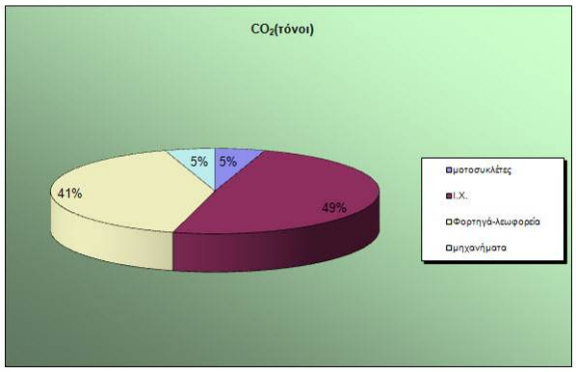

Figure 6. Graphs of physical quantities

They also managed to create a worksheet which integrated the previous material. This worksheet lacks on educational methodology as it follows rather superficially the required steps, leaving outside the deeper philosophy of it. This is a common assumption between several prior researches [3].

At last, their effort to approach the whole issue with an interdisciplinary glance it can be said that it was not fulfilled in the most extended ratio, but it was fair enough, as they embraced a large number of liaisons.

6. Conclusions-Proposals

We consider successful the whole attempt from the side of the students. It was shown that they managed to accomplish the main goals, which were to use technology in order to produce educational material, all though the problematic around the methodology consistence.

A systematic support effort for prospective Science teachers is required in order to exceed the confirmed problems concerning methodology issues, so that they become more ready to experience and thus to use it beneficial in their lesson. This support should include components of PCK, as it is considered to be a crucial issue for Teacher professional development [6], [8], [9].

7. References

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