DIGITALIZATION OF HIGHER EDUCATION THROUGH VIRTUAL REALITY EXPERIENCE

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Abstract: The digitalization of modern society and in particular the development of the concept of simulated realities and the attempts to create such provide great opportunities to increase the efficiency of the educational system using distance learning not only in emergencies but permanently

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1. INTRODUCTION

All knowledge gained through experience is stored longer in memory. A number of studies including [2] show that about 90% of all information about the reality around us is obtained through the visual analyzer, 9% with the help of hearing analyzer and only 1% - through other analyzers. The first known attempt at providing visual content was in the 19th century, when the English scientist and inventor Charles Wheatstone proposed a simple device he called stereoscope, which was designed for entertainment and displaying three-dimensional images. In the middle of the 20th century, the American producer and cinematographer, pioneer in virtual reality Morton Heilig introduced Sensorama - a machine that is one of the earliest known examples of multisensory or multimodal technology. After the end of World War II the rapid development of civil aviation, necessitates the training of pilots in a controlled (safe) environment. The idea of developing and implementing various types of simulators for pilot training for civil and military purposes has been adopted and widely disseminated. Their main disadvantage is the high cost of design and construction, hence their accessibility to a wider range of students.

2. ARTIFICIALLY CREATED REALITIES

The development of computer and communication technologies and ubiquitous Internet connectivity makes it possible to create digital content and simulate various types of activities, such as driving a car, airplane or others. At the same time, computer-aided technologies for design and training are receiving a major boost in development. The combination of new technologies and traditional training methods provides an excellent opportunity to teach and gain new knowledge and skills. The unprecedented closure of educational institutions in many countries around the world in early 2020 forces stakeholders to move partially or completely to distance learning through various information applications, platforms and ways to address the problem of education of students, pupils, children with special educational needs, etc.

The demand for electronic devices, uploading educational content and opportunities for effective practice and assessment has also increased. Analysts warn of the possibility of recurrence of such situations in the future and the difficulty in predicting their duration. Surveys of teachers and students show that the role of the teacher has not disappeared and he continues to play a significant role in the educational process. Taking into account the characteristics of "Generation Z", the teaching - learning process is oriented towards placing the learner at the center of the educational process through discovery learning, inquiry learning and critical thinking learning.

In the world of Generation Z, new opportunities for easier acquisition of knowledge and skills provide tools such as virtual, augmented and mixed reality. In short, they can be defined as:

- Virtual Reality (VR) is a computer-generated reality with a 3D image and in most cases with sound. It is created using large screens located in special rooms (Cave Automatic Virtual Environment - CAVE) or through VR glasses;
- Augmented reality (AR) refers to computer-assisted perception or representation that expands the real world with virtual objects. With integrated cameras in mobile devices, additional objects or information can be included in the current image of the real world;
- Mixed reality (MR) expands either augmented reality, which requires AR glasses, or augmented virtuality by connecting it with reality.

Table 1. Comparison of Virtual, Augmented and Mixed Reality [3]

Characteristics	**Virtual Reality**	**Augmented Reality**	**Mixed Reality**
The user is aware of the real world and the surrounding objects	No	Yes	Yes
The user can interact between the real and virtual world in real time.	No	Yes	Yes
Interconnection of objects from the real and the virtual model of the projected scenes.	No	Yes	Yes

Virtual reality technology plays an important role in the concept of telesensation [1]. Through it, a virtual world is created that viewers can enter and walk through and where they can handle virtual objects. The virtual world allows us a stereoscopic view from front or side, depending on our viewpoint, just as in the real world. The ability to enter and walk through the virtual world and handle virtual objects using hand gestures makes VR interactive and this is one of its most important features. Communication can be human–human, human–environment or human–computer. In the case of human–human communication, a variety of means are at our disposal. We talk together to communicate. We write letters or draw pictures and sometimes communicate using images and motion pictures. In human–environment communication, we recognize our environment via our five senses: feeling, touch, taste, vision, and smell. In human–computer communication, we interact with a computer by means of a mouse, a touch pad, or a keyboard. Human–human and human–environment communications have been developed over a long history of interaction. It is desirable to provide human beings with a human-friendly environment where we can interact with computers just as easily as we interact in human–human or human–environment communications.

3. VIRTUAL REALITY EDUCATION SUPPORT SYSTEMS

The goal of VR is to provide human beings with a virtual environment where user can interact with a computer just as he does in the real world, that is, by talking with a virtual human in a spoken language, by writing a letter, or by drawing a picture. User can grasp a virtual object by hand gesture and bring it to another place. In a human–friendly virtual environment, users can interact with a computer without any difficulties or barriers. When a virtual landscape is generated by VR technology, one can go there just as if it were a real landscape. Providing not only a 3D image of the landscape but also sound and smell helps with enjoyment of the scenery.

The VR education support systems have a number of advantages such as:

- Education independent of time and place, but only of hardware and software connectivity;
- Personalized and flexible training;
- Experiential learning - the acquired information is perceived as experience;
- Opportunity to assess the environment and extract the context;
- Opportunity to standardize a certain environment and study the behavior of students;
- Opportunity to analyze and review the actions that led to one or another scenario;
- Introduction of uniform evaluation criteria;
- Opportunity to introduce policies for mandatory and recommended activities to be implemented;
- The teacher becomes a mentor who supports and guides the learning process;
- Virtual projections based on reality, forming a new type of perception and allowing the presentation of concepts and scenarios, tested and evaluated by various criteria;
- Increase of the comprehensiveness and understanding of the implementation and operation of complex processes and systems;
- Opportunity to simulate hazardous situations as part of scientific experiments with no physical danger for the participants;
- Opportunity to quickly and easily switch from one virtual environment to another.

Along with the benefits of the VR education support systems there are some risks and limitations:

Significant costs for creating VRs and ARs and in some cases providing the appropriate equipment;

- Need to adapt curricula to the virtual environment;
- Need for additional training of teachers;
- Providing a backup option in case of technical issues;
- Vulnerability to malicious attacks - denial of service, voice phishing, fingerprint, eye tracking, etc.[4];
- Health problems and complications – addiction, dizziness, loss of spatial focus, anxiety;
- Loss of personal contact with other people and impaired communication.

Of course there are also technical limitations for VR types of environment which revolve around compliance, interaction and comfort. Just like in real life not every educational course is suitable for every VR education support system and it is necessary to define all corresponding objectives. In accordance with the goal a choice of the most convenient medium has to be made. The next stage of the cycle is the modeling and configuration of the selected platform. The tuning process includes an error correction procedure and ends with evaluation of the achievements. Based on the results of the assessment the shaping of VR environment may begin along with all interaction and convenience tools. The main idea here is the less users sense the VR interfaces, the more immersed they become. The final stage of the cycle is the testing process followed by implementation of the VR education support system.

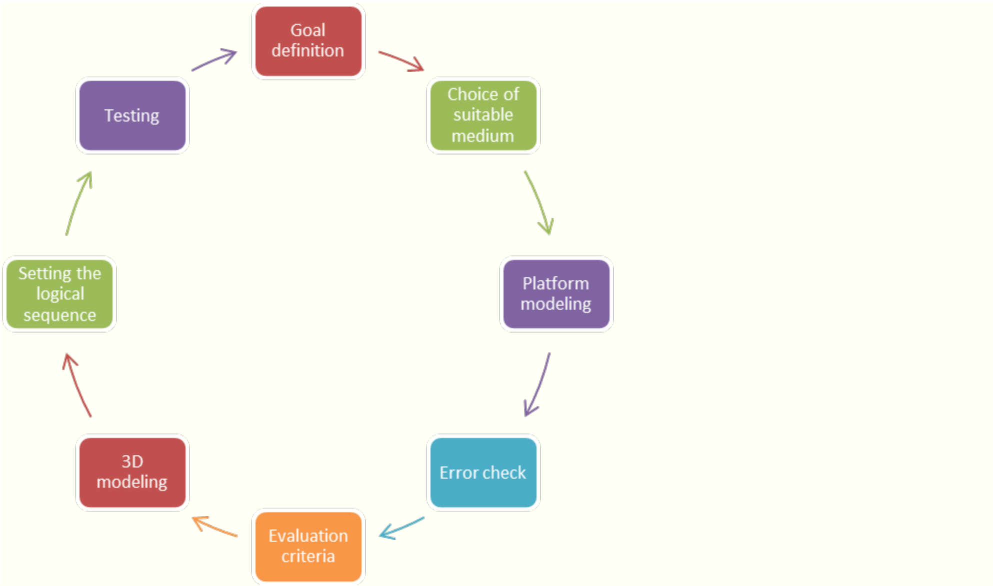

FIG. 1 VR education support system design and analysis cycle

4. REALITY OF VIRTUAL REALITY

VR applications are made up of two types of components: environments and interfaces. The environment is the world that we enter and put on a VR headset. An interface is the set of elements that users interact with to navigate an environment and control their experience. All VR apps can be positioned along two axes according to the complexity of these two components. In the top-left quadrant are things like simulators. These have a fully formed environment but no interface at all. You're simply locked in VR but not able to interact with it. In the opposite quadrant are simulated worlds that have a developed interface but little or no environment.

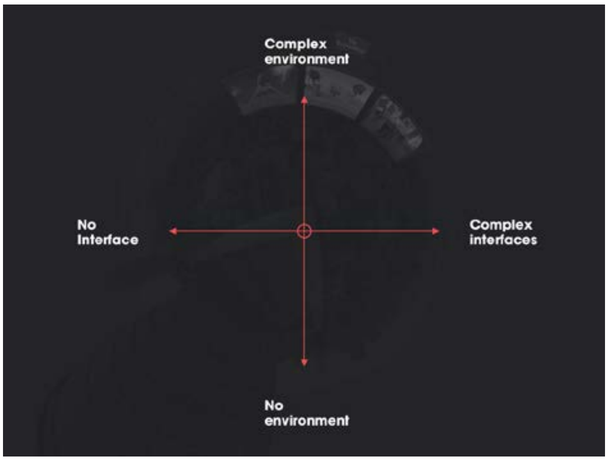

FIG. 2 Axes of VR main components [8]

The essence of simulated world presupposes it to be interactive [5]. The devil is in the details because it is unnatural to join a multidimensional environment and not being able to interact with any of the objects that are shaping it. Important aspect is to make design intuitive i.e. the way users interact with environment must match what they're used to doing in the real world. Another important feature of VR is the possibility to roam freely the simulated world – the more space is available to explore the more immersive the VR is. Appropriate music background and 360 degrees sound surround also contributes to the perception of been placed in a vast 3D environment.

When creating VR, the following human limitations should be considered [6]:

- Safety and comfort – prevention of VR sickness and disorientation by: making users familiar with controls and menus, keeping peripheral motion minimal and frame rates high, avoiding quick changes in brightness;
- Interaction and reaction – design of VR must be in accordance with the physical capabilities of the users e.g.: motion tracking sensors must respond dynamically, interaction zones must be in the reach of virtual users hands;
- Image and text scale – images and texts must be more detailed the closer the user is in order to avoid eye strain;
- Music and sounds – background music and interaction sounds must be tailored to VR environment to enhance the user experience

A typical company specialized in creation of simulated worlds should have a team of talented personnel including:

- Product owner (license holder);
- Analysis specialist - defines the goals, ways, means, participants, costs, benefits and risks of virtualization;
- Industrial expert - provides the most detailed and reliable information for the relevant field;
- Simulation system developer - creates the software backbone of VR;
- 3D graphic Designer – creates the 3D model of VR;
- Audio engineer – responsible for the selection of relevant to 3D environment music and sounds;
- Level engineer - management of level and spatial orientation of objects and avatars in virtual space, transition from 3D to 2D view and vice versa, management of rights, policies and special areas;
- Motion specialist – works on smooth logical and visual connection of the actions when moving the avatar or switching from 2D to 3D mode or vice versa;
- Programmers – help with software development;
- Testers – help with testing VR and provide feedback;

5. CONCLUSION

Distance learning has given impetus to the development of e-learning resources and the use of virtual, augmented and mixed reality. Adding new human-to-virtual communication allows you to create different types of behavior. Acquired new knowledge, skills and competencies in the form of games, entertainment or new experiences have the character of permanently acquired ones.

6. ACKNOWLEDGEMENT

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