A Serious Game to Promote Environmental Attitude

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A Serious Game to Promote Environmental Attitude

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Abstract. Environmental attitudes are essential for the today's world in which shrinking natural resources and pollution are one of the biggest problems of the society. The research challenges go in two directions: on the one hand, the environmental researchers try to reduce the impact of human actions on the environment and, on the other, human researchers try to educate people to adopt ecological behaviour. This is the main issue faced in this research to sensitize young people to the environmental health using multimedia technologies. The paper presents a serious game addressed to primary school pupils aimed at transferring knowledge about marine litter and four species of Mediterranean Sea that are estimated to be at risk of extinction. The aim is to foster knowledge about the marine life and to explain people the problems that marine litter can cause. The results of a pilot study that investigates the usability of the game is presented.

Keywords: Serious game · Game-based learning · Environmental education

1 Introduction

How many people know how much an airplane pollutes, or how long a plastic bottle remains in the sea before degrading? Why should we make the differentiated collection of waste? To save the planet, is it helpful to use a natural gas for our cars?

The environmental challenge, linked to the preservation of our planet and its resources, today is no longer avoidable. Through Agenda 2030 [24] all people of the world (even the poorest) are called to make choices radically different from those made in the past. These choices should be distant from the traditional production model, directed towards a new economic model that respects the environment, oriented to a society that does not produce waste but creates wealth and well-being trough the re-use and the regeneration of resources.

To make this happen, it needs a profound cultural change in people, in institutions, in the business world, associations. This change also calls into question the schools.

Environmental education wants to create learning experiences that, through thoughts, emotions and actions, lead students (pupils, teachers, parents) to discover, to rediscover or, more simply, to the affirm values and ethical behaviour respectful of

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environment. Today it is especially important during training and growth, since childhood.

The themes of exhaustion of natural resources waste and excessive waste production should be addressed already at the stage where the children learn to relate to the world around them. Only in this way, it will be possible to raise responsible attitudes towards the environment.

To achieve the most important objective of an educational process, the integral development of the person, it is essential to develop since the early childhood an authentic man-environment relationship. In order to fit in each person an authentic global consciousness is fundamental the training from the earliest years of life oriented to promote sound principles and values, such as respect, care and attention to the environment around us.

Environmental education helps to promote the necessary skills to challenge existing models and trigger virtuous processes of overall change of behaviours and lifestyles.

In European Union, environmental education has become an integral part of the curricular activities of primary and secondary school: several Member States have introduced it in their schools. The study of the environment is essential to prepare students to build a green future and to live in a sustainable society.

Internationally, the UNECE strategy (United Nations Economic Commission for Europe) for Education for Sustainable Development [20] has defined environmental education as a requirement for sustainable development, as a tool for good governance and for decision-making.

One of the fundamental aspects of environmental education is to be an education for the future, change-oriented education, which is able to promote pathways oriented to the quality of life, to human relationships, to relationships between humans and the planet. Condition for this change is a different way of thinking, a different culture, which, as demonstrated during this work, can also be favoured using serious games.

The paper is organized as follows: the next section describes the game-based learning and the serious games; Sect. 3 describes some related works, Sect. 4 presents the solution implemented; Sect. 5 illustrates a pilot study aimed at evaluating its usability. Finally, some conclusions and future works are described.

2 Game-Based Learning and Serious Game

The game-based learning has been largely recognized as one of the best approaches for learning for both children and adults [1–6, 14, 15]. Usually, the game dimension makes the learning easier, student-centred, fun and engaging and thus more powerful. Several works have investigated on the effectiveness of the application of this approach on specific contexts in which the engagement and motivation is essential to promote knowledge and skill acquisition [7, 11, 15]. As stated in [10], games support such pedagogical principles making the learning experience successful. Each level of the game is personalised on the basis of the player's abilities, feedbacks are immediate, the player has an active role in the game, and the game engages players and improves motivation in learning. Until some time ago, the game dimension was devoted mainly to young students, because it was thought that it was pleasing and effective only for this

kind of people and the game was not suitable for serious contexts, but it has been proved that also adults can be attracted to the games [4–6, 13]. Thus, the serious games are defined by Chen & Michael [3] as *Games that do not have entertainment, enjoyment or fun as their primary purpose.* In the last decade, the serious games have been largely implied in professional training and in informal learning contexts to promote knowledge/skills acquisition [17–19], engagement and motivation [12]. In this view, the research herein described adopt the serious game to develop environmental attitude in primary school students.

3 Serious Game for Environmental Education: Related Works

Video games have become part of our everyday life and our habits. Through technical and persuasive contents, they can transform personal and social behaviours of players.

This is also true in the field of environmental sustainability. Malone & Lepper [7], in fact, emphasize how the scenarios in video games can provide players analogies with some elements of the real world. This allows players to observe cause-effect processes tested in a real prospect.

The idea that games can be a tool to improve the people interest in environmental issues, led to the creation or modification of some existing games like Minecraft (https://minecraft.net/it-it/). It is a game in which the player has to construct buildings or structures, often setting fire to other elements in the scene. Minecraft has been modified by adding the visible effects caused by the carbon dioxide produced by burning. The player can help the environment by planting trees. The serious games dealing with water pollution and marine ecology are not very widespread, and few are the ones with educational purposes and able to promote environmentally-friendly behaviour. Usually, the few available are implemented or distributed by non-profit organizations that deal with children's education or environmental protection. To design and implement the serious game for our research, we started with the analysis of some serious games for children related to the topic of environmental education, and the pollution of the sea and the Marine Litter.

Clean Up the River (http://cleanup.noco2.com.au/) has been chosen for the interest that it has for familiar environment to children-players. In fact, our game is set in the Mediterranean Sea, which is the most known sea among students, and the characters are local marine species. The side effect will be the knowledge acquisition of the local environment.

WaterLife (http://games.noaa.gov/oscar/) was a model for the issue of marine waste. Our game invites to reflect on the consequences of waste in the sea and how these wastes end up in the products we eat.

Wild Kratts Habitats: Ocean (http://pbskids.org/wildkratts/habitats/ocean/) was considered because it provides some information of marine species. The goal of the game is the acquisition of knowledge about the marine species that inhabit the sea.

4 SeAdventure

The serious game named SeAdventure, is a platform game in which the player using an avatar swims through waste lost in the sea (Fig. 1). The intended users are primary school pupils aged between 8 to 10 years old, and the game was designed to be used in classroom as supporting tools for environmental education. The serious game set is the Mediterranean Sea and the characters are four species estimated to be at risk of extinction and the most interesting species for the intended users. The four species are: red tuna, great white shark, turtle (Caretta caretta) and the hippocampus (Fig. 2). Language, graphic, and interaction were accurately defined to meet users' needs and characteristics. The mission of the player is to help the character to swim and reach the final point avoiding junk and eating fish. When the character eats fish, the player collects healthy points, otherwise if the character eats junk unhealthy points are collected and the character swims more slowly for a few seconds. Both the points are used to build the final rank of the game (Fig. 3). To motivate the player to pay attention to the junk, a life is lost if too marine litter is eaten. Moreover, during the play, some knowledge pills about habitat, diet, lifestyle and dangers of the character are given. To improve the final rank, the player could answer to some quizzes (Fig. 4). This allows to motivate the user in reading the text.

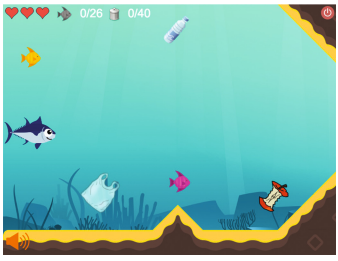

Fig. 1. The Red Tuna swimming in the sea

Fig. 2. The characters in the game (Red Tuna, Great white shark, Turtle Caretta caretta and the hippocampus)

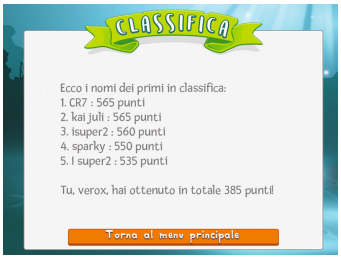

Fig. 3. Final rank of the game

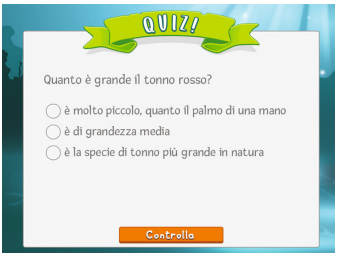

Fig. 4. An item of a final quiz about Red Tuna

Since to develop a serious game to foster environmental attitude is a complex process that involves different kind of professional figures, a software prototyping approach to develop the game has been used. It is a software development model that enables to understand customer requirements at an early stage of development. It helps get valuable feedback from the users and helps software designers and developers to understand about what exactly is expected from the product under development. Thus the first version of the serious game was submitted to a pilot study to evaluate its usability.

5 Usability Test: Procedure and Results

As said before, a first release of the serious game was submitted to a sample of primary school children aged between 8 and 10 years old to evaluate its usability. The pilot study involved 46 pupils attending the two classrooms of the 4th grade of an Italian primary school. The main goal of the study was to evaluate the usability and the usefulness of multimedia technologies and Game-based learning in fostering ecological skills. All the pupils (46) were new to ecological and environmental issues. The pilot study was conducted in the classroom equipped with notebook and a smart board. The marine litter problem was introduced by the teachers using a discussion and an explainer video which lasts 2 min. The students were very interested in discussing this topic, since all of them have found waste on the sand and in the sea during their holidays. The discussion was useful also to point out their feeling about this important issue. All pupils were very impressed by the un-ecological behaviour of people. This first step lasted 20 min.

Then the pupils were invited to use the serious game in pairs at least for four times to explore all the characters. This step lasted about 1 h.

Then two questionnaires aiming at evaluating the usability of the SeAdventure and its usefulness in acquiring knowledge were proposed. The questionnaires were very short and this step lasted about 10 min.

The first evaluable result was that users used the game without any kind of inconvenience, this to prove that both graphic and text were designed to meet typical children requirements. The result was confirmed also by the analysis of data collected using the questionnaire. Most students (86.9%) stated that the game was easy to use, the 84.7% said that the button functions were clear, the 95.7% stated that the game was funny. For what concerning the length of texts in the game: the 39.1% of students stated that it was suitable to their reading skills, the 43.5% thought it was quite suitable, and the 13% stated that it was too much.

The second questionnaire aimed at investigating the student perceived usefulness and satisfaction. The results are satisfying since the 83% of the subjects claim the acquisition of new knowledge, the 17% said that something was acquired (Fig. 5). Figure 6 shows how much attention students paid to the texts. The 88% of students stated that they will remember the information read in the game (Fig. 7).

The main result of this pilot study was the engagement of users in doing the activities. Teachers said that they rarely saw all students so interested in something and

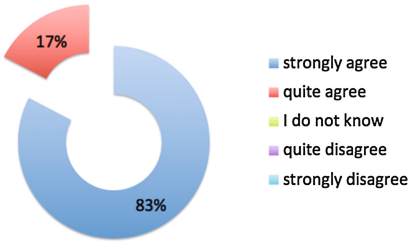

Fig. 5. I have learned using both the video and the game

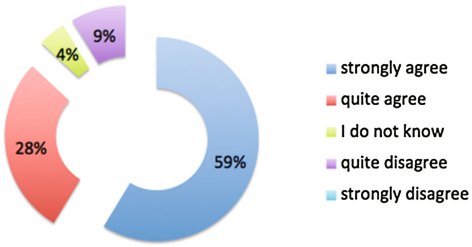

Fig. 6. I have paid attention to the texts

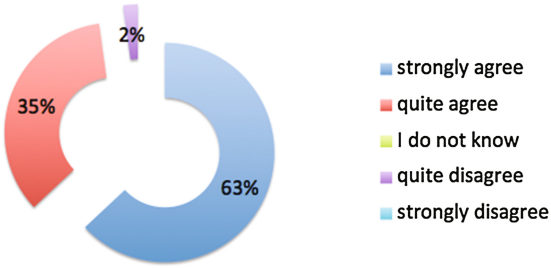

Fig. 7. I will remember the information read in the game

noticed the attention paid by students in reading the texts. Some of them, the most competitive, took notes to answer the final quiz and earned a good ranking.

6 Conclusions and Future Works

To promote environmental attitude has become one of the most important issue in education of next generations. It is important that young pupils become aware of the danger that un-ecological behaviour can cause to the whole ecosystem, including humans. In this context, it is essential not only to supply information but also change the human behaviours. The game-based learning and video game have successfully implied in the past such useful tool in both formal and informal learning contexts. In this view, the research presents a serious game addressed to primary school pupils to foster ecological skills and environmental attitudes. The pilot study revealed that students and teachers appreciated the approach, and the preliminary data gave good results also in the students' perception of usefulness and satisfaction. This allow us to go ahead in this research and a larger study will be performed in order to measure the learning effectiveness. Moreover, according with the software prototyping approach other components of the serious game will be developed.

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