

# Traveling the Seas of the World With ICT as an Ally

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**Abstract:** This paper presents the Sea4all educational program for sustainability. The aim of the program was to create educational tools which can be used by teachers during the implementation of programs in Primary and Secondary Education on sustainability and for the treatment of coastal and marine pollution. The educational tools-results of the project were: a) a Training curriculum for interested teachers, b) a Handbook containing appropriate and structured lessons and recommended activities, and c) an interactive electronic game for students. The eTwinning platform was used for teachers to communicate, and the aforementioned educational material was accessible through the Moodle distance learning platform. The lessons in the Handbook were proposed pilot lessons created by participating teachers, following an invitation of interest, to evaluate the effectiveness of digital material in the learning process and to include further teaching ideas regarding the deepening of and transfer of learning. Through the cooperation of teachers on the eTwinning platform and through the process of constant critical reflection by teachers, coordinators and the pedagogical team, substantial lines of communication, cooperation, and fertile interaction, which were reflected in both the cohesion and in the fruitful “conversation” among the results of the program. Moreover, the teachers themselves seem to have revised elements of their teaching culture, acquiring skills leading to transformative learning, especially in matters of sustainability and active citizenship.

**Key words:** education for Sustainability, coastal and marine environment, marine pollution, ecological footprint, digital learning tools, results of the program, citizenship, transformative learning

## 1. Introduction

Sustainability is a concept that has been widely used in recent years and is usually referred to in different ways and to different objects. Flogaiti (2011) [1] argues that the concept of sustainability covers a dual need: a) the need to eradicate poverty and conserve natural resources and b) the need to guarantee social justice and prosperity for present and future generations.

Many question whether the gap between theory and practice of sustainability can be bridged. Sustainability cannot become a reality, not even a goal, in a context of unscrupulous competition, without rules and moral barriers [2]. Although sustainability policies are in place, productive and consumption patterns have not changed substantially [3]. Active citizens can play an

important role and significantly influence political decision-making at cultural, economic, and environmental levels in order to achieve sustainability [4].

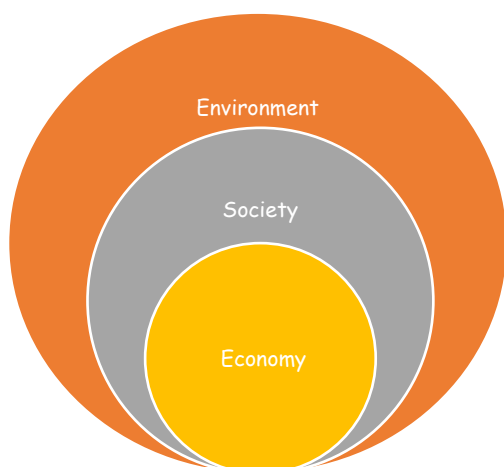
Thus, one is led to the conclusion that sustainability is a complex concept which initially started with an environmental orientation and resulted in possessing a strong economic and social orientation. Its content is quite rich and is approached from several different angles.

The main goal of sustainability is the protection of the environment. Therefore, every form of economic and social development should be guided by the environment. This orientation is shown below (Fig. 1).

The emergence of sustainability as a matter of particular importance at the political level, initially aroused interest and gradually created the need for the dissemination of its values and principles, as well as for their adoption by citizens at all levels of social activity. The safest way to achieve this goal is its introduction

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**Fig. 1** From economy to environment through society [1].

into the educational-learning process. This introduction gradually led to the development of a special form of education, called “Education for Sustainability”. Education for Sustainability (EfS) did not come from an educational movement or from interinfluence in the educational world but originated within the context of conferences and declarations of international organizations.

Gradually in the scientific and educational community the term “Education for Sustainable Development” was replaced by “Education for Sustainability (EfS)”. The reasons which led to the prevalence of the term EfS have mainly an ethical dimension. Specifically, the term “development” is usually associated with economic development, which has prevailed in the modern world and is based on the principles of a capitalist economy. However, in such a society there is an ever-increasing tendency to satisfy the insatiable needs of consumers in the developed world, resulting in distortion of the concept of sustainability, as the available natural resources which are required for this misunderstood “development” begin to be depleted. Consequently, the Sea4All program attempts to meet this need by providing teachers with the necessary guidance through appropriately selected and structured informational materials, recommended techniques, digital tools, and alternative experiential learning recommendations.

As EfS is not a mandatory subject, as established theories and policies require [5], teachers are expected to find ways to incorporate it into all aspects of the school curriculum. However, through the appropriate support and carefully-designed learning tools, teachers are able to significantly approach sustainability and work together to include in the learning process the topic of coastal and marine pollution, which has currently reached alarming proportions.

Of course, many scientists express their concern mainly because of the polysemy and ambiguity of the concept of sustainability [6]. This ambiguity is reasonable since EfS is a rapidly developing field, which causes some confusion regarding its application as a new form of education. It is necessary, however, to emphasize that it is not one subject among many, but a new dimension, which diffuses throughout the curriculum [6].

From the above, it seems that in order to promote EfS there is a need for guidance and provision of practical, applicable recommendations, something that Witta et al. (2012) [7] argue does not exist. Despite EfS promotion policies, researchers argue that there is an information gap on how EfS can be translated into practice [8]. A review of the literature, however, shows that the gap still exists given the broad and ever-evolving nature of the concept of sustainability. The difficulty of integrating sustainability into educational practice is also due to the fact that it is not a mandatory subject of the curriculum, as the established theories and policies require [5], but rather teachers are expected to diffuse it into all aspects of the already heavy curriculum. As a result, educators often tend to emphasize only some aspects of sustainability instead of all, as is required for a holistic understanding of an issue [9].

### *1.1 Co-Building a Sustainable School*

The “Sustainable School” is a visionary school which functions as a community. It is based on the communication and cooperation of all members of the

school community and in daily school life and gives opportunities for everyone (students, teachers, administration, parents, local community, etc.) to deal with common issues and their sustainable management through participation and team spirit. A sustainable school serves democracy and human rights, promotes

culture and the environment, and shapes active and creative citizens.

The educational programs and actions which can be implemented in a “Sustainable School” (Fig. 2) can be extended to all eight pillars of sustainability. These pillars essentially embrace all areas of learning.



**Fig. 2 The eight pillars of the Greek Sustainable School.**

The Sea4All program proposes actions related to the protection of the marine and coastal ecosystem. The proposed actions (lesson plans) can cover most of the eight pillars of sustainability but primarily the pillar of waste management, including liquid and solid waste. In the context of the implementation of actions related to this program, we created our own “Alphabet Book of Sustainability.” One example of this is “O” for oceans. It is concerning that the oceans, which are essential to life, were among the first to be damaged and now must be among the first to be saved. Examples of this destruction are the melting ice and the contagious plankton.

## 2. Material and Methods

In attempting to create a community of informed and sensitized educators regarding the content and objectives of sustainable literacy, we utilized principles of synchronous and asynchronous education and the application of new technologies in teaching and

learning. In this context, we proceeded to develop: 1) Educational material, on the topics: a. sustainability and sustainable development, marine and coastal oil pollution (stains) and floating plastic objects, b. aims and teaching methodology (curriculum), taking into account the characteristics specified by UNESCO (1997, 2005) for sustainable education. 2) Guide for Educators (Handbook), with lesson plans and immediately feasible interdisciplinary, multidisciplinary activities to achieve the goals of the program. 3) An electronic game. This material was posted on an online distance learning platform (MOODLE), to which any registered teacher had direct access.

It is worth noting that for the development of the electronic game, the following were designed: a) specific scenarios-case studies based on original stories with fictional protagonists and hypothetical incidents of pollution, scientifically documented. The objective of the game is the students who, through virtual reality,

exploratory learning, pulsated guidance and difficulty, successfully “execute” the missions assigned to them, answering related questions or completing demanding learning activities (completion of concept maps, word-searches, decision-making) and advancing to the next stage of new cognitive challenges and “tests”, b) recommended lesson plans, with incorporated recommendations regarding the use of the electronic game, which were piloted at schools of the Regional Directorate of Primary and Secondary Education of Crete to optimize the functionality of the electronic game and to redesign the proposed teaching approaches, after feedback from educators, and finally c) the structure of each lesson plan (included in the Guide for Educators (Handbook) consists of the following elements: Introduction, Objectives, Materials, Recommended Activities, Reflection, Evaluation, ideas for possible extensions, References and Links to useful teaching material. In addition, the Handbook, a product of the European program, “converses” with the rest and especially with the electronic game. It includes recommendations of the possible use of the game per lesson, thus increasing its value in the learning process.

The suggested modules are 10 in total and have the following titles:

- A sea of civilization

The value of the sea in time and history

- A map consisting of ... words

Mapping concepts for marine pollution

- The treasure emits an SOS

The value of the sea to the economy

- Learning about the dangers that threaten the sea

The case of the oil spill

- Learning about waste found in the sea
- Balance of marine ecosystems
- Safety of food originating from the sea
- Coastal pollution
- Recycling- Reusing- Reducing consumption
- The sea and sustainable development

At the same time, these contain corresponding

proposals, interdisciplinary and multidisciplinary teaching, indications of expected teaching time per lesson, as well as recordings of scientific terms-keywords, which require elaboration for the deepening and better understanding of each unit. With the aim of cultivating the creative thought process, development of critical thinking — active participation, use of new technologies and structuring attractive learning environments that invite multi-sensory learning and fostering of values, the Teacher’s Guide includes alternative experiential learning activities, such as:

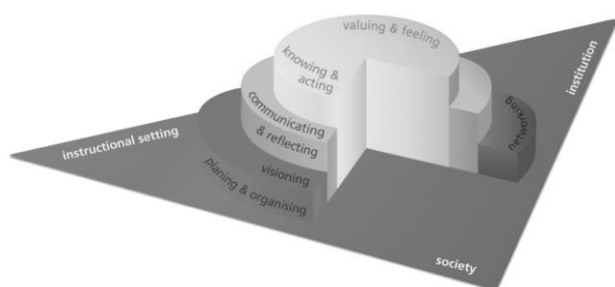
- Field actions
- Role-playing games
- Frozen image
- New technologies
- Games
- Creative writing
- Production of dialogue

In addition, some indicative goals which were set for the students in relation to the utilization of Technologies of Information and Communication are the following:

- To appreciate the added value of group and collective action, recognizing it in the effective treatment of environmental issues, which have already been developed in multimodal learning environments
- To cultivate their audio-visual skills
- resources, under conditions of graded difficulty
- To develop skills of observation, research, recording, classification, comparison of digital and printed data as well as problem solving
- To acquire skills in handling educational electronic games

To acquire skills of investigation and problem solving with the optimal use of digital and printed learning.

The model which was used for the involvement of teachers in the program is the KOM-BiNE competency model [10] which is schematically reflected in Fig. 3 below:



**Fig. 3 The KOM-BiNE model for the teachers' involvement [10].**

Based on the above model, teachers should cultivate skills to create the optimal climate in the classroom that will encourage learning, taking into account the individual needs of students, choosing the appropriate teaching and learning methods, and creating the right opportunities for active student participation. One goal is always the involvement of the community through the achievement of appropriate collaboration with local agencies and scientific institutions.

In its final form and translated into all the languages of the partners, the Teacher's Guide, as well as the other products of the program, will be available on the platform in the near future.

### 3. Results and Discussion

Finally, the aforementioned Training Curriculum for teacher education, material produced for Sea4All, entirely captures the philosophy of targeting the formulation of an "educational community" of professionals with competence in matters of sustainability. It is achieved to reach as results the following:

- 1) To understand the need for prominence of the educational process of modern environmental issues and focus their interest on the degradation of the marine environment, undertaking to critically select reference texts
- 2) To utilize educational scenarios: a) transforming the proposed modules into cognitive and participatory objectives and undertaking their formulation in at least one module per group, in declining guidance

conditions, b) selecting the appropriate teaching activities and the appropriate educational material for the achievement of each teaching goal separately, taking into account the available educational resources (Handbook, interactive games, simulations, etc.)

- 3) To roughly assess the existing material which has been used for discussing marine pollution issues, stating succinctly strong and weak points of its use
- 4) To be able to detect and utilize the necessary educational material, by utilizing conventional and digital resources available (printed material and digital knowledge tools)
- 5) To be aware of the available digital cognitive tools and to recognize the contribution of these tools, through their necessary combined use, in order to achieve the goals of exploratory learning, as a preferred form of learning in the discussion of social issues and cultivating attitudes in school
- 6) To be able to utilize the available digital tools (simulations, microcosms, etc.) in the learning process by participating as trainees in micro-teaching in an inquiry learning scenario with a hypothetical problem relative to the content of the program, and encouraging the use of new digital cognitive tools.
- 7) To be able to successfully design a research cycle in small groups, understanding the added value of digital cognitive tools for its success and the contribution of exploratory learning as an appropriate teaching approach to critical social issues, participating first as trainees in a micro-teaching module, using a worksheet during training.
- 8) To understand the form and purpose of worksheet use as a part of exploratory learning and creative integration of ICT in the learning process, undertaking to design their own, after

the research topic has been chosen, relevant to marine pollution and their specific interests.

- 9) To be able to navigate the program platform and extract the necessary information for each topic under study.

It is worth noting that in proportion and within the fruitful “conversation” of the program results, the above-mentioned results of the teacher’s training curriculum determined their respective and thus correlating teaching activities of both the Handbook (Teacher’s Guide) and the computer game.

As it was expected, promoting EfS through education constitutes a complex procedure requires guidance and scaffolding, which seems to be rare [7]. The EfS directors promotion strategies cannot supersede the gap of insufficient guidelines and support material for teachers who wish to implement EfS in their classes. As such, EfS still remains a riddle for many educators [8]. Its inclusion in educational practices does not take the form of a specific module and is not expressed with a focus on a particular discipline. Educators are expected to disseminate the EfS premises (UNESCO, 2005) across all aspects of an already overloaded modularised curriculum. Not surprisingly, educators manage to highlight only part of the sustainability aspects that are requisite for the overall understanding of a subject at hand [9]. This often explains why most educators tend to identify the ecological and bio-physical dimensions of a sustainability issue and highlight its environmental sustainability aspects. This practice is often associated with how they perceive “sustainability”. Likewise, 87% of teachers participating in a survey perceive the environmental aspects of sustainability as the core of EfS.

#### 4. Conclusion

In the context of Sea4All key proposals for sustainability such as: social justice, balance, cooperation, reciprocal relationship of the natural-social-economic environments, comprehensive

treatment of social problems and their educational significance, such as: all-round, multi-sensory, multi-disciplinary and not fragmented learning, with emphasis on the promotion of the socio-emotional sector, on the strengthening of the team, on the development of active citizenship skills, defined the educational philosophy of the program and the educational material which was produced.

Qualitative data of the limited a-phase pilot, due to time constraints, in addition to feedback from participating teachers in the dissemination activities of the program, seems to have led to the promotion of literacy in sustainable marine and coastal pollution and thus, the formation of an enlarged and informed learning community trained to educate in engaging environments, today’s students — potentially active citizens, with values, knowledge and team spirit.

Moreover, it is expected that the results of the b-phase implementation of the program, which is already underway, will soon document the added value of the material, which will at the same time be enriched with the transfer of authentic learning experiences, possibly resulting in safer navigation of and life in the natural aquatic environment, and making social justice and sustainable development possible.

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