

PROJECTS ABOUT WEEE TOXIC MATERIALS MANAGEMENT IN GREEK SCHOOLS

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ABSTRACT

The project method is one of the new teaching methods in Greece. It is generally considered a means by which students can develop independence and responsibility, and practice social and democratic modes of behaviour. The management of the waste of electronic and electrical equipment (WEEE) has become a serious problem nowadays. The situation in Greece is under investigation. The Greek population seems to be still worryingly unready. School programs are proposed, through the Environmental Education courses, for the achievement of the desired goals in WEEE management. In this paper, we present some relevant projects, developed in Secondary Education Greek schools and we discuss their first results. We are presenting our research and innovations realised during the last 3 years. Through our educational innovations, remarkable changes in the knowledge and understanding of WEEE management were observed in the group of students where the projects were applied.

Keywords: *WEEE management, Greek schools, Secondary Education, Environmental Education, technology courses*

INTRODUCTION

The huge growth of the electronics industry over the last years through the development of a mass consumer market has created a lot of concern for the management of the waste of electronic and electrical equipment (WEEE)¹⁻⁴, because of the possible physical and chemical hazardous substances contained in EEE. With legislation on hazardous substances in place since 2003 in California, and more set to come into effect in the European Union in 2006, and with China also

considering legislation, governments are clearly asking companies to address this issue⁵. Electronic and electrical equipment includes items such as cathode ray tubes (CRT) monitors, televisions, laptop computers, central processing units (CPUs), peripheral equipment (keyboards, mice, cords, speakers), printers, fax machines, mobile phones, stereo equipment, answering machines, telephones etc. Their hazardous substances are heavy metals as Hg, Cd, Pb, Cr^{VI} etc. The European Union (EU) has recently introduced new directives on

electrical and electronic equipment in relation to its composition and the levels to which it should be recycled. The Restriction of Hazardous Substances (RoHS) directive⁶ restricts the use of six hazardous substances in electrical and electronic products. The WEEE directive⁷ prevents waste by encouraging reuse and recycling. These hazardous substances have already been banned from cars (End of Life Vehicles directives) and from packaging materials (Packaging directives) since the nineties.

The situation in Greece is the focus of the present work. New legislation has been established but the Greek population seems to be worryingly unready. Though Western European population is more used to recycling and WEEE recycling development seems easier, Europe is late in realizing the importance of the environmental issues compared to United States. In USA⁸ and in some Asian countries, WEEE recycling has been already developed, mainly through private companies. In Greece, programs are proposed, for the achievement of the desired goals in WEEE management. In this paper, we present some projects, developed in Secondary Education Greek schools and we discuss the results.

THE GREEK EDUCATIONAL SYSTEM IN BRIEF

The Greek State⁹ offers free access to all Greek citizens, to general education. The basic principle of the Greek educational system is to provide an education that fights to secure equal opportunities, access and support for all students in all levels of general education. The Greek general education consists of two levels; Primary and Secondary. Primary Education caters for pupils of 6 to 12 years of age, and Secondary Education caters for pupils of 12 to 18 years of age. Education is compulsory for all Greek pupils up to the age of 15 years.

The Greek Educational system is highly centralised. The Ministry of Education is

responsible for all educational matters. The spinal cord of the educational system is the National Curriculum, which is centrally developed under the authority of the Ministry of Education. All Greek schools must follow the National Curriculum and the proposed school time schedule. The educational practice in the majority of schools reflects a teacher centred system. Courses such as "Technology" and "Environmental Education" (EE) have been added recently to the Curriculum, and brought some innovative approaches to teaching. Despite the attempts for innovation, there are various remaining difficulties in including new projects and especially multidisciplinary projects such as those about recycling equipment and stabilizing hazardous materials.

"TECHNOLOGY" AND "ENVIRONMENTAL EDUCATION" COURSES

Technology has recently been introduced in many countries as a subject in its own right or as an integral component of general education. Technology courses are compulsory for all students in Greek Secondary Education¹⁰. As a curriculum component, however, 'technology' is often confusing and incoherent. In some countries, technology is placed in the context of 'design and technology', as in England and Wales. In other countries, the term technology implies modern information technology and Information and Communication Technologies (ICT). In some countries the stress is on the technical (and underlying scientific) aspects of technology while, in others, Greece included, the emphasis is placed on the interactions of science, technology and society. Becoming familiar with technology, utility and practical examples is often used to build confidence in the children since, through technology, they can come to understand that science and technology are not just about knowing but also about doing and making things work.

Environmental questions are increasingly forming part of school science and technology curricula. Since the early 90s, there has been an

optional course in the Greek curriculum¹¹, both in Primary and in Secondary Education, called Environmental Education (EE). Raising the environmental awareness at school, the pupils will also have to deal with issues of socio-scientific nature. The treatment of these issues requires project work undertaken in an interdisciplinary and cross-curricular setting. The most significant teaching difficulty in EE is the lack of an integrated educational plan. The EE teachers are not motivated enough to get involved in EE programs. Although the educational material is considered adequate, there is still room for improvement, though the structure of the Greek National Curriculum does not allow an integrated confrontation of the problem of WEEE management. The degrees of freedom of the particular courses enabled us to plan and realize projects focusing on educational aspects of the recycling of equipment and stabilization of hazardous materials.

OVERVIEW OF THE PROJECTS

We present our research and innovations realised during the last 3 years, in schools of Secondary Education in Greece. We have to mention that metal properties and moreover, heavy metal properties, are, in practice, not studied through the courses of the Greek curriculum. There is an exception in secondary technical education (only a relevant chapter in a textbook), but it is addressed to a very limited percentage of the Greek pupils. We have tried to cause an interaction among school population, local community and recycling organizations (Fig. 1). A project method was chosen, as most appropriate for the problem at hand. The requirements for the proposed projects were: a) study of all the stages of recycling, b) work in small groups, c) multipart interaction, d) assessment of the use and prior knowledge on recycling equipment, dangerous materials and stabilization and, e) study of equipment that is commonly used and can be recycled or safely disposed^{12,13}.

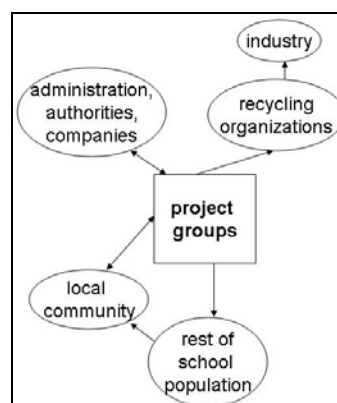


Fig. 1. Interaction among school, local community and recycling organizations.

ASSESSING THE USE AND RECYCLING OF EEE IN HOUSEHOLDS

We have conducted a research study via 1600 questionnaires in about 30 school units, recording and analyzing the knowledge and the habits of school population about WEEE management. We have also gathered data from the teachers, school administration and students in a University Physics department.

Analyzing the data, we found that Greek students of Secondary Education have almost complete ignorance of metal properties and of heavy metal toxicity. EEE is used in significant amounts in pupils homes (Fig. 2) and is often renewed.

Greek students find it difficult to make out the composition of EEE and to realise and understand the size of the waste management problem (Fig. 3). Although they declare that they are involved in recycling procedures (Fig. 4), they usually do not dispose of WEEE the way they should do (Fig. 5). On the other hand, they know that WEEE must be separately collected but they rarely know where to dispose of such equipment (Fig.6).

EE courses seem to have a positive effect on raising the pupils' environmental awareness on recycling matters, but the rest of the Curriculum

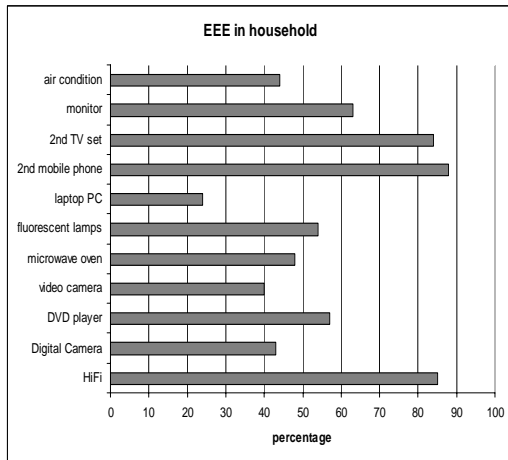


Fig. 2. EEE in household

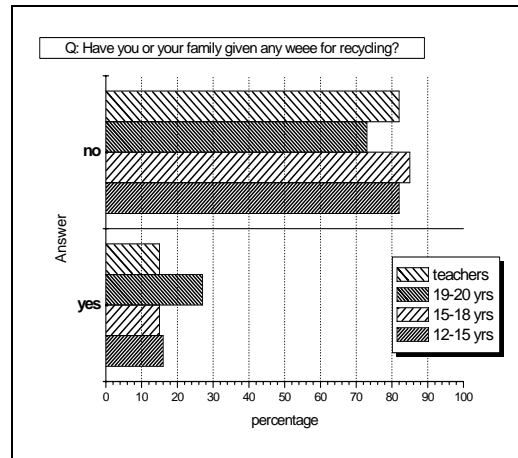


Fig. 5. Greeks do not –so far- recycle WEEE.

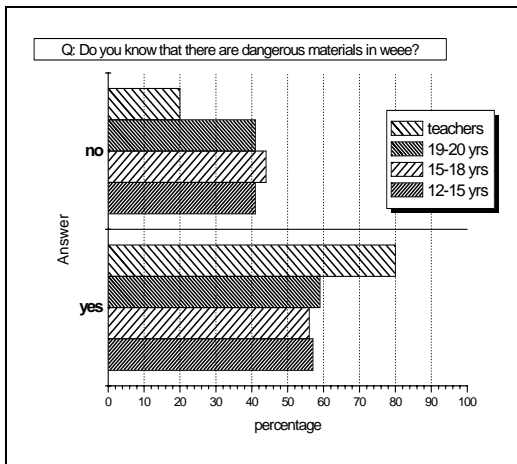


Fig. 3. Awareness of the existence of toxic metals in WEEE.

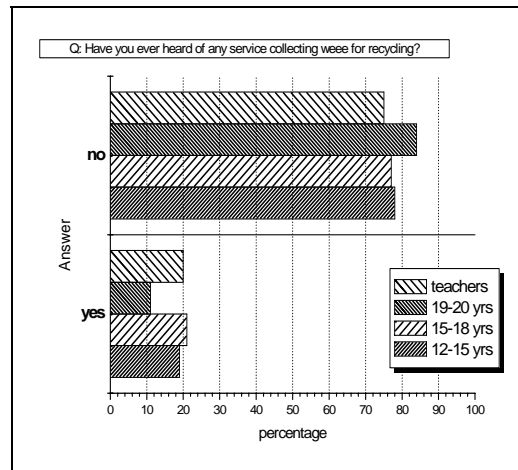


Fig. 6. Unknown recycling channels.

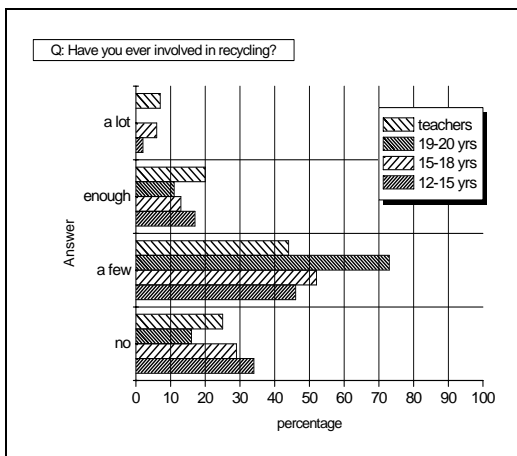


Fig. 4. Involvement in recycling procedures.

(such as Physics, Chemistry and Biology courses) is not adequately supportive. Although teachers are quite familiar with WEEE management issues (as can be seen in figures above), the limited flexibility of the National Curriculum does not favour necessary innovations and initiatives in an adequate range.

THE TWO PROJECTS

Based on the results of the above research, we have planned and realised two special projects (through the EE and Technology courses) during the last 2 years, in 3 schools in Greece. Projects' organization is presented in Fig. 7. After the issue was chosen, 15 to 20 students

were organized in groups of three students, according to their capabilities and interests. Each group undertook a special subject. The issues were related to WEEE recycling, namely batteries and fluorescent lamps collection and recycling. Batteries and fluorescent lamps were chosen, as adequately familiar to pupils. During the project period, groups interchanged information and resources, under the supervision and guidance of a physics/EE teacher. The final project's result was shaped after 6 months, working in groups for about 2 hours per week.

We had to start almost from zero, as there was not any knowledge so far about the metal properties, the WEEE composition and the way batteries and fluorescent lamps function. The special sign about WEEE disposal (symbol indicating separate collection for WEEE; the symbol consists of the crossed-out wheeled bin and must be printed visibly, legibly and indelibly on EEE) was unfamiliar (Fig. 8).

There was also lack of ways to forward such waste to recycling. In these courses/projects, students, working in groups, researched and found relevant information (in school libraries but mostly through the Internet). They interviewed the local authorities, EEE traders and recycling plan managers. Many of them

realised the size of the problem, after they had become familiar with the certain substances that this equipment includes, with the material properties, and with the complexity of the recycling plans. In Greece, it is still difficult to forward WEEE for recycling, as such channels have not been developed yet. As battery recycling is an exception¹⁴, students installed recycling bins for batteries in their schools and informed the rest of the students, their teachers and the local society. The collecting rates were amazingly high and the collected batteries were forwarded to the collaborating organisation. During the first month, more than 2 batteries per person were deposited in the bins. Most of the batteries were of sizes AA and AAA, but there were also mobile phone batteries and rechargeable batteries, in small percentages. A similar program about fluorescent lamp recycling did not have the same successful result, as there has not been organised such a recycling program in Greece yet. Final results of the projects were used to create an educational CD, which was distributed to the local authorities and to many other Greek schools, in order to be used in EE courses and projects. The current version of the CD contains a lot of information about heavy metals, WEEE, toxicity, recycling, etc., and helps the user to be motivated and to find ways for proper WEEE disposal. A multiple-language version of the CD is being planned.

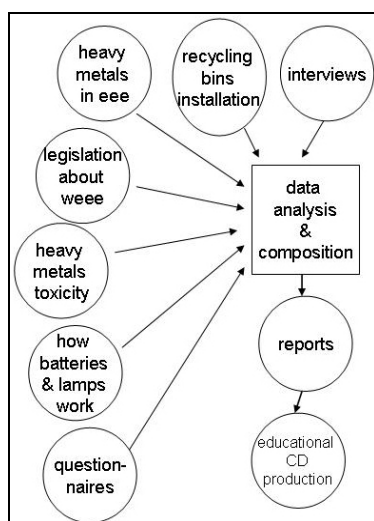


Fig. 7. Project modules.

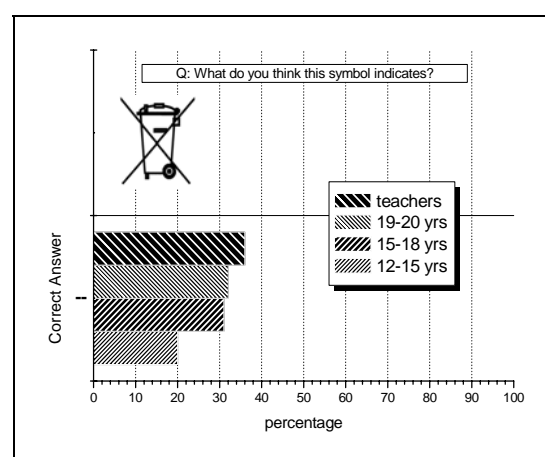


Fig. 8. The symbol indicating separate collection for WEEE is not familiar to Greeks.

DISCUSSION

The results of the research and of the projects show that there is a major problem about WEEE/toxic materials management issues in Greek schools. On one hand, it has to do with the existing National Curriculum and the lack of necessary interdisciplinarity. On the other, there is a noticeable decline in the recruitment of students to science and technology (ST) studies. 'Europe needs more scientists' is the title of a report¹⁵ by the High Level Group on Increasing Human Resources for Science and Technology in Europe. This report examines the condition of ST in the European Union and pays special attention to the number of people entering ST education and careers. The falling recruitment to ST studies is seen as a large problem in most European countries. The same tendencies are noted in the USA and in most other countries in the Organization for Economic Cooperation and Development (OECD). It is a paradox that the most ST-driven economies in the world are experiencing a lack of interest in ST studies and careers among young people. The economic significance for a country to have a high number of skilled scientists and engineers is well accepted. But young people do not choose their studies or careers because it is good for the domestic economy. Instead, they base their choices (when they have such choices) on their own interests, values and priorities. It is obvious that ST studies and jobs no longer have the appeal in wealthier countries that they had some decades ago.

As a positive response to the projects from a significant percentage of the pupils was recorded, we believe that projects of this kind are promising and we schedule to apply them in a wider range of school units. These projects can be also applied in other countries, since the project method is gaining acceptance and can support the educational goals for the proper WEEE management, raising synchronously the pupils' interest in ST studies.

CONCLUSIONS

Through our projects, we hope to stimulate an informed discussion on important aspects of WEEE management and its role in society and in education. The project method is utilized in many educational systems to promote better involvement of the students in the learning process and their acquaintance with professional methods. Students had initially almost complete ignorance of the materials contained in WEEE. They generally didn't know the need for waste collection and processing as well as for possibilities of recycling and stabilization. Through our educational initiatives, a considerable number of pupils (in the school units where our projects were developed) have changed behaviour and showed an interest in toxic materials in WEEE. Some students are mobilized, participating voluntarily in related projects and seeking knowledge about techniques for materials processing.

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