RENEWABLE SOURCES AND ENERGY SAVING IN PRIMARY AND SECONDARY EDUCATION: THE RELATIONSHIP BETWEEN PUPILS' KNOWLEDGE AND THEIR BEHAVIOR IN IONIAN ISLANDS

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ABSTRACT

The purpose of this research is to explore the views of pupils of primary (6th grade) and secondary education (3rd grade of Gymnasium & 3rd grade of lyceum) of the Ionian Islands, about renewable sources and energy saving. In Greece, significant research has been carried out on renewable sources and energy saving. Their findings showed that the public as a whole has a positive attitude to energy saving and the utilization of renewable energy sources. At the same time, the contribution of RES to economic growth and society is recorded. In addition, it has been shown that the change of human behavior is considered a sufficient and necessary condition to solve the important environmental problems of our everyday life and makes students behavior; knowledge and perceptions on environment and it's problems, an act of major importance.

Keywords: *Renewable sources, energy saving, primary and secondary education, knowledge, behavior*

INTRODUCTIONS

Renewable sources and energy saving

Renewable sources and energy saving is a huge issue for modern society. There is no doubt that the need to make countries out of conventional fuels is becoming increasingly urgent [2]. Renewable energy sources (RES) according to their origin density and energy carrier are divided into many categories. except for the tidal energy due on the one hand to the Rotation of the Earth and on the other hand to its attraction from other planets All other forms of energy are directly related and related to solar energy. In particular, RES are endless sources of energy and enhance the savings of the country's depleted energy resources by improving its energy autonomy, strengthening Imports – Exports, limiting their import, and creating reserves of local mineral resources for its prosperity and future [6]. However, RES have significant disadvantages. First, they have a small rate of return (= or < 30%) and high investment costs, so it is expensive compared to non-renewable energy sources. They are not able to meet demand since their

performance is affected by climatic conditions. Also, they cannot be installed everywhere, but only where conditions (nature, climate) allow it. In fact, wind machines are characterized negatively by many for their aesthetics, noise, and bird deaths. Finally, hydroelectric projects are implicated in the release of methane during plant decomposition and aggravate the greenhouse effect.

It is often noted, however, that the field in which today's man needs significant support is the basic training provided. Nowadays the phenomenon of climate change is discussed, mainly due to human errors out of ignorance or interest. It is therefore clear that it is important for students to know the true dimension of the environmental problem, the healthy ways of reacting to being tackled while saving energy and, above all, to lead to ecological attitudes of life or even to propose sustainable new practices to ensure the quality of their own and their planet's future [3]. The results of the study through the data processing of the views of primary (6th Grade Primary) and secondary school students (3rd Grade Gymnasium and 3rd Grade Lyceum) of the Ionian Islands on RES and energy saving, are expected to put the teaching work on RES and the environment on new bases. Information will be extracted and skills will be developed that will enable the student to become more cognitively adequate and more effective in his daily life and more generally in his life in the exploitation of RES, energy saving and environmental sustainability. On the basis of the results of this research, it will be possible to design effective educational interventions to improve the education provided for RES, the environment and sustainability, to create an atmosphere in which students, as future active citizens, will have a positive attitude and a similar culture for the exploitation of RES and energy saving while finding ways to address the environmental problem, in order to prevent the depletion of energy sources and dangerous ecological disasters such as those caused by climate change [2].

Energy and European Union

According to the statistics, the European Union, although it has increased in states, needs about 7% of global energy consumption since 2000. Ah is expected to increase energy consumption in China and India due to their huge populations with similar global consequences. both the countries of the Union and all other countries consumers by making them responsible for managing their energy needs in such a way that climate change becomes controlled and even at the lowest possible cost to those involved. The target of using 12% of renewable energy in the European Union has found obstacles to the slow development of corresponding markets and highlighted the need for immediate actions in this area to make energy targets possible [9].

At the lowest possible cost to those involved, both households and tertiary sectors and transport rely exclusively on oil which is not only not inexhaustible but like coal has a huge cost of extracting processing distributors and exploiting a positive element is the fact that while a large amount of electricity is consumed

every day by residents at the same time the industry has managed to significantly control this overconsumption with modernizing systems while there is still huge potential for improvement. in the European Union the entry of new spaces on the one hand created the expectation of economic growth in Europe in the energy sector, but things are not so optimistic as the new countries in their efforts to develop will need more energy reserves either endogenous or exogenous [2].

Europe does not have rich indigenous natural resources, so it is an important customer of imports from other countries. It makes sense since its consumer needs are greater than it produces and it has not been able to reduce energy waste, the introduction of energy is a one-way street. Domestic oil, natural gas, the European loan and Community coal are neither inexhaustible nor the cost of their exploitation much higher than what we find at global level. According to experts, coal and uranium do not pose economic risks and are characterized by stability on the world market, which is not the case for oil and gas where there is a great deal of volatility both in prices and in the distribution of stocks, creating insecurity on the world market with similar effects on the European economy [8]. The development of RES helps to limit the negative effects of both unstable global fossil fuel prices and exchange rate risks. The EU's renewable energy targets by 2030 will reduce the EU's dependence on imports of energy resources and materials, unpredictable fossil fuel prices and uncertainty about the balance of the European economy [9].

The energy management system in Greece

The use of renewable energy sources has led to a new emerging sector of the economy which is widely known as the green economy. These are those economic activities which, on the one hand, try to reduce the use of fossil fuels and, on the other hand, promote the more efficient use of energy with recyclable materials and renewable energy sources (RES). The main reasons that lead to the green economy and the need to use RES are environmental protection, economic growth (new jobs, new specialties, new scientific disciplines), national security, the future of the planet, prosperity, sustainability and sustainability in all areas related to the environment and human life. The latter factor led to green entrepreneurship, i.e. all those economic activities related both to people's vital needs and to the quality of life in the environment where they live and grow. According to Greek researchers [5] , the rich fertile natural environment, the favorable geographical location as well as the rich sustainable forms of energy (solar - wind) Zeus ensure a significant advantage now in both green economy and green entrepreneurship.

In particular researchers [3] mention that in recent years the management of energy in Greece has changed significantly. First of all, we have the dynamic entry of the use and exploitation of natural gas into the Greek reality, the integration of Greece into large European networks for the promotion and exploitation of renewable energy sources, the realization of a culture of energy

saving and the opening of the market to the exploitation of electricity outside the borders. All these changes have produced positive results in the safe energy supply of Greece, in the reduction of the uses of import oils at great cost, many economic benefits to the Greek funds ensuring the un renewed energy urgent achievement of more efficient processes in the production and consumption of energy corresponding protection of the environment and upgrading the related services addressed to Greek consumers [4]. In more detail, there is an increase in electricity demand as its price is more economical than other European countries. Another determining factor shaping the Greek energy balance is natural gas. Its import from Russia (before the war with Ukraine), Algeria and other producing countries has a significant impact on the country's wider economic and social situation as it enriches the list of energy sources. Over the last five years Greece has been dynamically integrated into these networks and is using natural gas in both major urban centres and the province. Fuel is also worth mentioning, even in private means of transport. The thematic core of this study is RES. There is no doubt that the focus is on the main Greek renewable energy sources. These according to Kyriakarakos, et al, [5] are solar radiation, wind energy, geothermal energy, biomass, the actions of the sea and finally hydraulic energy. In Greece RES do not participate dynamically in the energy balance. Wind potential varies marginally in exploitable prices while solar significantly outweighs the minimum utilization (relative to potential) of wind energy and biomass predisposes the establishment of production facilities for both of these types of RES [3].

Education and renewable energy sources

In the Greek education system, in addition to the Energy programmes implemented within the framework of Environmental Education, every school year in the schools of Primary and Secondary Education, Renewable Energy Sources are the subject of a study of students in the main educational process as basic modules of the Curriculum and Interdisciplinary Curriculum in the school textbooks, in order for students to understand the usefulness and necessity of RES. By studying the textbooks, in those of the Primary School the modules are introductory, while the large amount of information is found in those of the Gymnasium in simple form, while with greater depth in the textbooks of the General Lyceum. (Source: Institute of Educational Policy) [5]. Environmental Education appears in the early 1970s at international conferences and conferences of major international organisations (UN, UNESCO) to address environmental problems. Since the 1990s it has been linked to the concept of sustainable development and incorporated all three dimensions of sustainable development, namely society, the economy and the environment. At the same time, school education was established, environmental programmes were carried out in schools and the Environmental Education (Env. Ed.) was established. The Env Ed aims at the active participation of students in learning and society, critical thinking and action, intervention in values, attitudes and behaviours and the opening of the school to society, while adopting methods that a) promote participatory and

experiential learning, b) exploit pre-existing knowledge and experience and c) develop social interaction. The main method of the Env Ed is the project, while the field study is often used for the implementation of out-of-school programmes [5]. Since the 1990s it has been inextricably linked to the concept of sustainable development, which "aims to help people develop behaviours, skills and knowledge to make informed decisions for the benefit of themselves and others, now and for the future, and to act in accordance with these decisions" [2].

METHOD

Cohen & Manion [1] proposes the design of research as a strategic action for this approach, which will effectively satisfy the demands of research. They consider that by following such strategic planning in the research process, the data are linked to its objectives and objectives with similar results, whereas otherwise this is not possible. All three types of research project coexist, as descriptive and mainly concerns the identity of the sample, research (exploration) with the investigation of assumptions and causative (casual) with analyses, discussion and conclusions.

Participants

A sample of 12 Primaries (39 % of the sample), 11 Gymnasiums (35 % of the sample) and 8 Lyceums (26% of the sample) of the Ionian Islands Region. A total of 706 questionnaires were completed, of which 278 (39.4% of the sample) were from the PE and 428 (60.6% of the sample) from the SE. Of the total number of students surveyed, 278 (39.4% of the sample) attended 6th grade of Primary, 245 (34.7% of the sample) in 3rd grade High School and 183 (25.9% of the sample) in 3rd grade of Lyceum. In a sample survey, the number of individuals in the sample is crucial so that the results are reliable. Also, the validity of a survey increases if there is a larger sample, but mainly from the extent to which it can be classified as representative in terms of the survey requests, in which case the size is considered less decisive, as long as the degree of statistical error is at safe values, in our case not more than 5%. The dispersion of population observations [1] plays a primary role in determining the size of the sample.

Instruments

For the purposes of the survey was used (a) for primary and secondary schools questionnaire at http://www.surveygizmo.com and for high schools the questionnaire at https://docs.google.com/forms, consisting of 4 parts, i.e. as many research issues (knowledge, perceptions, attitudes, suggestions) which are the subject of this research: A PART: Questions on renewable energy sources (q: 1-25), B PART: Energy saving questions (q: 26-35), C PART: General questions (q: 36 -42) and D PART : Summary – feedback (q: 43-45), In the pilot survey (30 questionnaires- 10 per school type) there was a multiple choice question about the financial situation of the parents, but the participants' comments were not positive

about its existence and 2 of the 30 who answered it were "not answering", so it was removed. Despite the advantages offered by online research (saving resources, efficiency, ensuring anonymity), it also presents some disadvantages such as possible errors in population coverage, difficulty in determining the sample and its representativeness. Technical problems due to lack of infrastructure were addressed by printing a satisfactory number of questionnaires from school principals and sending them to the researcher by post.

Procedure

The collection of the research material took place in public primary and secondary schools in the Ionian Islands. The survey was launched in October 2014 and completed in May 2015, i.e. during the same school year. The printed questionnaires (for practical reasons of lack of infrastructure) were distributed by the school principals, while the researcher was in online communication with them throughout the time of their completion. Participation in the survey was voluntary. All survey participants were informed that the data would be used purely for research/academic reasons with absolute anonymity. The percentage of pupils' responses was 37 % for their classmates from the participating schools, while for all pupils in the Ionian Sea (6th PS, 3rd GS, 3rd LS) the percentage was 13%. The final sample consists of 706 students. The fact that it gives a statistical error e=3.76 and a reliability rate of 95%, safely allows the results to be generalization even at national level.

Statistical analysis of the data was carried out using the statistical software S. P. S. S. 21.0. Differences in significance .05 were considered statistically significant. Before the results were extracted, an audit was carried out (a) of the structural validity of the questionnaires with the exploratory factor analysis and(b) an assessment of the internal coherence of the factors with the Cronbach factor a. The exploratory factorial analysis used the analysis of principal components with rectangular rotation of the maximum varimax to maximize loads. The final number of factors was based on being the values > 1 and the visual examination of the scree plot chart with Bartlett's sphericality test and Kaiser-Meyer-Olkin's rule [7].

RESULTS

Factor analysis and reliabilities

Specifically, for the whole questionnaire the coefficient α was .71. In each dimension studied the coefficient α ranged from .68 to .82 (Table 1): efficacy for information attitudes .68 and efficacy for energy saving attitudes .81. The values of the reliability factor α, if we delete a question (if item deleted), showed that none of the questions needed to be removed from the scale, since by subtracting a question there was no particular change in the values of α. (Table 2).

Table 1. *Means for TSBS and its subscales*

Means	a
Efficacy for information attitudes	.68
Efficacy for energy saving attitudes	.81

Table 2. *Factor loading for the TSBS*

Teachers' sense of behavior Scale (TSBS)	**Factor**	
	1	**2**
How or/and where did/do you learn about renewable energy sources and energy saving:		
School	.703	
Family	.639	
Books	.621	
Magazines	.609	
TV	.623	
Network	.662	
Friends	.653	
If you want to save energy, what are you willing to do:		
Do you turn off the light when you don't need it?		.781
Do you turn off computer game machines when you're not playing?		.776
Do you wash your clothes at the lowest possible temperature?		.788
Do you close doors and windows when the air-condition is working?		.782
Do you regularly maintain air-condition and heating system?		.807
Do you have a solar water heater or photovoltaics in your home?		.792
Are you on foot or with an MME and not with your car?		.784
Are you participating in the recycling program?		.790
Do you want to be more informed to contribute to the energy saving effort?		.812

Predicting levels of pupils behavior

In the international arena, one area that has been highly studied is the correlation of knowledge and attitudes. Zimmerman [6], after a 15-year research review, concluded that people with a higher level of knowledge about the environment exhibit more positive attitudes towards it than people with a lower

level of knowledge. Timely action, even when you do not possess the whole truth, is more important than possessing the whole truth and it is too late. In contrast, research by Yount and Horton [6] showed that by increasing people's knowledge of environmental issues, it does not change their attitudes towards them [6]. The two dimensions of the behavior are positively correlated (.12) and from the average values it follows that the attitudes in terms of information are 3.05 (43.57%) with a maximum of 7 and with respect to the ES behavior 8.40 (64.61%) with a maximum of 13 and therefore the students seem to seek to be informed by the available sources and more take care to save energy, so they are both satisfactory. Analysis of the correlations between the dimensions of students' knowledge and attitudes on renewables and energy saving found that all variables of the stops are also correlated with all the variables/dimensions of knowledge about renewables and energy saving. The greatest correlation was observed between the knowledge of RES and the attitudes of the ES (.74) and the smallest in the knowledge of the and the attitudes of information. The dimensions of the associated factors have a positive sign and therefore students who have basic knowledge about the ES have a similar energy-saving behavior, while the sources of their information affect more the quality of their knowledge and less their mentality for ES. Remarkable were the results from the multiple regression analysis, a) to examine the possibility of predicting the " ES behavior " (dependent variable) from the variables/dimensions of the "knowledge" of RES and Energy Saving (ES) (independent variables), where it emerged that in 54.3% of the variability of the "ES behavior" was explained by the variable / dimension of the ES knowledge (energy saving), which contributed significantly to the prediction of the "ES behavior", while the variable/dimension of renewable sources was not important in the forecast. It should be noted that the relationship of the variable "ES stops" with the variable "ES knowledge" (energy saving) was positive and b) to examine the possibility of predicting the "information stops" (dependent variable) from the dimensions of "knowledge" (independent variables), where it emerged that in 10.3% of the variability of "information stops" was explained by the variable / dimension RES knowledge (renewable sources), which contributed significantly to the prediction of " ES behavior ", while the variable/dimension of ES knowledge (energy saving) was not important in the forecast.

Differences in trait knowledge and behavior according to gender, and age/class of students

To investigate possible effects of gender, age/class o and their interactions on Greek pupils' trait knowledge and behavior, two-way ANOVA were conducted. The dependent variables were the trait behavior and the knowledge, and the independent variables were (a) the gender with two levels and (b) age/class with three levels (6th Grade Pr, 3rd Grade Gym, 3rd Grade Lyc). The results showed a statistically significant gender effect, ($F(1, 700)=11,551$, $p=.001<.01$), no significant effect on age, ($F(2, 700)=.911$, $p=.403>.05$) and non-significant gender and age interaction, ($F(2, 700)=.922$, $p=.398>.05$). Examination of the averages showed that boys had a lower percentage of correct

responses than girls. To examine differences in students' behaviors in terms of gender and age/class, a two-sided (2X3) variance analysis (Two-way Anova) was again performed. =.005<.05), while showing a non-significant effect on gender (F(2, 700)=3.783, p=.052>.05). An examination of the averages showed that the boys had a lower percentage of correct answers than the girls apart from the boys of the 3rd Grade Lyc who preceded them with a difference in terms of postures.

CONCLUSION

This study seeks to capture the evolution over time as well as the current situation prevailing in the field of renewable energy sources in Greece and especially in the Ionian Islands. In particular, by placing particular emphasis on RES that are utilized, i.e. wind, solar, hydroelectric, geothermal, oceanic - wave energy, as well as energy from biomass / biogas, and through the processing of data of the views, perceptions, attitudes and proposals of students of primary (6th gr Elementary) and secondary education (3rd gr Gymnasium and 3rd gr Lyceum) of the Ionian Islands for RES and energy saving (ES), to come up with proposals for the future. The specific purpose of this work, apart from the interaction of the four main factors of RES and ES (the knowledge, perceptions, attitudes and proposals of the students who participated), is to investigate the influence of the level of education and their demographic characteristics (the gender and age / class of their parents' studies, the profession of their parents, the place of residence and the type of their residence) in the formation of these factors. From the correlations it emerged that a) the two dimensions of knowledge are related to each other (.17) and from the average values it follows that the knowledge about RES is relatively low for students since they have an average value of 7.37 (26.32%) when the maximum is 28 points and a satisfactory level of knowledge of ES 4.47 (63.85%) when the maximum is 7 points. This shows the preference of students to study that it has to do with the practice of the RES and not with the theoretical framework of RES. It should be noted that the relationship of the variable "information stops" with the variable "renewable sources" was positive. The highest percentage of volatility forecast occurred at the ES behavior (54.3) and the smallest at the information behavior (10.3). Having a marginally higher percentage of prediction, the factor is considered the most important predictor. Therefore, students who have knowledge of ES can predict the correct ES attitudes, while those who have knowledge only of the theoretical framework of RES can predict their attitude towards the sources that are informed about it. The ES attitudes cannot be predicted by a good knowledge of the theoretical framework and the information attitudes are not predicted by how many and what practices the students know.

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Appendix section

Questionnaire (list of questions)

Renewable sources and energy saving in Primary and Secondary education: knowledge, perceptions, attitudes, and proposals

PART A: Renewable energy sources

1. What forms of renewable energy are you aware of?

2. For which forms of renewable energy can you give not only a clear definition but also explain in detail?

3. What is the aim of the use of renewable energy sources?

4. Where have you heard' about renewable energy sources and energy saving?
   a) school b) family c) books d) magazines e) TV f) internet
   g) friends

5. Why have renewable energy sources not yet been sufficiently developed in Greece?

6. Do you consider that the State has taken the necessary measures for the wider dissemination of renewable energy sources

7. Why is it considered imperative to choose the development and use of renewable energy sources?

8. What do you know about bioenergy and biofuels?

9. The use of renewable energy sources essentially helps to solve some environmental problems

10. In solving what environmental problems does the use of renewable energy sources help?

11. What do you know about hydropower or hydropower?

12. What do you know about solar energy?

13. What do you know about wind energy?

14. What you know about geothermal energy (in Greece)

15. What do you know about tidal energy?

16. What do you know about the energy of waves?

17. What do you know about bioenergy and biofuels produced from biomass?

18. What do you know about bioenergy and biofuels produced. from forest biomass?

19. What do you know about bioenergy and biofuels produced from agricultural plants?

20. What do you know about bioenergy and biofuels produced from livestock manure

21. What do you know about bioenergy and biofuels produced from the bio-based part of municipal waste?

22. What do you know about bioenergy and biofuels produced from urban sewage?

23. Bioenergy has served in the past and in the present the energy needs of the Greek people

24. How do you see the prospects of bioenergy in Greece?

25. How do you see the future of biofuels in Greece?
    a) bioethanol b) biodiesel c) biogas

PART B: Energy Saving Questions

It is completed by the student

26. You are trying to save energy

27. Do you use economy lamps (noble gases, electronics)?

28. Why do you not use economy lamps in all areas of the house?

29. Do you use high-performance household appliances that save energy, ie. have a relatively low electricity consumption?

30. At what temperatures does your mother sets the washing machine?
    a) 90°C b) 80°C c) 70°C d) 60°C e) 50°C f) 40°C g) 30°C h) 20°C

31. Have you heard of the energy savings achieved when the washing machine is set to a certain temperature?

32. Did you know that good thermal insulation contributes to energy saving?

33. Are the external walls of the house double where there is a fiberglass layer in between them, serving thermal insulation?

34. Is there thermal insulation on the floor and ceiling of your home?

35. Do you make sure to close the air vents in the external doors and windows of your home?

PART C: General questions

36. You reside in

37. What is your father's profession?

38. What is your mother's profession?

39. What is your father's educational level?

40. What is your mother's educational level?

41. Gender

PART D: Recap - feedback

It is completed by the student

42. What obstacles do you find there are to implement energy saving and renewable energy? (SCORE FROM 0 TO 5)

Technical 1 2 3 4 5

ignorance of those responsible 1 2 3 4 5

ignorance of the public 1 2 3 4 5

indifference of the public 1 2 3 4 5

non-acceptance of the public 1 2 3 4 5

lack of skilled proffesionals 1 2 3 4 5

institutional-procedural obstacles 1 2 3 4 5

costs - insufficient funding 1 2 3 4 5

Other (please specify) 1 2 3 4 5

43. Did you know that with small daily interventions you contribute to energy saving?

Do you turn off the light when it is not needed?

Do you turn off gaming machines when you're not playing?

Do you wash your clothes at the lowest possible temperature?

Do you close doors and windows when the air-condition is working?

Do you regularly maintain air-conditioning and heating system?

Do you have a solar water heater or photovoltaics in your horne?

Do you move on foot or by MMK and not by car?

Other (please specify)

44. If so, what are you willing to do?

Did you know that with small daily interventions you contribute to energy saving?

Do you turn off the light when it is not needed?

Do you turn off gaming machines when you're not playing?

Do you wash your clothes at the lowest possible temperature?

Do you close doors and windows when the air-condition is working?

Do you regularly maintain air-conditioning and heating system?

Do you have a solar water heater or photovoltaics in your home?

Do you move on foot or by public transport and not by car?

Are you participating in the recycling program?

Other (please specify)

45. You want to be more informed to contribute to the effort to save energy?