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Recycling and Students: If It Comes From the Earth It Can Go Back to the Earth

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Abstract: Recycling and composting are two waste management actions for the benefit of humans and the environment. The use of recyclable materials has been continuously increasing due to environmental and art developments. Good food starts with good soil. Composting is a direct way of recycling. It is a natural process that converts organic materials into natural fertilizer. Students of the 6th Heraklion High School, through an environmental education program, used recycled materials and made the portrait of Nikos Kazantzakis, old-fashioned bags, a worm named Rosalinda, and a wooden compost for school. The students also made a lamp of plastic cups and presented a small theatrical event about the plastic bag. The project was implemented in the 2018-2019; by 25 females and 20 males students, lasting seven months. The aim of the program was to provide the student with an environmental awareness and quality of life in their daily life with an objective to sustainable development. The evaluation of the program using anonymous questionnaires and comics determine whether a recycling education program would lead to a positive change. The survey results confirmed that students understood well the important role of composting and recycling in our lives.

Key words: recycling; composting; environmental education; sustainable development

1. Introduction

Nowadays, after four billion years of evolution, the planet has to face environmental issues that are mainly due to human activities. The agricultural sector of the Balkans is currently facing important challenges on the basis of non-sustainable techniques that are employed for the management of natural resources. The development of tools, policies and practices for the protection of the environment is deemed essential. The rate with which the environment is spoilt, necessitates the participation of the citizens in environmental decision-making. Every citizen must obtain the ability to understand the environmental issues, to perceive the causes of the problems, to evaluate the possible solutions and have participatory skills. This demands the development of a communicative procedure among the citizens, the experts and the management. However, the climate change is a reality. At present, in 2020, the concept of recycling is becoming more and more intense, as the shadow of the climate change intensifies the need for energy saving. Recycling, apart from developing, is also multidimensional, since it includes the philosophy of "nothing is wasted" [1]. Recycling paper, plastic, aluminium, glass etc., is widely known. However, recycling fabrics as well as composting are becoming common. All these take place in a world whose population is constantly increasing, multiplying people's needs that are becoming more demanding. Protecting and preserving natural resources, reducing the emissions of greenhouse gases, reducing the produced waste and choosing the optimum management technology for them, having the production of agricultural products with ecological labeling (eco-label products), applying sustainable practices in the production so that they have a low carbonate imprint [2]. Cooper and Palmer (1992) [3] state that we will realize the true meaning of a

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sustainable society when we will have cut the last tree, caught the very last fish, polluted the last river. In this framework, the need for imperative adjustment methods to the new reality, that of climate change, make environmental education a smart solution for sustainable development.

2. Recycling

Recycling is both an economic as well as environmental activity. As an economic activity, recycling represents recovery of residual value from waste product. As an environmental activity, recycling is neither inherently positive nor negative. Life cycle assessment methodology can be applied to the recycling process just like to any other process to assess the overall impact. The environmental impact can be assessed in terms of local, regional and global impacts. Ecoprofile is a form of life cycle assessment but with the application of weighing factors which allow for comparison and rating of impacts [4]. Waste treatment is one of the most substantial and critical management challenges. The waste generation of EU 28 has been slightly reduced, but it is still increasing in some of the EU countries, for example, Germany, Iceland, Switzerland, Czech Republic, Finland and Denmark. Integrated waste management combines a variety of strategies for both waste management, and prevention should be encouraged instead of having all the focus on how sustainable the waste treatment and how much share it constitutes in the overall waste treatment practice in a country [5].

3. Composting

The natural composting process driven by earthworms and aided by microorganisms is known as composting. Composting converts a diverse array of organic waste such as agro-horticultural crop waste, weeds, forest leaf litter, sewage sludge, and industrial waste into excellent soil conditioner compost. Good soil health is necessary for sustainable agriculture and compost application is an effective way to maintain the soil health and productivity. Compost application improves bulk density, water holding capacity, and humic substances of the soil. Long-term research has proved that compost application to soil maintains its fertility and health, making it more suitable for crop production, and decreases dependency on chemicals. So, composting is a typical aerobic digestion process, which converts organic matter into compost, a humus-rich, earth-like product. The composting process has been long associated with the treatment of green waste from agricultural farm and garden. With the increasing limitations in landfill capacity, food waste which previously was earmarked for landfill is used for aerobic composting. It has been estimated that food waste contributes to around 1/3 of the compost produced in the EU, with the remaining compost obtained from farm slurry/manure, sewage sludge, and energy crops. The advantages of composting include generation of a fertilizer, soil conditioner-like product, reduction of waste volume, reduction in presence of pathogenes, control germination of weeds in agricultural fields, and elimination of undesirable odorous compounds. In composting of food waste, microorganisms, including bacteria, fungi, mold, and actinomycetes, use the organic components in food waste degrading them into short chain chemicals, e.g., humic acid. Compost can be carried out in vessel, aerobic windrow, or aerobic pile. During the composting process, the temperature often raises to a high level as microbes release heat (55°C for 5-7 days or 75°C for 2-3 days). This increase in temperature is responsible for the deactivation of pathogens and weed seeds. In comparison with green waste, food processing waste normally contains high-water content of about 80%. Therefore, food processing wastes are commonly composted with green waste or bulking agents, such as sawdust, rice husk, wood chip, and wheat straw to adjust a suitable C/N ratio and to reduce the moisture content. For food processing waste, such as olive mill waste, which contains a low nitrogen content, co-composting with farm slurry/manure

improves the nutritional value of the compost [6]. Finally, aerobic and biological composting of bio-waste is a process that requires experience and technical skills, thus backyard composting can be a challenging task for the average household, with failed attempts often leading to its abandonment [7].

4. Environmental Education

Environmental education is playing a crucial role in today's societies, given the environmental problems they face, as for example climate change. The adoption of environmental education as an inert part of the educational system is a necessity in order the Environmental Education Centers (EEC) to be able to provide knowledge, values, and skills so that both students and the society through awareness raising, and activation to become active and environment sensitized citizens [8]. The term Environmental Education (EE) was first stated by Thomas Pritchard, in a conference of the World Union for the Protection of Nature IUCN), in Paris, in 1948. According to Hungerford and Peyton (1980) [9], EE comprises the procedure which "will help the citizens gain knowledge of the environment and above all, they will become competent and determined, to have the disposition to work individually or collectively for achieving and preserving a dynamic balance between the quality of life and the quality of the environment". EE plays the role of the mediator, trying on the one hand to make the school curriculum more active, more experiential thus attractive, and on the other hand, through the current affairs of the ecological concern, to seek for solutions on environmental problems with responsible and active participation of all the people involved in its programmmes [10]. Chapman (2007) [11] states that the education for sustainable development with environmental education belong to the same genealogic tree. The Education for sustainable development (ESD) includes social (S), economical (E), natural (N) education and their interaction [12]. In Russia, formal education is incorporated with non-formal (universities, non-governmental organizations). In the non-formal education there are "activity centers" (after-school activity centers) where there are many teaching and learning ways that evade the strict school standard. Also, environmental programmes take place during students' holidays in collaboration with university teachers or students. As Madison (2007) [12] states, the necessary background for the implementation of this education is democracy (D). So, EE aims at changing people's attitudes and behaviors with ultimate objective the creation of a new environmental morality, the formation of citizens with vigilance who have the ability to research, solve problems, take decisions and act [13].

5. Sustainable Development

It is known that sustainable development comprises one of the fundamental objectives of the European Union. It poses questions regarding how can the economic growth, the social consistency, the equality of North-South and the protection of the environment compromise. The businessman Paul Hawken states that «we reached a point when the value we add to our economy now, is by far surpassed by the value we extract, not only from the future generations as part of the reduction of the natural resources but also from ourselves as part of the states in which life has become unbearable, the decrease in jobs, the weakening of our health and the rise of criminality. In biological terms, we have become parasites that are destroying our host. However, many economists believe that we can use technology to expand or surpass these limits [14].

The report (report Brundland) of the World Committee on the Environment and Development (WCED) (World Commission on Environment and Development) states in the book, Our Joint Future (1987), the meaning of sustainable development as the development that is "able to satisfy the needs of today's generations, without risking the potential of the future generations to satisfy their own needs" [15]. Sustainable development is an economic growth of

another form that takes into account the adequacy of natural elements. It also takes into consideration the need for the preservation of the basic ingredients of the natural elements in time and the immediate and long-term needs of a place. Sustainable development has the character of a complete solution to the environmental problem. This solution makes some suggestions to society. These suggestions are for example recycling, the formation of a culture based on the relationship of man with nature and the cultural tradition, the promotion of the participation of the citizens in the procedure of decision-making, the disposal of the free time in naturalistic activities e.t.c. In order for sustainable development to take place and for the environmental problems to be faced, the state promotes actions that take place in education with environmentally friendly content [15].

6. The Environmental Education Program

The students who participate in EE programmes understand the role of different social groups better, obtain the feeling of cooperation and solidarity through collective projects that take place, they practise in taking decisions, form a positive attitude towards the environment, developing a responsible personality [16]. Briefly, we would say that through EE programmes, students could, like Socrates in his youth, turn to the research of wisdom about nature [17] passionately so as to learn the causes of the problem.

6.1 Environmental Classes

Students of the 6th High School in Heraklion, through an environmental education program, used recyclable materials and made the portrait of Nikos Kazantzakis, old-fashioned bags, a worm named *Rosalinda*, and a wooden compost for school. The students also made a lamp out of plastic cups and presented a small theatrical event about the plastic bag. The project was implemented during the year 2018-2019; by 25 female and 20 male students, aged 14 and 15 years old. The project lasted seven months. The aim of the program was to provide the students with environmental awareness and quality of life in their daily life aiming at sustainable development. The evaluation of the program using anonymous questionnaires and comics determine whether a recycling education program would lead to a positive change. The survey results confirmed that students understood the important role of composting and recycling in our lives well.

6.2 Purpose — Goals — Originality

The purpose of the programme was to provide the students with environmental awareness and quality of life in their daily life aiming at sustainable development. The goals were a) the students to develop critical thinking related with rubbish management b) to wonder as to which materials are recyclable, c) to understand the role of germs in recycling, d) to develop artistic skills, e) to understand the necessity of the participation of all the citizens in the attempt to preserve and protect the environment. The originality of the programme lies in the fact that the students manufactured their own school composter which was the only one in a school garden of all the schools in our city. Also, we threw rubbish in Art, meaning that we cut in tiles, boxes of Cornflakes and tubes of toothpaste, confetti, straws and we glued them on the portrait of Nikos Kazantzakis which had been drawn by the guidance of the Arts teacher.

6.3 Materials — Methodology Tools — Activities

The following methods, materials and activities were implemented in the programme:

- Cooperative, experiential and discovery learning.
- Intersectionality (connection with Biology, Physics, Theology, Arts).
- Participation in the European week for reducing rubbish in Daskalogianni Square with the creation of bags from reusable clothes (Fig. 1):

Fig. 1 Creation of bags.

- Display of our creations at the Christmas bazaar of our school in St Mark's Vasiliki.
- Discussion with experts from the Uniform Association of Rubbish Management of Crete (UARMC) — Foundation for Research & Technology-Hellas (FORTH)
- Educational visit to the Recycling factory in Akrotiri in Hania, in the Environmental Education Centre Vamos;
- Participation in the Hellenic student Theology Conference at the Cultural Centre of Heraklion with our small theatrical act and a presentation entitled "A plastic bag narrates", posted on the website of the school: https://www.youtube.com/watch?v=FSaKrTDbdNg&feature=emb_title
- Crafts (Fig. 2) from recyclable materials (paper from egg cups, kitchen rolls, pots of yoghurt, inactive lamps, buttons, plastic glasses).
- A lamp from disposable plastic glasses (Fig. 3).
- The manufacture of a wooden composter in our school garden (Fig. 4).

Fig. 2 Crafts from recyclable materials.

Fig. 3 A lamp from glasses.

- Cut tiles from recyclable materials (paper and plastic) glued on the portrait of Nikos Kazantzakis (Fig. 5).
- Creating Rosalinda (decomposer) (Fig. 6) from recyclable materials (paper and metal): https://drive.google.com/file/d/1qLMFsQr91TmcjFxEs-A3Jk7EafcUMIQj/view.
- In the lab of our school we observed a decomposer that we found in our composter and the creation of comics (Fig. 7).

Fig. 4 Manufacture of the composter.

Fig. 5 Craft of the portrait of Nikos Kazantzakis.

Fig. 6 Creation of decomposer.

Fig. 7 Observation of a decomposer at the lab and comics.

- We visited the recycling factory in Kalamata and in the Environmental Education Centre Kalamatas we played creative games with useful information about recycling.
- The school's parents' association bought recycling bins and the Municipality gave us a free compost bin in our school garden (Fig. 8):

Fig. 8 Recycling bins and compost bin.

- Research with a questionnaire of 18 multiple choice questions in 289 students of the school in random classrooms. The findings showed optimistic results.

In conclusion, we consider that the students became optimistic and creative making earnest qualitative effort for the protection of the environment.

7. Results and Findings

The questionnaire before and after the program had a goal to investigate awareness of and children on environmental issues (recycling, composting). Also, had a goal to evaluate their level of knowledge on the management themes. The pre-questionnaire was given in October 2018 to children and in the beginning of May 2019 the final questionnaire. The questionnaires were given was anonymous. No difficulties were found in the understanding of the questionnaire as pro-survey had taken place. The initial and final questionnaire had 18 multiple choice questions. In the open-ended questions the content was analyzed. It was found as a positive impact as far as the environmental program goes on communicating relationships parent-child. A 97% of the children enjoyed the program activities. It was surprising that a 83% of the students didn't know about the composting. The students enjoyed the educational trip. The main conclusions arising from the implementation and evaluation of the Environmental Education Program were: the children that participated understood new subjects. Cognitive and sentimental objective were achieved by means of: conversation and newspaper articles, the use of audiovisual media, the hand-made construction of the composting bin and *Rosalinda*, the moral dilemma, the experiment using laboratory equipment, the role-play, the interview discussion with experts, the visit to Environmental Education Center, the overview of the study area, the mapping concepts, the closed questions, the open-ended worksheets, the unscramble the word, the collage creation. It was found that the project contributed to the development of critical thinking and living experience. The role of media and family in environmental information and awareness is strong. The use of new technologies brought about positive results. The knowledge gained were clarified. Friendly feelings and a responsible attitude towards the climate change were achieved (e.g., they brought home fruits and vegetable peels and threw them into the school's composters. rom the time the compost was made, the students began to eat healthy and were asking the canteen for a lot of fruit to throw the fruit there. The resulting fertilizer was used in the roses of the school and noticed the difference in smelling and growth. We sensitized the parents and bought us three recycling bins that were quite attractive to the pupils and thus separated the paper, aluminum, and plastic materials.

Many students are slowly dumping their trash into the bins with the information provided by the students in the environmental team. Finally, they are bringing this mentality to their home, and many students have begun to separate waste and recycle in order to save energy and thus reduce climate change. From the above program it appeared that nothing is lost on our planet. Whatever comes from the Earth returns to the earth.

8. Discussion

The next generations must continue to enjoy the welfares of nature. In order for our children to live in a sustainable environment, let's stop destroying it. Let's hope that we will not discover the earth's limits when they will have been surpassed. Can the planet dispose unlimited resources to man for the satisfaction of his needs or has it reached its limits? How must man manage the elements of the environment from now on when in fact they are essential for his survival? The EE programmes can highlight the modern environmental issues as priority concerns in the family environment, improve critical thinking in order to spread the environmental information. Through the voluntary EE programmes, we aspire to have a better and more qualitative future. We hope to have diffusion of environmental sensitization with the parents, students, school community's contribution, for a world with sustainable development and qualitative education. Finally, the dipole recycling-environmental education might contribute to the climate change positively. So, it needs a quality culture to achieve a sustainable development.

9. Suggestions

We could suggest that Environmental Education be integrated in the school curriculum of Primary and Secondary Education. In addition, as Wegner (1998) [18] states, a Community Practice could be implemented. That is to say, a group of people that share a concern or have the same interest/passion for something they do and learn how to do it better, as they interact regularly, aiming at the diffusion of their findings for seeking solutions regarding matters of managing environmental issues.

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References

[1] UNEP, United Nations Environment Programme, 2019.

[2] Δ. Γ. Κόκκορης, Γ. Π. Δημητρακόπουλος and Π. Ντάλιας, Βιολογική Ποικιλότητα. Αθήνα: Υπουργείο Περιβάλλοντος Χωροταξίας και Δημοσίων Έργων, 2005.

[3] E. D. Cooper and A. J. Palmer, *The Environment in Question*, London and New York, 1992.

[4] J. Leidner, Introduction to recycling, in: Akovali G., Bernardo C. A., Leidner J., Utracki L. A., Xanthos M. (Eds.), *Frontiers in the Science and Technology of Polymer Recycling*, NATO ASI Series (Series E: Applied Sciences), Vol. 351, Springer, Dordrecht, 1998.

[5] Y. V. Fan, and J. J. Klemes, Sustainability of Waste Recycling and Recovery Process, EU 28 (2019) (27), available online at: https://ssrn.com/abstract=3400640.

[6] E. Rudnik, *Composting Methods and Legislation in Compostable Polymer Materials* (2nd ed.), Elsevier B.V., 2019.

[7] S. Scalet and T. F. Kelly, CSR rating agencies: What is their global impact?, *Journal of Business Ethics* 94 (2009) (1) 69-88.

[8] Y. Nikoloudakis et al., Composting as a service: A real-world implementation, *Future Internet* 10 (2018) (11).

[9] F. Eliadis, K. M. Doula and A. A. Zorpas, The role of Environmental Education Centers in climate change

education and awareness raising of the society: The cases of Cyprus and Greece, in: *Open and Equal Access for Learning in School Management*, 2018, doi: 10.5772/intechopen.71561.

[10] H. Hungerford and B. Peyton, A paradigm for citizen responsibility: Environmental action, *Current Issues* VI, (1980) (Nov. 1098) 146-154.

[11] Α. Αθανασάκης, Μεθοδολογικές αρχές, προϋποθέσεις και δυσκολίες για την εφαρμογή προγραμμάτων Περιβαλλοντικής Εκπαίδευσης, Αθήνα: Νέα Παιδεία, 1996,

[12] D. Chapman, Education for sustainability: Looking for directions, in: Björneloo I., Nyberg E., *Drivers and Barriers for Implementing Learning for Sustainable Development in Pre-School through Upper Secondary and Teacher Education*, UNESCO, Technical Paper N°4, February 2007.

[13] O. Madison, The Role of Integration of Non-formal and Formal Education for Sustainable Development in All Levels, in: Björneloo I., Nyberg E., *Drivers and Barriers for Implementing Learning for Sustainable Development in Pre-School through Upper Secondary and Teacher Education*, UNESCO, Technical Paper N°4, February 2007, p. 101.

[14] Α. Γεωργόπουλος, *Περιβαλλοντική Ηθική*, Αθήνα: Gutenberg, 2002.

[15] G. Miller, Βιώνοντας στο περιβάλλον ΙΙ - Προβλήματα περιβαλλοντικών συστημάτων, (επιμ. Παυλόπουλος, Κ.), 9η έκδοση, Αθήνα: ΙΩΝ, 1999.

[16] Θ. Λαζαρέτου, Περιβαλλοντικά προβλήματα και Δίκαιο, Αθήνα: Υπουργειο Περιβαλλοντοσ Χωροταξιασ Και Δημοσιων Εργων, Εκκε, Γενικη Γραμματεια Νεασ Γενιασ, 2002.

[17] M. Rickinson, Learners and learning in environmental education: A critical review of evidence, *Environmental Education Research* 1 (2001) (3) 207-301.

[18] Β. Κάλφας, Αριστοτέλης - Περί Φύσεως, Αθήνα: ΠΟΛΙΣ, 1999.

[19] E. Wenger, Communities of practice: Learning, meaning and identity, in: Φεσάκης Γ., Θεοδωρίδου Σ., & Ρούσσου Μ., Προκλήσεις του σχεδιασμού και της λειτουργίας εκπαιδευτικών διαδικτυακών κοινοτήτων πρακτικής: Η περίπτωση της κοινότητας των Σχολικών Κηπουρών. Διεθνές Συνέδριο για την Ανοικτή & εξ Αποστάσεως Εκπαίδευση, 2013.