EDUCATIONAL VIRTUAL REALITY TOOL TO TEACH STUDENTS TO RESPECT ENVIRONMENT

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Abstract

In an educational system formed by methodologies of the 19th century, teachers of the 20th century, and students of the 21st century, the educational innovation mediated by Information and Communications Technology (ICT) should settle once and for all. Our students live daily with cutting-edge technology, including Augmented Reality (AR) and Virtual Reality (VR).

In this article, we propose the design of an educational tool with immersive virtual reality technology, with the possibility to interact with the virtual environment with the aim of offering simulations, interactive experiences and evaluations. Therefore, it is a virtual reality tool to be used by professionals of the education. On the other hand, from the point of view of the student body, will be seen as an educational resource more enjoyable and motivating than traditional resources, such as text books or videos.

The agenda included in this tool is framed within the field of the natural sciences. In particular, it will help to interact with the environment to learn in first person the possible causes and consequences of their destruction.

In this way, teachers will be able to achieve higher levels of education, in which not only takes into account the knowledge or wisdom, but an education based on a few basic pillars in the form of "learning to learn", "learning to do", "learning to be" and "learning to live together". In this regard, both the VR and the AR encourage a moral commitment to be aware of their acts, to live an experience in which they are immersed, and to be protagonists of their learning, instead of being mere spectators.

Keywords: Education; Virtual Reality; Educational Innovation; Virtual Environment.

1 INTRODUCTION

One of the main problems facing the Spanish educational system is the lack of educational innovation. This is because this education system belongs to the traditional learning methodologies, based on memorization and repetition of knowledge. This methodology is not motivational and it is useless in a world in which the information is within the reach of all, thanks to the information and communication technologies (ICT).

For this reason, an educational revolution is necessary since it will bring the technological and teaching innovation most appropriate to each context. One of the educational innovations that should be implemented in the classroom is the Augmented Reality (AR) and the Virtual Reality (VR), of which it is necessary to make a distinction.

On the one hand, "The AR is the combination of digital information and physical information in real time through different technological devices. This method consists on using a set of technological devices that will add virtual information to the physical information and, therefore, involves adding a synthetic virtual part to the real setting". [1]

On the other hand "the VR is a simulation of a three-dimensional environment generated by a computer, in which the user is able to see and manipulate the contents of that environment". [2]

In the past few years, there have been many works on AR while VR has received less attention. Therefore, the present work focuses on the development of an educational tool of immersive VR.

One of the most interesting applications that is being implemented in the field of education is the Magic Book of HIT in New Zealand, in which students read real books via mobile devices or tablets and see virtual content in the pages. In this way, the students can get involved in the scene and experience a virtual environment. [3]
The prestigious Massachusetts Institute of Technology (MIT) and Harvard University are developing in their programs and education groups applications of AR in the form of games which involve high-school students in real-world situations with additional information that is incorporated in their mobile devices through GPS and Wi-Fi.

Firstly, the experiences and projects of RV are limited in the field of education. Nowadays, most of these projects are in the initial stages of implementation. RV is used mostly in marketing, advertising, medicine, architecture and entertainment. RV started to be put into practice decades ago but it has been in the past two years when it has become more important since now there is a technological market and a more advanced society. Over the next decade, RV will progress rapidly in different areas and it will be very important in the education sector, from its earliest levels up to university education.

In the educational contexts, some projects use these experiences. One example is the anti-bullying campaign “Ni paso, ni me paso”, that recreates in a video, a common bullying scene that many children and adolescents suffer in their schools. However, this virtual experience is limited to an immersive video, without interaction with the virtual world. [3] [4]

The company inMediaStudio also incorporates the virtual reality. Some examples that this company includes are: Church RV where learners can know architecture and masterpieces; the project Inmersive Worlds, Interactive and Immersive technology where learners use virtual glasses in an environment controlled by the teachers. Finally, the project Imageen 360º where students have the opportunity to travel through time and know faraway places. [5]

Perhaps the most famous VR experience that has more impact on education is developed by Google: Expeditions. This app is described as follows: "With Expeditions of Google, students can travel without leaving the classroom. The teacher, which acts as a guide, can be directed to the scout groups, formed by all the students in the class, by various collections of 3D images of 360º. During the trip, students will be able to see interesting sites." [6] [7]

Finally, one of the more ambitious proposals for the following years is the project that is being developed by the division "Solve" of the Massachusetts Institute of Technology (MIT), an initiative to solve challenges and global issues: the project ViREd: Virtual Reality Education - Low Cost Classroom-like Learning, aims to solve the problems in the education of refugees after the war in Syria. This initiative aims to create a virtual school to welcome to all those who need, providing an immersive experience in 360º, so that children can attend to their lessons virtually. The initiative is being developed nowadays but before doing that, it is necessary to elaborate more educational materials as the mass creation of viewers Google Carboard in order to distribute this between the refugees. [8]

In short, Virtual Reality and Augmented Reality are two technologies that will be very popular in the next few years and that today, it is still an experimental technology in the field of education.

Finally, it must be borne in mind that, "to enrich the virtual worlds it is important to have adequate and appropriate platforms to create 3D models that are appropriate for the experiences in real-time and very easy to use." Also, "the most delicate and risky aspect of this issue is that we may not be able to separate the real and the virtual experience, because we have all the information we gather from you, at the same time, in the same space, immediately." [9]

2 METHODOLOGY

As indicated above, the present work will focus on the development of an educational tool in Immersive Virtual Reality.

The tool consists on an Immersive Virtual Reality system that tries to raise students' awareness of taking care of the environment. In order to develop this, we used the game engine Unity3D (Fig.1).

This system allows students to design 3D environments through many tools and gives the change to include animations.
Firstly, we design the 3D environments, and then, we include the animations in 3D along with the audio associated to each scene.

Secondly, we create the source code for each of the scenes. The source code in Unity3D is divided into different scripts, where each of the scripts is related with a specific behaviour. For example, we can attach a script to the 3d model of an igloo in order to control when and how it should be thawed.

Finally, it is necessary to incorporate the user interaction with the system. Until now, we have implemented an application for Android devices that converts the majority of smartphones in a remote control that recognizes the user's movements and allows you to interact with the virtual world.

In order to create immersive virtual reality systems it is necessary to create a stereoscopic image on the screen of the device so that later on, with the use of Virtual Reality glasses, you can get an immersive experience. To achieve this, we have used the tools for developers or SDKs (Software Development Kit) that both Cardboard and Oculus put at our disposal for the platform Unity3D.

The objective of the first design is to raise awareness to students in 5th and 6th grade in Primary Education and teach them the causes of environmental degradation and the possible consequences of not taking care of the environment.

Thanks to the VR, students will be able to interact with a digital natural environment and see with their own eyes the effects of their actions on it.

In the Spanish educational system, the tool is included within the block of contents related to the human beings, where a distinction is made between the types, their characteristics and the classification of living beings; includes the ecosystems, the relationship between the natural and physical environment with humans and the attitudes that support the sustainability of the environment. In addition, this tool provides the students with the opportunity to know and appreciate the natural heritage of Castilla y León, where all the children live.

This educational tool will include some contents that are presented in the current Spanish legislation:

- Know how to respect and take care of the living beings. Other topics are conservation of the environment, pollution and natural recovery.
- Know rules of conservation and prevention.
This tool must be included in the agenda for the knowledge of the environment. The main topics presented are the environment; sustainable development; the main problems (pollution, global warming, deforestation, the loss of biodiversity); the responsibilities of citizens to preserve the environment (save water, electricity, fuel, deposit garbage and waste in appropriate containers and respect the fauna and flora).

In this way, the educational tool will include different scenes that show the problems already mentioned, and students must find the solution to the problem presented.

The students are immersed in a world of Virtual Reality glasses, and initially, they found themselves in a scorching and arid desert (Fig.2), with a pool of water and the skeleton of some animals. This scenario is the first scene of the system. The goal of this is that students can observe with their own eyes the devastating effects of climate change and the consequences of not taking care of the environment. This scene must be supported by a "voice" that tells a story: "This is a message from the future. We are in the year 2100, where civilization has succeeded in destroying our planet. The human being has, over the past 100 years, has been contaminated our waters, polluted the atmosphere, burnt and cut down our forests which caused the extinction of many species. This is what happens when there is no respect for the environment: loss of the fauna and flora of the environment, a drastic increase of the temperature, the melting of the north and south poles… But there's still time to save the world. There is no need to bring our layer to be a superhero. It's time to get to work. You will be aware of all the acts that lead to the destruction of the planet. Your task is to practice here, so you can fulfill your mission in the real world. Good luck!".

In the next scene, the students will be in a forest with a large river on one side. The scene must show a small camp (Fig.3), in which you can find a tent in front of a fireplace; a backpack with objects and a fridge. In this scene, the student must interact with both the backpack and the fridge: In the backpack the students will find a few batteries that they will throw in the river and soap to wash. The residues of the soap will go to the river. In the refrigerator, they will find bags and cans, that they must throw in the river.
After performing these actions, the recorded voice and the images will explain the students how they have contaminated the environment and the solutions will be displayed: the students have to collect the cans, plastics and batteries and put all of them in a container. In addition, the students will see that the industrial soap is usually no biodegradable, and that if they want to wash things in a river, they have to make sure that they are using biodegradable soaps.

To give realism to this scene we included the real sounds of the river, the birds singing, of the wind, as well as sounds when they interact with objects (the sound of water by throwing something).

In the same scene above, there is a bonfire in front of the tent. Here, the students must observe how the fire in a forest can be easily spread because of the wind or the cigarettes butts that have not been completely turned off.

Then, a gust of wind will be produced and the fire will burn a few dried herbs. The students will witness how the fire spreads until the fire is completely scorched.

The recording voice will tell the students that bonfires should not be started in the forest for two reasons: it is against the law and also because a great fire can be produced. In addition, the students will know that their lives may be at risk.

In order to have a more realistic scene, the teachers can include the sounds of rivers, birds singing, the wind, and the sounds while there is interaction with objects like the sound of the fire. Teachers can also include animations like the branches of the trees that fell.

In the next scene, the students will be in the South Pole. Instead of a tent, there is an igloo (Fig.4).
Through this scene, the students will experience an increase in the temperature in order to see how the igloo and its surroundings are melting until the students see a small, isolated island without any vegetation.

Using the recorded voice, instructors can teach the students how the melting of the poles occur due to global warming, the CO2 emissions that arrive to the atmosphere, the pollution of cars, airplanes and industries, etc. The teacher can also display small videos that show pollution in cities, melting poles or floods.

In a new scene, the student will be in an environment full of trash. They will need to select each object and classify it in the containers that will be around yellow for plastics; green glass; blue for paper; gray for organic debris.

The students can walk down a street in a city, in which they can see dirt, trash, pollution. The students’ task will be to move forward and collect all the waste that you find, and sort them into their respective containers.

In the last scene, students will find themselves in a room in the town hall, in front of the mayor, and they must select which are the acts that damage the environment and what are their possible solutions. With these activities, students know how to communicate to the competent authorities, explain their concerns and give their proposals for improve the environments.

This simulation fosters the students’ critical attitudes and social concerns, so they can become more active citizens in the future.

To give realism to this scene, an option is to include the mayor in front of the student sitting in a table with his/her councilors. This scene serves both as an evaluation and demonstration of what has been learned.

In order to design all these scenes, it has been a model composed of 10 steps [10]:

1. Define the objectives for the course.
2. Mark the ones that can be used in a simulation.
3. Put the objectives not selected in a file for future considerations as Virtual Reality Technology evolves.
4. Inspect each chosen target to determine which could use a computer-generated simulation. The objectives not selected in this step, send them to step #3.
5. Consider the objectives chosen to determine which could use 3D simulations. The objectives not selected is this step, send them to step #3.
6 Decide on the level of realism, type of interaction, type of sensory input and output required for the chosen objectives.
7 Choose the Virtual Reality software and hardware more appropriate for the objectives, based on the results of step #6.
8 Design and build the Virtual Environment;
9 Evaluate using a pilot group.
10 Modify according to the results of the evaluation.

3 RESULTS
The objectives for the design of the tool are the following:
1 Understand that the environment of a human being is composed of everything that affects your life.
2 Learn that humans alter the environment and that this can cause great harm in the Earth.
3 Know the most serious problems that people cause to the environment with their activities.
4 Understand that the citizens have responsibilities toward the environment and learn about some of them.
5 Know what is the responsibility of the authorities with regard to the protection of the environment.
6 Assess the protected areas, such as national parks, as an important measure for the protection of the natural environment.

Of the above objectives, we have given priority to make the virtual experience the following:
1 Learn that humans alter the environment and that can cause great harm.
2 Know the most serious problems that people cause to the environment with its activities.
3 Understand that the citizens have responsibilities toward the environment and learn about some of them.

Finally, it is necessary to decide on the level of realism, type of interaction, type of sensory input and output required:
1 A virtual recreation will be created with different natural environments.
2 The type of interaction will depend on each activity. The tool incorporates several scenes, in which the student should not contaminate a river and see its effects; observe how a fire is deforestation; increasing the Earth's temperature (global warming) to observe the melting of the poles, the increase of the mass of the water, and the increase of flooding; take waste and garbage from an environment and rank them by containers; etc.
3 The sensory input and output will be the VR goggles of cardboard, or cardboard, and a device (for example, a cell) to command mode to interact with the environment. In addition, Scenes should incorporate explanations and directions through audio, for the understanding and the acquisition of knowledge is greater.

The developed system currently includes the complete immersion in a camping.

4 CONCLUSIONS
There are four conditions that are necessary for the "Immersive Virtual Reality" [11]:
1 A broad field of vision that objects in the world could be detected by a peripheral vision, ideally with a visual angle of 200º horizontally and 120º vertically.
2 A locator of position and attitude of the body of the participant.
3 Translators who interpreted the natural behavior of the participant, such as look or point.
4 A non-significant delay of the speed at which the virtual environment was updated in response to the movements and actions of the participant.
Of the 3 types of applications that are in accordance with the format of VR (tutorial, exploratory and generator) [11], the most adapted to the design of this tool would be the exploratory. According to this design, students direct their own learning through a process of discovery guided by the teacher. Teaching techniques that support it are the study of cases, (the student analyzes in detail their decisions before the end of a solution, using their prior knowledge). In VR format, the tool would contain natural environments (virtual) where the student can modify the characteristics of the objects and/or processes according to their knowledge or criteria.

It is clear that in the coming years we will find a large number of Virtual Reality systems that will be used as educational tools. This technology gives students the opportunity to interact with any type of environment. In this case, we have tried to simulate the effects of environmental pollution in our planet. The developed system has been tested in different children between 9 and 15 years old that is why we have been able to obtain different conclusions. Firstly, it is worth noting that children find the system attractive and entertaining because they see it more as a game than a teaching tool. Secondly, we have been able to raise awareness among students of the importance of taking care of the environment, as they have been able to see and feel the disastrous effects of the pollution. It has been found that students maintain a level of greater attention to the didactic content when using a Virtual Reality System, in comparison with traditional resources such as videos, books, or even interactive experiences by computer. This is due to the fact that the students are isolated within the virtual environment so they will not get distracted.

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