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Renewable energy education in Ionian Islands of Greece

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ABSTRACT: The looming depletion of the conventional fuels of the planet, combined with the ever-increasing demand for energy and the gradual deterioration of environmental problems, led modern societies to turn to the exploitation of renewable energy sources. Renewable energy sources (RES) are the natural available-energy sources, which are abundant in the natural environment, which are not depleted, but are constantly renewed and which can be converted into electrical or thermal energy, such as sun, wind, biomass, geothermal energy, chutes and marine traffic. In this PhD thesis there is a detailed description of the RES sector in Greece, focusing mainly on the forms used to produce mostly electricity, that is, wind, hydro, solar energy and biomass. In addition, the characteristics, the evolution, the current situation and the perspectives of res used to produce electricity are presented. Finally, the purpose of this research was to study the understanding of children about renewable energy sources and how it changes after teaching. There were 706 students (Table 1) from 31 schools (12 Primary, 11 Middle and 8 High schools) from 4 (of 7 in total) Ionian Islands (Corfu, Kefalonia, Lefkada, Zakynthos) who attended a) 278 from the 6th grade of Primary School, b) 245of the 3rdgrade of Middle School and 183 of the 3rd grade of General Lyceum, during the school year 2015-2016.

KEYWORDS: renewable energy education, teaching-learning material, advantages, disadvantages, misconceptions

I.INTRODUCTION

Since the human discovered the fire began to evolve it at a fast pace and needed more and more energy. During the industrial revolution, humanity used steam. The need for energy was great so people besides lignite started using oil and doing mining. Peopleused the above for heating and to move. But the combustion of lignite and oil caused carbon dioxide and sulphur dioxide. These two gases were very harmful to environment, gathered in the atmosphere and caused problems such as the greenhouse problem or the weakening of ozone (Matzianos, 2006). The problems they have created in the environment and the reduction of oil reserves have forced people to look for new sources of energy that do not pollute the environment so much. The new sources found them in nature. They used the air and the sun and created machines that generate electricity without polluting the environment. Thus, we have non-renewable energy sources and renewable energy sources. Non-renewables are sources that cannot be replaced by humans within a certain period, because many years passed to create them. Non-renewable sources include the solid fuels of coal, such as lignite, anthracite, etc., the liquid fuels with their processing such as oil, fuel oil, gasoline etc.,gaseous fuels such as natural gas, LPG etc., the nuclear energy we take from the radioactive materials(Zimmerman,1995). Although, renewable energy sources are the sources that supply us with energy in great depth of time. They are the sources that are constantly fed by the energy of the sun (solar energy),the wind (wind energy), the chutes (hydro power),the energy of waves, streams, oceans, biomass energy, geothermal energy(Kyritsaki, 2009).Renewable energy sources may be more limited, but they help to protect the environment, which is why developed countries are increasingly oriented towards them(Rizou&Sdrali, 2005). Based on the above, the research questions that directed this research are:

a) What is the understanding of children for uses of energy, existing types of energy, their timeless use by humans,
b)socio-cognitive and socio-approaches to the didactics of science in primary and secondary schools of the Greek Ionian Islands,
c) what do students really understand about their renewability, the impact of their use and how to reduce energy consumption and

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d) how does this understanding change after a relevant didactic intervention. In the present work we did not implement an innovative training programme, but we aim to study the issues within the usual educational frameworks. The remaining paper is structured as follows: Section1 provides an introduction of the topic and Section 2 Theoretical background: about renewable energy sources. Section3 is an overview of the methodological approach, and Section 4 analyse the results of the research. Section 5 concludes.

II. THEORETICAL BACKGROUND

A) The use of energy.

One of the main pillars of support for the modern model of economic development at global level is the use of energy. Undoubtedly, modern societies consume huge amounts of energy for the movement of people or products, to meet the needs of households in lighting and heating as well as for the operation of industrial units(Yount& Horton, 1992). The continuous improvement of living standards is inextricably linked to the increase in energy demand. In the current era, the largest proportion of energy stems mainly from so-called conventional energy sources, i.e. thermal plants that operate with mineral resources, such as oil and its derivatives, solid coals, natural gas and nuclear. In short, adhesion energy derives from a exothermic reaction such as the combustion of these resources by converting the generated thermal energy into another form. Essentially, they are rich in quantity of natural resources in the subsoil of the planet, but in the timescale of the human species are considered exhaustible, i.e. their replenishment is very slow. The intensive exploitation of them beyond the risk of their rapid depletion, has proved to have brought about an aggravating effect on the ecosystem of people, creating a series of environmental problems with a leading greenhouse effect. These effects have been found to tend to take irreversible character, making it questionable the survival of subsequent generations. Nevertheless, nature has a multitude of other sources of energy intangible form, which be from antiquity, to cover various energy needs, such as wind and water (Bouradas, 2010).

These forms of energy are called Renewable energy sources (RES), because they are associated with the daily cycle of nature and are therefore considered practically inexhaustible. Currently, apart from the wind and water, this category includes the sun, the geothermal and the "transient" gas from the biodegradation of organic materials from household and agricultural waste. The interest in the wider utilization of RES, as well as for the development of reliable and cost-effective technologies that commit their potential was presented initially after the two oil crises of 1973 and 1979, and consolidated the last decade, following the awareness of global environmental problems. RES was very expensive at first and began as experimental applications(Yount& Horton, 1992).

Today, however, they are considered in the official planning of the developed States for energy and, although they are a very small percentage of energy production, steps are being prepared to enable them to be exploited further (UNESCO-UNEP, 1985). The cost of applications of soft energies has been falling over the last twenty years, especially wind and hydropower, as well as biomass, can now compete against equal traditional energy sources such as coal and nuclear Energy. Indicatively, in the USA a 6% of the energy comes from renewable sources, while in the European Union Directive 2001/77/EC of the European Parliament seeks 20% of its electricity needs to be covered by alternative sources up to the 2020.

B) Types of mild energy:

1. Wind power. Used for pumping water from wells as well as for mechanical applications (e.g. milling in windmills). It has begun to be widely used for power generation (Kaldellis, 2005).

2. Solar energy. It is used more for thermal applications (solar water heaters and furnaces) while its use to produce electricity has begun to gain ground, with the help of the policy of promoting renewable energy sources by the Greek State and The European Union(Bouradas, 2010).

3. Hydro power. They are the well-known hydroelectric projects, which in the field of mild forms of energy specialise more in small hydroelectric. It is the most widespread form of renewable energy. Other cases of water exploitation for energy production are the following: energy from tides. It exploits the gravity of the sun and the moon, which causes elevation of the water level. The water is stored as it ascends and to redescend it is forced to pass through a turbine, producing electricity. It has been implemented in England, France, Russia and elsewhere. Wave energy. It exploits the

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kinetic energy of sea waves. Energy from the oceans. It exploits the temperature difference between the layers of the ocean, using thermal cycles. He's in the process of being investigated(UNESCO-UNEP, 1985).

4. Biomass. It uses the carbohydrates of plants (mainly waste of the wood, food and feed industry and the sugar industry) in order to release the energy committed by the plant with photosynthesis. Urban waste and waste can still be used. It is used to produce bioethanol and biogas, which is more environmentally friendly than traditional fuels. It is a power source with many features and applications that will be used more widely in the future(Bouradas, 2010).

5.Geothermal energy. It comes from the heat generated by the radioactive decay of the Earth's rocks. It is exploitable where this heat naturally rises to the surface, e.g. in the geysers or hot water sources. It can be used either directly for thermal applications or to produce electricity. Iceland covers 80-90% of its energy needs, in terms of heating and 20%, in electricity with geothermal energy(MEECC, 2012).

C) Advantages of renewable energy

They are very environmentally friendly, having virtually zero residues and waste, they will never be exhausted as opposed to fossil fuels, they can help the energy self-sufficiency of small and developing countries, as well as provide an alternative to the oil economy, flexible applications that can produce energy commensurate with the needs of the local population, eliminating the need for huge power plants (in principle for the outdoors) and for transferring energy over long distances, the equipment is simple in construction and maintenance and has a long-life time, subsidised by most governments(Bouradas,2010).

D) Disadvantages of renewable energy

They have a quite small rate of return, of about 30% or lower, it therefore requires quite large initial application costs on a large land surface. For this reason so far they are being used as complementary energy sources. For the above reason, at present, they cannot be used to meet the needs of large urban centres. Also, the supply and performance of wind, hydro and solar energy depends on the time of year and the latitude and climate of the area in which they are installed. For wind engines there is a view that they are not elegant from an aesthetic point of view and that they cause noise and death of birds. But with the development of their technology and the more careful choice of installation sites (e.g. on offshore platforms) these problems are almost solved. For hydropower projects they are said to cause methane release from the decay of plants that are under water and thus contribute to the greenhouse effect(Zimmerman,1995).

III METHODOLOGICAL APPROACH

The research was attended by 706 students (Table1) from 31 schools (12 Primary, 11 Middle and 8 High schools) from 4 (of 7 in total) Ionian Islands (Corfu, Kefalonia, Lefkada, Zakynthos) who attended a) 278of the 6th grade of Primary School, b) 245 of the 3rdgrade of Middle School and 183 of the 3rd grade of General Lyceum during the school year 2015-2016. The third class of the General Lyceumwas selected as the students of the third class completing their studies in secondary education have meet all the knowledge that the Greek educational system provides to pupils and students on issues Environment.

SCHOOL YEAR 2015-2016 - IONIAN ISLANDS (CORFU-KEFALONIA-LEFKADA-ZAKYNTHOS)				
	SCHOOL UNITS	MALE	FEMALE	**TOTAL**
Primary Schools (6th)	12	123	155	**278**
Middle School (3rd)	11	104	141	**245**
High School (3rd)	8	94	89	**183**
TOTAL	**31**	**321**	**385**	**706**

Table 1: Students who responded to questions

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The used questionnaire (45 questions) was: http://www.surveygizmo.com/s3/2053568/1o (Fig.1), consisting the 4 research questions, which were asked to respond as far as possible at the end of the research:
Part A: Questions on renewable Energies (25 Q)
Part B: Energy Saving questions (10 Q)
Part C: Questions General (6Q)and
Part D: summary – Feedback(4Q) with both closed-ended and open questions. The questions were studied with great diligence, to be as easy as possible to complement them and easily and quickly to their indexing. Prior to the finalization of the questionnaires, questionnaires were tested on a small sample of students to correct errors and possible omissions. Data analysis and graphics were done with the program SPSS 22.

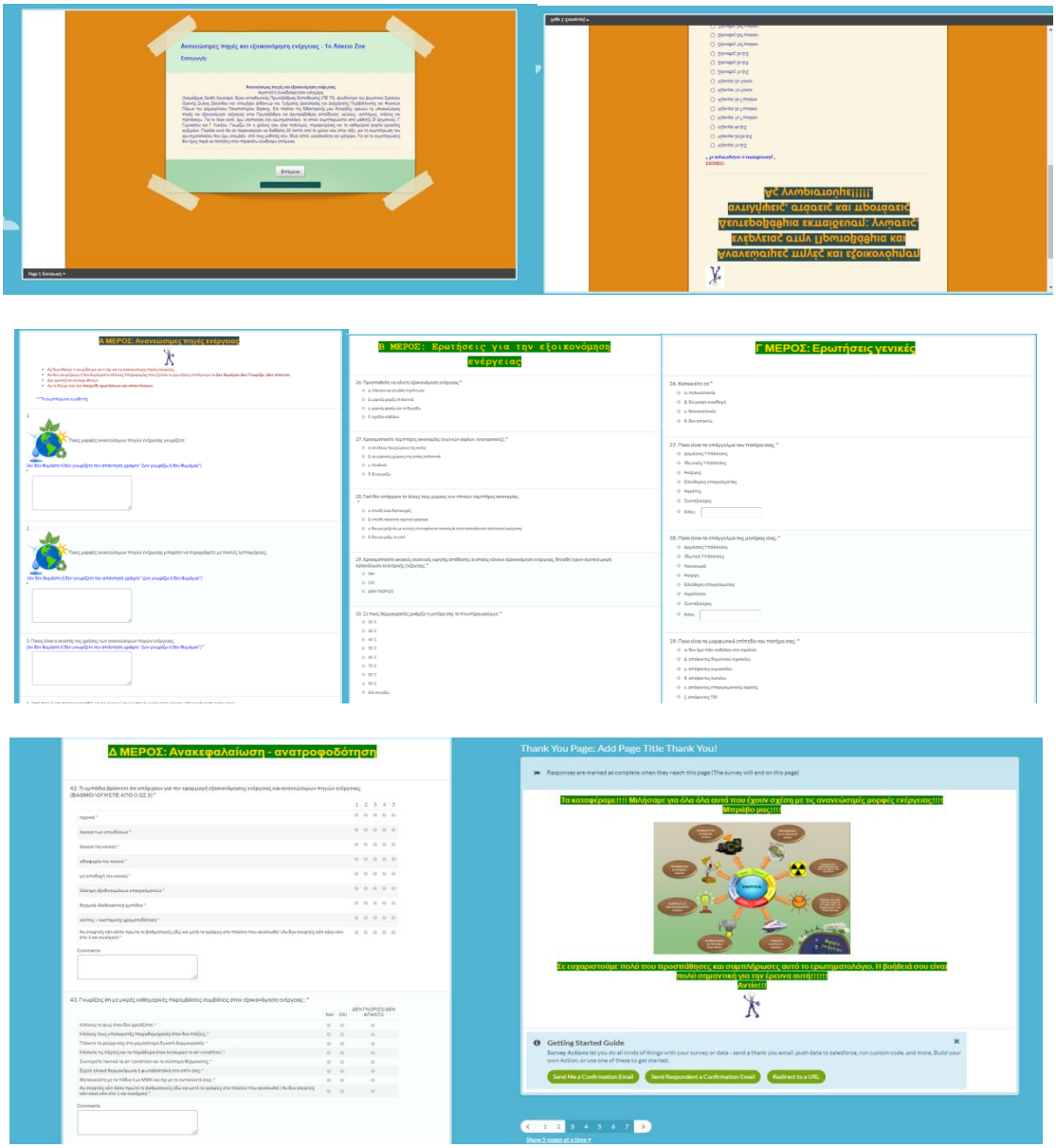

Figure 1: The online Questionnaire
http://www.surveygizmo.com/s3/2053568/1o

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IV. RESULTS

The analysis of the first questions (PART A does not show any particular changes, after teaching, to children's perceptions of energy uses. Both times children refer to the use of energy by human for daily activities (e.g., lighting, heating, device operation, etc.). However, few children refer (PART B)to the energy used by the human body itself (e.g., "to run", "for our Strength") or other living organisms (e.g., "plants to Grow"). It is worrying, however, that this confusion occurs not only before teaching, but also after that, without even showing it weakening. Also, in both of the above subjects, both before and after teaching, children's alternative ideas appear. For example, they mention "space" and "natural" as forms of energy. Especially the second ("natural") mention it as a source(Zimmerman,1995). Although prior to teaching, most children, in general, have considered renewables from non-renewable energy sources, after the completion of the didactical intervention, notable improvements in their understanding were presented. Especially with regard to renewable energy sources such as biomass, wind, water and geothermal, many more children after teaching say that they will never be finished. Corresponding improvement for non-renewable sources occurs in coal, and to a lesser extent in gas, where after teaching more children, than before, seem to have been convinced that these will be depleted. For the other main non-renewable energy source used today, oil, the situation remains almost stable, since the same number of children consider both before and after teaching that at some point it will be finished. Of course, there are some misunderstandings from some students who consider, even after teaching, that nuclear energy, solar and geothermal will end, while coal and oil do not.

In general children separate the environmentally friendly energy sources from those that cause pollution. However, after teaching this distinction is much more evident for mild energies such as sun, wind, water, biomass and geothermal energy, where significantly more children seem to realize their environmental friendliness. On the other hand, for non-renewable energy sources such as nuclear, petroleum, coal and natural gas, several children, from primary school, seemed to know that these have significant effects on the environment.

The question about actions to reduce energy consumption (PART C) presents some of the most important and interesting changes in children's responses. More specifically, while prior to teaching, few children reported specific actions that we can take in order to use environmentally friendly energy sources (e.g., bus/foot instead of car, use of natural Gas) After that, the vast majority of children cite a variety of energy-saving actions and use of renewable sources such as use of economical lamps and solar water heater, full disabling electrical appliances when not in use , washing at low temperatures in the washing machine, purchase of energy devices Class A, use of bicycles and public transport with parallel reduction of car use. In this case the important thing is that the actions proposed by children are practical and not theoretical, they are easily workable even by the same and have immediate and obvious results. Emphasis(PART D) was placed on such actions in order to illustrate the ways in which each of the children can be involved in the solution of the problem and contribute to the reduction of energy consumption and the increase use of Res.

V. CONCLUSIONANDRECOMMENDATIONS

Summing up the above results we can reach the following. Most children recognize the various forms of energy, both before and after teaching. Also, both times they perceive the limited ability to use energy sources in the past and the abundance of available energy sources nowadays. However, a confusion arises between sources and forms of energy. Social-cognitive and social-approaches appear to the didactics of science renewable energy sources in the age of primary and secondary school. About what students really understand we collected diverse views. For example, pupils report water and wind as energies or electrical and thermal as energy sources. Also, it was important after teaching to improve the understanding of children about which are considered renewable and which are not. Although, corresponding improvement, after teaching, appears in the understanding of children about the impact of energy sources on the environment. Children recognise the environmental burden caused by conventional sources and the benefits of using renewable sources. Finally, an impressive improvement showed, after teaching and children's responses, to the ways of reduction of consumption energy.

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