Taking it to the next level: the potential of the EduPARK app to promote nature's conservation in an urban park

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Abstract
The 2030 Agenda for Sustainable Development clearly reflects the urgency to embed the principles of Education for Sustainable Development into all levels of education. The approach towards the 2030 Agenda is important, not only because of the crucial role that education will play in the implementation of the Goals, but also in increasing its impact by orienting towards the emerging sustainability challenges. This research arises by combining this problem with the new trend of using mobile devices in education. Research shows that mobile devices are able to promote students' learning and increase attention, motivation, and the development of key competencies. The EduPARK is a research and development project that promotes interdisciplinary mobile learning, supported by the development of an app to be used in an urban park, providing students' involvement, motivation, and engagement to enhance authentic and contextualized learning. This paper comprises a case study that aims to promote a contextualized learning to make students aware of Sustainable Development problems. To achieve this goal, we developed an interdisciplinary educational guide, focusing on attitudes of nature's conservation, to be integrated in the EduPARK app. The main target public are students at basic education in formal and non-formal educational context.

Keywords
EduPARK, Nature's Conservation, Mobile Learning, Augmented Reality, Game-based learning

1. Introduction

The 2030 Agenda for Sustainable Development adopted by world leaders at the United Nations Sustainable Development clearly reflects the urgency to embed the principles of Education for Sustainable Development (ESD) into all levels of education [1]. The 17 Sustainable Development Goals is a plan of action for people, planet, and prosperity. ESD aims to develop competencies that empower individuals to reflect on their own actions, considering their current and future social, cultural, economic, and environmental impacts, from a local and a global perspective [2]. Education is an essential tool for achieving sustainability [1].

This PhD research arises by combining this problem with the need to follow the trend in the use of mobile devices and considering the scarcity of this type of educational resources in the Portuguese context. Nowadays, students are part of a generation that values the use of technology and as its interaction is permanent, it is relevant to create opportunities for students to interact with mobile devices, as a new way of learning. Mobile devices have achieved a tremendous popularity in recent years because of their versatility and multi-functionality [3]. Consequently, several researchers encourage their integration in education aiming to capture their interest with something that is familiar and indicate a positive correlation between the use of technology and learning [4]. The combination of mobile devices and games can be highly motivating to the players and, at the same time, promote learning [5]. Mobile games can enhance students' motivation and engagement for learning [6].

The study is supervised by Lúcia Pombo and Teresa Neto and it is framed on the EduPARK project (http://edupark.web.ua.pt) that created an innovative app for authentic learning, supported by mobile and augmented reality (AR) technologies, for game-based approaches in a green park [5]. Mobile devices can include apps with AR to facilitate learning in outdoor environments. For instance, AR can reduce students' cognitive load through the annotation of real-world objects and environments and it has the potential to foster learners' motivation, engagement and enjoyment by applying and discovering resources in the real world [7].

In line with the above mentioned, this paper reports a research related to EduPARK project to present a new interdisciplinary educational guide about Sustainable Development in order to analyze its educational value based on students' opinion, questionnaire responses, and on AR game logs results. One of the particularities of EduPARK is the fact of moving learning out of the classrooms into outdoor spaces, students may enjoy, such as a local urban park – the Infante D. Pedro Park, in Aveiro (Portugal). This park is a large green area, in an urban context, with high biodiversity and historical patrimony, with potential to provide learning experiences that promote the importance of plants, habitats, and their conservation [8]. Mobile devices, games and green parks can be used together to promote serious and authentic learning and challenging conventional thinking about learning [5, 8].

Our study aims to (i) contribute to innovative learning approaches by combining ESD, mobile learning, games and AR, (ii) promote students' scientific knowledge to protect the planet from degradation, through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change and (iii) understand the impact of the EduPARK educational strategy in terms of factors, such as intrinsic motivation and authentic learning. Because our research is being developed in Portugal, based on most recent published data, our study also aims to contribute to enhance and promote innovative practices in Portuguese educational contexts.

This paper is organized as follows: i) the introduction that identifies the significant problem in the field of research and outlines the current status of the problem domain and related solutions; ii) the section 2 that summarizes the context within the research is developed: the EduPARK game and the interdisciplinary educational guide created under the research; iii) the section 3 that describes the contribution of the research by presenting the proposed approach and methodology; and finally, the section 4 with some final remarks.

2. The EduPARK Game

AR technology has been successfully used in several contexts, such as health professional training, complex equipment maintenance and repair or even marketing [5]. More recently, pedagogical use of AR games have been an active topic among educational technology researchers. AR allows overlapping virtual elements, such as 3D models, with real objects of the physical world, in real time, producing a new "human-computer interaction". The literature has collected evidence of positive learning outcomes from the use of AR mobile game. As an example, in 2018, Laine [9] published the results of systematic literature review on articles describing AR mobile games published in 2012-2017. For this study it is relevant to highlight three AR games, which are similar to the EduPARK app: i) AREEF, where the players use water-proof tablets to learn about environmental awareness by playing the game in the swimming pool ii) Conserv-AR, a mixed-reality mobile game to promote awareness on wildlife conservation in Western Australia and iii) Nature AR, which provides direct interaction with real-world objects using mobile AR and natures' elements as markers.

With AR mobile game and nature's conservation in common, the EduPARK app main relevance is its innovation in terms of outdoor learning strategies, articulating curriculum contents with game challenges and AR technology [5]. It was developed with the aim of supporting social constructivism approaches to teach in a game-based approach for students' engagement and motivation [5, 8]. The game is organized in four stages, each one corresponding to a path with quiz questions, usually a multi-choice to be answered whilst the players are in a specific area of the park, so the player can enjoy a healthy walk while learning [8].

The EduPARK game can be used autonomously, and at any time, through the game mode or explore freely mode with no specific game or associated trajectory. The game mode includes several interdisciplinary educational guides shaped by quiz games for students from basic to higher education,

but also for tourists/ public in general. Each guide includes a different set of quiz questions, virtual caches, and paths through the park, AR information, multimedia content (images, videos and animations) [5, 8].

At the beginning, players are welcome by the project's mascot, a female monkey that talks with a friendly human voice in order to get closer to the player [5]. To better support the players, the mascot provides guidance during the game by giving:

1. Information about how to play the game, through a tutorial that is triggered the first time a new player profile accesses a game;
2. Guidance about the path in the park;
3. Relevant educational content for question answering (images, audios, videos, including information augmenting the reality) and
4. Feedback to the participants right after answering the questions.

During the game, the players have to search for AR markers in the park that will deliver information to answer specific quiz questions. AR markers are installed in the park in plaques or in tiles and includes information about plant species and historical and regional issues. All plaques have the same layout, but the information in each one varies accordingly to the plant species, such as: the scientific and common names, the information about the plant, leaf, flower and fruit, its family (in biological classification), its origin and some curiosities (Figure 1). The AR information overlays on top of a real-time camera feed of a feature within the park, and it can include images, audios, videos, schemes, or 3D models [5].

Figure 1: An example of a plaque with AR marker next to a plant species and AR marker detection

The goal is to accumulate points by answering correctly the questions, visualizing AR markers that help to answer questions, and finding virtual caches in a logic of treasure hunt. Players are presented at the end of each stage to find a specific virtual treasure with bananas, having five minutes to find it. The longer the time players need to find each treasure, the less bananas they collect. After this period, if the treasure is not found, the game proceeds normally initiating a new stage. The accumulated bananas can be used for help with the following quiz-questions [5, 8].

2.1. Green Educational guide

The problem found – nature's conservation - very relevant nowadays, was still little explored in the EduPARK, therefore, it was considered relevant to develop a guide with a set of challenges and interdisciplinary questions with multimedia content related to the theme to alert students to the importance of protecting the environment [10].

We developed "Green educational guide" to bring awareness to the ecological problems and change some environmental attitudes and it comprises four topics for each stage: nature´s conservation, lake and biodiversity, save water and air pollution.

The "Green educational guide" has 30 questions comprising four areas: Science, Maths, Physical Education, and Citizenship Education that have been integrated in the EduPARK app. In addition, we

developed 13 multimedia contents (animations and images) about math, science, and sustainability development.

For each question, it was necessary to submit in the EduPARK app: i) an introduction to the question and an audio; ii) multimedia contents; iii) the question; iv) four response options; v) feedback to correct and wrong answers and an audio; vi) image, video or audio for the feedback; vii) points added (if the answer is correct); viii) associated AR marker; and ix) instructions to find the AR marker.

In sum, in a time of change and constant references to problems in education in Portugal, it is intended that this research collaborates for the development of innovative learning pedagogies in order to work on the problem identified related with ESD: "The importance of nature's conservation".

3. Methodology

The EduPARK activities for this study aim to investigate how playing a game, supported by an interactive mobile AR app, in a park outdoor context, may promote sustainable development learning in interdisciplinary way and motivation for learning. This research follows a qualitative approach and fits as a case study. We organized activities for students from the 1st, 2nd and 3rd Cycle of Basic Education in formal and non-formal education contexts to play the "Green educational guide" [11]. The research question that guide the work is: "How do the strategies used in EduPARK, in line with the exploration of the Interdisciplinary Educational Guide, promote motivation, the construction of knowledge and influence the students to change their attitudes towards nature's conservation?" so, the goals are:

1.   To realize the contribution of mobile and game-based learning strategies with AR in the motivation of students in learning, in non-formal context;

2.   To analyze the construction of knowledge in terms of nature's conservation using the Educational Guide, involving issues on Science, Maths, Physical Education, and Citizenship Education;

3.   To evaluate the impact of the activity on the changes in attitudes of the involved students in terms of nature conservation, before and after the activity.

To achieve these goals, we developed specifically instruments for this study. In addition to the "Green Educational Guide", we intend to apply two questionnaire surveys, completed by students before and after the activity, one focus group at the end of the activity with the aim of the group sharing their feedback, opinions, knowledge, and insights about the activity and one observation grid to be filled out by the researcher and to assist students' observation during the activity. Thus, to evaluate the goal 2 and 3 we intend to use all the instruments and methods mentioned above. However, the main goal (1) will only be evaluated by the results of the "Green Educational Guide", the focus group and the observation grid. The questionnaire survey will not be used to evaluate the first objective.

These sets of data will be triangulated, in a quantitative and qualitative way, to provide a more comprehensive knowledge about the impact of the EduPARK activity on Sustainable Development.

4. Conclusions

The EduPARK project developed an innovative interactive mobile AR game to promote authentic interdisciplinary learning in a specif urban park. This paper suummarizes the construction of one of the educational guides integrated in the EduPARK app about Sustainable Development. The goal of this PhD thesis is to develop an interdisciplinary educational guide about nature's conservation to promote knowledge about education for sustainable development and motivation in the learning process. As the educational laboratory of the EduPARK is a green park in the Aveiro city, these activities are particularly important in what concerns Sustainable Development, contributing to promote nature's conservation attitudes in citizens.

This PhD started in October 2018 and, by now, we are starting the activities in Infante D. Pedro Park. However, since the EduPARK project was born several sessions of the app's exploration in the park were organized, so we can estimate some results. The EduPARK app is an example of a successful mobile AR game for learning. The great relevance and innovation of EduPARK is related to cross-subject outdoor learning in formal, informal, and non-formal contexts, supported by mobile technology,

in an integrated perspective of Science, Technology, Society and Innovation [8]. The game of the EduPARK app has raised interest and enthusiasm from users, who learn in a fun way while strolling in the park and, at the same time has a high impact on its users' authentic learning and has a high impact on its users' authentic learning [5]. Looking for hidden treasures can arouse curiosity, which is an intrinsic motivator factor and keeps the player engaged in learning during the game [5].

It is expected that the Interdisciplinary Educational Guide articulated with the innovative EduPARK strategies may promote: i) motivation for new ways of learning; ii) the construction of new interdisciplinary knowledge; iii) change of attitudes towards environmental problems in the current world; iv) nature's conservation attitudes v) value green parks and vi) healthy lifestyles.

As a final note, we intend to have data to contribute to changing conventional thinking about mobile learning, games in education, and green parks, supporting an innovative perspective of education.

5. Acknowledgements

6. References

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