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UTILIZAREA REALITĂȚII VIRTUALE ȘI A ÎNVĂȚĂRII ELECTRONICE PENTRU A ELEVA CONȘTIENTIZAREA ÎN TEMELE DE MEDIU ȘI DE SUSTENTABILITATE – DE LA ENERGIA SOLARĂ LA ECONOMIA CIRCULARĂ ȘI ECOLOGIA PĂMÂNTULUI

USING VIRTUAL REALITY AND E-LEARNING FOR ENHANCING AWARENESS IN ENVIRONMENTAL AND SUSTAINABILITY TOPICS - FROM SOLAR ENERGY TO CIRCULAR ECONOMY AND EARTH ECOLOGY

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Rezumat. *Noile metodologii in educație sunt extrem de importante într-o lume globalizată în care transferul de cunoștințe este absorbit într-un ritm foarte rapid. Realitatea virtuală face parte din tranziția digitală, având o gamă largă de avantaje precum noi: ușurința de a participa la conținut captivant, suport atât imaginea cât și sunetul, precum și posibilitatea de a desfășura antrenament de la distanță fiind formatorul într-o singură locație și stagiar într-o altă locație. Conținutul multimedia legat de durabilitate, energie regenerabilă, economie circulară a fost produs și integrat în scenarii virtuale într-un mod foarte atrăgător în cadrul unui proiect internațional Erasmus+ cu patru parteneri din patru țări europene..*
Cuvinte-cheie: *realitate virtuala, invatare digitala, educatie, energie regenerabila.*

Abstract. *New methodologies in education are extremely important in a globalized world where knowledge transfer is absorbed at an extremely fast pace. Virtual Reality is part of the digital transition, having a wide range of advantages such us: ease to participate in immersive content, support both image and sound, as well as the possibility to conduct training from a distance having the trainer in one location and the trainee in another location. Multimedia content related to sustainability, renewable energy, circular economy has been produced and integrated into virtual scenarios in a very appealing way within the framework of an international Erasmus+ Project with four partners in four European countries.*
Keywords: *virtual reality, digital learning, education, renewable energy*.

Introduction

In the rapidly evolving landscape of education technology, Virtual Reality (VR) stands out as a transformative tool that promises to revolutionize learning experiences [1]. It is a powerful way to bring new content into the classroom as well as in companies for specific training purposes. It is aligned with the digital transition, allows learning at a distance and is a new methodology of knowledge transfer which is very appealing to young generations. It can reach a global audience using personal computers and mobile phones connected to the internet. It is also possible to create a full immersion into the learning experience using Virtual Reality glasses where virtual scenarios are

displayed in color on a 3D imaging in front of our eyes, with an appearance that looks very real. Across Europe, the interest in VR is growing.

The current article focuses on current state of the art in four European countries: Sweden, Portugal, Romania and Bulgaria. Within the European Union's programs for supporting education, namely within the Erasmus+ framework, a joint project focused on Virtual Reality is being carried out by four institutions from these countries. The Project is called VR4Learning [2] and has the goal of creating videos for online courses, and using virtual and augmented reality for digital learning. This includes training sessions with 3D glasses which will enable learning at a distance in an immersive environment. In this joint effort, youth from diverse backgrounds has the opportunity to learn about green transition and sustainability efforts for our planet, making knowledge acquisition appealing and attractive. This new methodology is easy to be applied in a classroom environment as well as in a company or a workshop for training purposes. It can also be used as a way to transfer knowledge in a multidisciplinary team as it is the case in hospitals with surgery teams with professionals of different expertise.

The comparative research carried out to map the current national developments in the project partner countries showcases unique approaches and challenges in adopting VR technologies in educational settings, reflecting broader trends and national priorities in digital learning.

Use of Virtual Reality (VR) to teach in upper-secondary schools in Sweden has become more common during recent years [3]. VR equipment has grown to be more affordable and more user-friendly. Much indicates that VR will be a more conventional tool in the future schools [4]. Today, more frequent use of VR occurs in some adult education programs, for example, in engineering and medicine, because VR enables simulations and visualizations of various scenarios and phenomena.

In Bulgaria the investments in VR both on school education and higher education level are growing. The Ministry of education and science set a national resources repository called the "Digital rucksack", where students and teachers have open access to VR and AR materials [5]. Global industry leaders like EON Reality set up in partnership with "Prof. Dr. Asen Zlatarov" University the first XR laboratory in Bulgaria, aiming to enable over 5,000 students and 750 teachers and enterprise users to access EON-XR along with specialized software from EON Reality for the next five years [6].

Exploring VR in education within Portuguese context reveals a focus on technological innovation transforming various sectors, including education. Various actors from education and training sector are embarking in international partnerships to explore and test different modalities of VR in learning [7,8,9]. Tools like Augmented Reality (AR) and Virtual Reality (VR) are becoming central to the new period of exponential increase in information consumption and bring forward new, immersive formats for it [10].

In Romania, the integration of VR into education is part of a broader trend towards embracing immersive technologies to enhance learning experiences. These technologies are being explored for their potential to increase student engagement, improve knowledge retention, and make learning more interactive by allowing students to learn by doing rather than just observing, reading, or listening [11]. In Romania educational establishments are urged to evolve in preparation for the future and consider the fact that the next generation of adults has a much stronger connection to virtual reality and has the potential to immediately adapt to changes in the digital landscape. A recent study confirmed that the Z generation in Romania spends a lot of time in the virtual world, interacting with metaverse applications more than their older friends, family, or teachers, which should be taken into consideration when designing their learning experiences [12].

Methodology

The methodology being applied in the project makes usage of two technologies to enhance learning: creation of virtual reality scenarios and e-learning videos, in topics related to sustainability, ecology, circular economy and solar energy. The students have the opportunity to access these tools online at any time and location, thus facilitating and easy access to the educational materials.

The Virtual Reality scenarios are created using specific 3D cameras with a wide lens camera that can capture reality of a certain location in a 360° perspective (Figure 1).

Fig. 1. Cameras used to capture 360° images (©Insta360)

The camera can be placed on top of a tripod and take several pictures using a time clock, so that there is no need for the user to be close to the camera, thus avoiding to appear in the images takes. At a later stage, the images captured at the same spot and in the same time, will be merged together using an image software that is able to connect together two different images from the same location and merge them together based on the color of each pixel, so that ideally there is no visual sensation of overlapping when looking at the final image. Special care needs to be considered of parameters like the level and brightness of the light, the position (height) of the camera, the capture mode, the distance between different shots. Fig. 2 illustrates some of the specifics of the 360° lens.

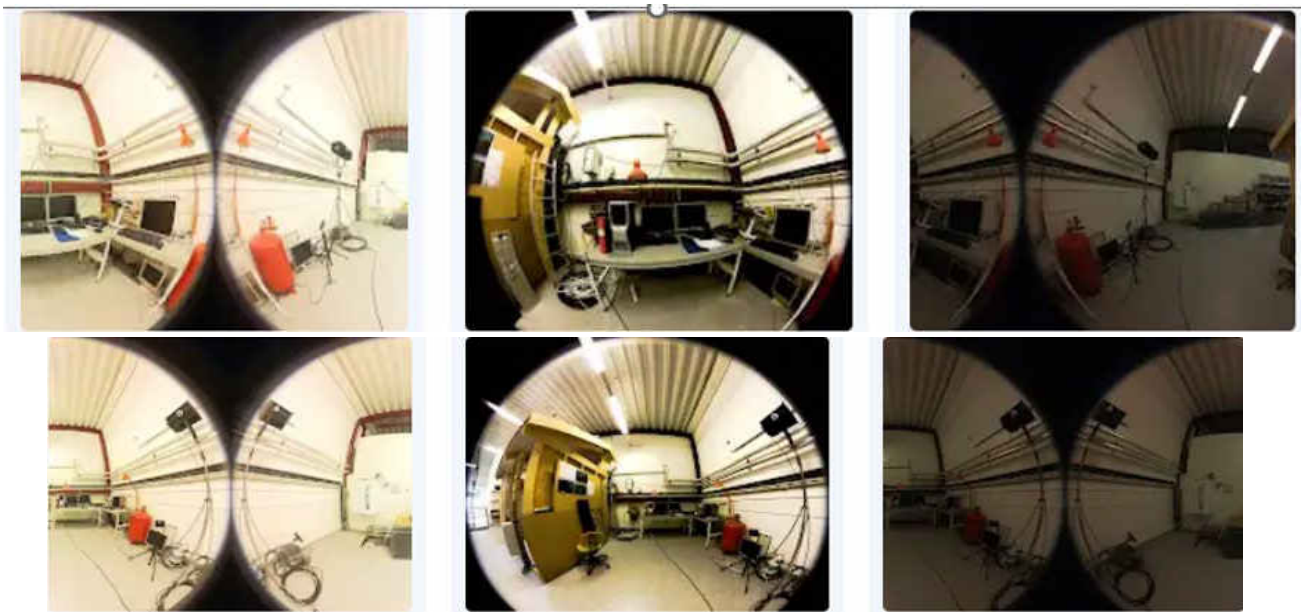

Fig. 2. Example of images captured using the „fisheye" camera lens

Another way to create VR scenarios is using a digital computed approach. In this case, objects exist in 3D mode in libraries that are used to create a virtual scenario where the user can move himself while being in a room with windows, information on the walls and even TV screens where videos can be seen. Users can navigate through the virtual space illustrated in Figure 3 and choose the content they want to learn about or enter a specific room.

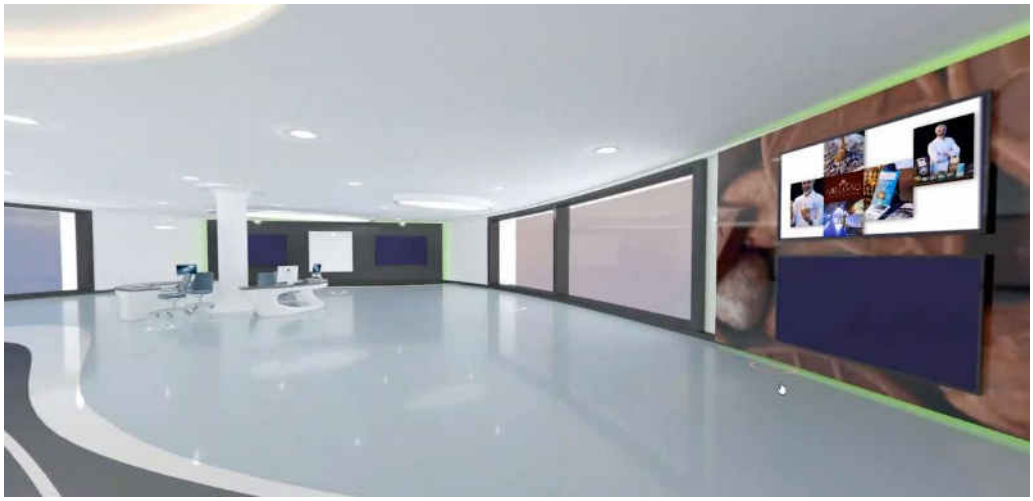

Fig. 3. A screenshot from one room of the VR Scenario

Users are able to enter a VR Scenario from any location and be guided through the learning process. Short courses can be thought from experts from different countries without travel, thus facilitating the access to information.

E-learning videos can be embedded into the VR Scenarios as well. The videos were produced in a professional Multimedia Studio (Figure 4) for 4K image resolution and voice recording. Several recordings are taken in order to produce the best results. The studio facilities give the opportunity to choose the content added to the e-learning videos: audio, lecturer presence, 2D and 3D animations.

Fig. 4. E-learning videos – work in progress at the recording multimedia studio

A library of e-learning videos is currently available online on the project's YouTube channel [13], in English as the original version and with subtitles in all European languages. More than 10 videos have been created in the following topics: air pollution, circular economy, waste management, textile pollution, Earth ecology, solar energy and renewable energy resources. Engaging visuals together with a captivating audio background are designed to catch the interest and raise awareness in sustainability topics. The voice of lecturer guides the students throughout the course content, and can even appear at certain times, giving a personal perspective.

Results and Discussion

The two technologies used in the VR4Learning project are designed to give students the opportunity to access these tools online and at any time and location, thus facilitating an easy access to the educational materials.

During the creating process, several VR workshops have taken place, where users have provided feedback of their experience for follow up and improvement. As illustrated in Fig 5, participants from all four countries of the project were present in the virtual environment, following the guidance of the main trainer that conducted a guided tour through the VR scenarios.

The testimonials of users participating in the VR workshops mention the ease of being immersed in a scenario that they would not easily access otherwise. The work being performed, integrates multimedia content with specific written information (e.g. in posters on the wall of the virtual scenarios) as well as with audio information in a way that makes it very attractive to learn and absorb new knowledge. Both audio and sound are added in the VR Scenarios for a fully captivating the attention of the users.

Some of the benefits of the VR Scenarios include the ease to participate in immersive content, with the possibility to conduct training from a distance with the trainer in one location and the trainee in another location. Furthermore, there is the possibility to elevate the training level by involving experts that can record their voice in advance. New content on various topics, including state-of the art technologies can be created in a way that is not technologically too complex.

Fig. 5. International VR workshop (image captured with 360 degrees camera)

Students are able to enter a VR Scenario from any location and be guided through the learning process. They can choose self-study short courses or courses thought by experts from different

countries Access to information is widely increased and encouraged, giving students the opportunity to travel virtually. The E-learning videos together with the VR Scenarios bring flexibility, wide accessibility, cost-effectiveness, engagement and global reach. Students retain more information in digital learning compared to traditional face to face courses [14]. It is more convenient to follow the information and establish a learning pace, as the material can be visualized and revised according to individual needs and preferences. Furthermore, the CO2 emissions are significantly reduced. A study from Britain's Open University [15] found that digital courses amount to an average of 90% less energy and produce 85% fewer CO2 emissions per student than conventional courses in the classroom.

It is worth mentioning that motion sickness and/or headaches can be experienced when being immersed in a VR Scenario [16] as each user has an individual sensory perception. Different levels of discomfort can be experienced by different persons using the same device and the same virtual environment. Discussing the possible causes and effects, or approaches for decreasing the experienced discomfort is not in the scope of this paper. However, the VR workshops were organized having in mind time limitations for using the VR sets and adjusting to the sensorial feedback given by the users, in the process of creating the VR scenarios.

Digital learning allows users to select the duration of instruction they prefer, and give the opportunity of repetition if deemed necessary. The length of the VR4Learning e-learning courses varies from 3 to 10 minutes, being focused on interesting information delivered in a dynamic way in short courses. Even without prior knowledge in the particular topics, the courses contain a short introduction and overview meant to raise awareness into environmental and sustainability issues relevant to current times.

Conclusions

VR4Learning, an Erasmus+ project, focuses on new methodologies, namely digital learning and VR for increasing knowledge and awareness in environmental and sustainable topics. The benefits of using digital learning and Virtual Reality for knowledge transfer is evident and is suitable to be stimulating for all ages. Particularly young students, are nowadays more inclined to experiment digital learning and virtual environments. The ease of access makes the content reachable worldwide. This new methodology is easy to be applied in a classroom environment as well as in a company or a workshop for training purposes. It can also be used as a way to transfer knowledge in a multidisciplinary team or in an international environment, benefiting from input from experts associated with various institutions.

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