VIRTUAL REALITY AS AN INNOVATIVE AND IMMERSIVE LEARNING TOOLS FOR HEIS IN PALESTINE

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Abstract

Education and technology are an interconnected. While education has not changed for years in terms of applied teaching approaches and techniques, we are witnessing a continuous innovation in terms of instructional technologies, ICT infrastructure, and the delivery methods related to education.

The article presents the project TESLA - Virtual Reality as an Innovative and Immersive Learning Tools for HEIs in Palestine, supported by European Commission under the programme Capacity building in the field of higher education. The TESLA project originated from a critical need or challenge to provide a solution for some taught courses where not only traditional learning is considered to be obsolete but also the current used technology is not sufficient to offer the optimal quality of teaching/training for a certain category of courses where the human perception and immersion are two master components for learning. The idea grew up when other Palestinian HEIs join the initiative launched by Al-Istiqlal University to develop a collective virtual reality component, giving it more depth and more challenges to overcome, especially that each university has already its own courses, vision, and objectives.

Keywords: virtual reality, Erasmus+, instructional design, innovative learning, ICT

1 INTRODUCTION

The TESLA (TESLA, 2019) project originated from a critical need as it is the first governmental higher education structure specialized in training future homeland security staff for the different Palestinian Authority's Institutions.

The critical need or challenge is to be able to provide a solution for some taught courses where not only traditional learning is considered to be obsolete, but also the current used technology is not sufficient to offer the optimal quality of teaching/training of courses where the human perception and immersion are two master components for learning. Spatial knowledge, which is cited by Armbrüster et al., (2008) is necessary when it comes to teach future forensic science experts on how to approach a crime-scene to take samples without effacing crucial evidence. The same thing goes as well for geography and topography where students need to interpret a given map; they need to reappropriate the terrain to give meaning to their theoretical learning, where depth perception in the key component is in the learning process.

The idea grew up when other Palestinian HEIs join the initiative launched by Al-Istiqlal University to develop a collective virtual reality component, giving it more depth and more challenges to overcome, especially that each university has already its own courses, vision, and objectives.

Shraim&Khlaif. (2010) exposed the general overview regarding the adoption and readiness of new technologies into learning and teaching in Palestinian HEIs, underlining also the need of the collective work, collaboration, and unifying different synergies.

Nearly, every Palestinian HEI's is offering a specific format of eLearning. Since 2005, multiple projects were funded by European Commission came to the light among them. Avicenna Virtual Campus which

is the creation of a new community of universities sharing best practices and pedagogical innovation through a network of E-learning centres across the Mediterranean involving 15 countries including Palestine. RUFO is another example in which five universities in Palestine participate in with the purpose to create an interuniversity network in Palestine for the development of individual and collective competences in the field of open and distance learning.

2 METHODOLOGY

Although the challenges already faced by the conventional eLearning: digital divide, lack of experience on online systems, bandwidth and infrastructure issues (Shraim&Khlaif, 2010), virtual reality is quite a new explored area in Palestine not only at universities but also on institutional level (municipalities, local councils, etc.). In frame of TESLA project, VR is expected to strongly support the following challenges:

1. **Providing outstanding visualizations that aren't possible in the traditional classroom** - Vavra et al. (2011) stated that visualization can refer to what the visualization is in terms of product, object or visual image, and how visualizing objects is in terms of process, activity or skill. Visualization objects can be pictures, three-dimensional models, schematic diagrams, geometrical illustrations, computer-generated displays, simulations, animations, videos and others. These objects can be displayed in a variety of media formats, such as paper, slides, computer screens, interactive whiteboards or videos, head mounted display, 3D glasses, and may be attached with sound and other sensory data. In addition, virtual reality will provide students with high-level abstraction material in some complex subjects, which are not easy to understand without advanced instructional techniques, methodologies, and high-end technology hand-on. Despite the advantages of conventional eLearning, at some point in the learning process, every student needs assistance that interactive systems do not provide. Virtual reality (VR) promises to deliver the best aspects of both real-world classrooms and online distance learning into a single platform.
2. **Providing controlled risk-free simulations and realistic learning scenarios** - Anzai& Simon (1979) stated that computer simulation provides learners with the opportunity to learn by doing and interaction. While Kumar & Sherwood (2007) indicated that computer simulation is useful to foster problem solving skills for learners, through simulating the real-world situations to improve the classroom teaching. To simulate a real-life situation, we need first of all a model to be developed; this model should represent the key characteristics, behaviors, functions, interactions, actors and medium of the selected physical or abstract system or process. In some cases, simulation is a crucial need for some courses and/or specializations that cannot be taught without the presence of simulator such as flight simulators for commercial and military jets pilots. Although hands-on practice is an essential component in the learning process and prototyping, it is the costly part in learning process in terms of time and money. In several cases the educational institutions have limited budgets to bring raw materials, devices and instruments for specific hands-on training. The hands-on practice is also a time-consuming regarding the limited teaching hours in the classroom or in the lab. In this case, Virtual reality saves money and time; learners also will practice upon their own pace. Moreover, Virtual reality removes the needs to repeat prototyping and/or implementation, which are expensive. What it does instead is to replace this with a single model that can be frequently used. Virtual Reality found various applications over the world during the previous three decades. In contrast, VR is still an innovative concept in Palestine and it is started to be used for mobility and travel, citizenship values, cultural heritage, and awareness campaigns. However, it is still not specifically used for education although it has great potential to put accent on smart learning and blur more the boundaries in between formal and informal learning. In the frame of this section a diagnostic survey for both instructors and students in the Palestinian higher education institutions which will take part in the virtual reality components' development and utilization has been realized.

2.1 Palestinian HEIs involved into the project

Al-Istiqlal University benefits from this experience to create a virtual crime - scene investigation to introduce students to real-life crime cases before enabling them to use the real tools provided by the DNA Laboratory facility that is currently being under construction (e.g. DNA extraction kits, PCR and gel electrophoresis apparatus analysis which are very expensive to afford). The student of the

university also benefits from the geography and topography courses which will use a virtual map of Jericho to teach them how to read and interpret information from a topographic map.

Al-Quds Open University (QOU) is adopting the blended learning model as the official educational / learning system in the University. QOU is following one of the best open educational practices. Therefore, QOU is publishing all the digital material as Open Educational Resources (OER) for all learners worldwide. Nowadays, QOU is seeking to enhance its learning model with the virtual reality (VR) technologies and ubiquitous learning techniques. VR in learning is a trending learning method that brings life to the applied sciences. It is meeting the learning styles for the digital native students and simplifying the ubiquitous learning techniques. QOU believes that this VR Erasmus+ project is a unique opportunity to collaborate and develop a VR learning model that can be adopted on a wide scale in QOU courses.

Palestine Polytechnic University (PPU) aims to graduate qualified labor forces able to make a positive change and fulfil the needs and requirements of the community in scientific, technological, and research fields, as well to provide innovative ideas and solutions. In this context, PPU is planning to utilize VR as a cutting-edge technology in its teaching methodologies. This enriches the content and enhances the quality of the subjects related to geographical information systems. The planned virtual environment will provide students with a valuable interactive learning and experimenting tool. Knowledge is transferred as well as perception within the affected topics, namely geology, hydrology and principle of topography, are expected to be considerably supported.

The Arab American University (AAUP) aspires to be known for graduating students who far exceeds the expectations locally and globally. It adheres to the highest technical standards by using innovative teaching techniques such as adapting VR in education process. AAUP is looking to have a real impact on the society through innovative strategies and research. Virtual reality will be expanded in this project to include the instruction of three courses Physics, Biology and GIS courses by a common learning management system using maps and built-in tools. This will enable AAUP students to perform tests and simulate real life conditions in an instructional context.

3 RESULTS

With the aim to fulfill project's objectives, all three universities have chosen the course and expand them in line with the instructional design implemented principles of virtual reality.

3.1.1 Al-Istiqlal University

At **Al-Istiqlal University** chose some laboratory experiments from the course of forensic molecular biology to be a model for the use of virtual reality in education at Al-Istiqlal University. The application of virtual reality technology will help to their students and teachers in understanding and performing many lessons more than traditional strategies in learning.

Pedagogical Knowledge (T-PK) and the Philosophy behind VR topics-use

The developed scenario helps reconstructed through data collection, 3D library creation, and 3D modeling, all of which culminated in VR being used as a tool of communication between the learners and the tutors.

The philosophy of the scenario is based on critical thinking and its most achieved form dialectics. When students are put in the virtual reality of the crime scene, they face some questions and scientific problems that need to be solved, and dialectics that occur help in understanding the subject.

By using the crime scene investigation as case study, the added value of using VR as an "Edutainment" tool, entertainment with an educational aim. Virtual reality design can address the needs and desires of criminal investigators by developing them as a combined vision and collaboration tool. This presents a system designed to teach students the techniques and processes of crime scenes using this virtual reality technology. The goal is to provide a platform that improves the ability to enroll in Crime Scene Investigation practical learning in a rich and stimulating environment and is likely to be experienced in practical workshops.

The Methodologies of the VR utilization in classroom

The constructivist approach has a positive impact on students' ability to solve problems in science, so this methodology has been used to support critical-constructivism as a learning model that supports the implementation of learning in the developed virtualized environments. Students are faced with

problems both in the crime scene and in the scientific laboratories urging them to use their higher thinking skills in order to find solutions to these problems.

A virtual field trip is a practical use of VR in the classroom. It consists of a guided tour of distant places. Problem solving is a suitable method for utilization in the subject chosen by our university (crime scene investigation and DNA analysis). It is a field trip to the crime scene in order to identify it, gather biological forensic evidences from it and transfer these evidences to the laboratories to examine the DNA for solving crime purposes. When paired with effective instruction, students should be able to acquire the same benefits as though they actually visited the crime scene. Moreover, not only students can act as scientists, but as active and critical-reflective learners, a role that the Palestinian Community of learners - and not only- mostly need.

3.1.2 Al-Quds Open University

In this project, QOU team with collaboration and with the other partners will develop two experiments in the course Physics 101, the movement law and the energy conservation experiments. In these experiments, our team will try to integrate and simulate the virtual life environment with virtual physics lab instruments to conduct real life situations. Finally, this course is a prerequisite for the Faculty of Technology and Applied Sciences, and will be targeting all its students along West Bank and Gaza Campuses.

Pedagogical Knowledge (T-PK) and the Philosophy behind VR topics-use

Learning physics is difficult for many students all over the world, because it requires students to employ various methods of understanding and translate from one to other-words, tables of number, graphs, equation, diagrams, and maps. Physics requires the ability to use algebra and geometry, and go from the specific to general and vice versa, and usually the focus on those skills is more than binding them with real life activities.

Students at Al-Quds Open University and all students in distant learning face many difficulties in learning physics especially laboratory activities, they desire comparable learning experiences to those happened in laboratory or in real life to help them deeply understand the subject, so using Virtual reality will map their needs.

Our scenario is about **Newton's laws of motion**, and the focus will be on how to help students see the application of those laws in real life. The learning activities are picked from what is familiar to the Palestinians, all the environments that the avatar interacts in are familiar to the Palestinian students, but could be used also for any environment. To be more motivational to their students, it could be changed to familiarize the game from their environment.

The Methodologies of the VR utilization in classroom

The scenario has been build based on mixed learning theories, students will generate meanings about the learning topic in constructive process, she/he will experience all variable effect's motion so it will be experimental and experiential. After students interact with this scenario and do all the activities, she/he will develop deep understanding about learning topic and could analyze any type of motion.

Students will create their subjective representations based on interaction between their ideas about Newton's laws of motion and experiments.

The VR learning environment provides depiction of the contextual factors that surround the scenario problem so that the students can understand it. The authenticity of the problem helps students to value problem's significance and relevancy and lead students to higher motivation and engagement in finding the solution for the problem. Moreover, students through VR authentic, multi-sensory experience understand the subject area as it is more alive (ibid).

The Methodologies/Strategies of VR components used inside, and outside classroom are:

- **Flipped Classroom** - students working in groups, identify what they already know, what they need to know, and how and where to access new information that leads to resolution of the problem. Learning activities that promote this way of learning and the teacher facilitates and guides the learning process in the classroom have been developed.

- **Online collaborative learning** - students are encouraged and supported to work together to create knowledge, to invent, to explore ways of innovation, and by so doing to seek the conceptual knowledge needed to solve problems.
- **Experiential Learning** - students are engaged in strategic active opportunities to learn by practice, and reflects on those learning activities, which empower them to apply their theoretical knowledge in physics to daily life activities in different situations inside and outside the classroom.
- **Deeper Learning Approaches** - students engage in critical thinking, problem-solving, collaboration, and self-directed learning. To remain motivated, students need to be able to make clear connections between the VR environment and the real world, and how the new knowledge and skills will impact them.

3.1.3 Palestine Polytechnic University and American Arab University in Jenin

Although the proposed idea is applicable in a variety of subjects taught at PPU and AAU, it has been intended to implement the concept - in the first stage - in a limited number of topics. In particular, targeted area are geographical information systems (GIS). Specifically, the affected topics are:

- Geology,
- Hydrology,
- The principle of topography.

Pedagogical Knowledge (T-PK) and the Philosophy behind VR topics-use

The philosophy of the scenario is infused from **Critical Dialectic Interest**, when our students extend the notion of "*understanding*" a situation in Jericho area and the Dead Sea, to form a "*critical consciousness*" and "*action*" in order to solve critical presented problems, aiming to liberation and release from such situations targeted in environmental phenomena and changes.

Activity learning in the VR Learning Scenario enhance students Interest (engagement), delivering powerful new experiences they may not have encountered before by using the VR to present the reality of the topography surface and to highlight the problems in the area. In addition, the scenario will spark new interest in the subject matter, provide a shared experience for better classroom discussion, and improve overall engagement by sharing knowledge presentations, theories and calculations. Moreover, the scenario provides unique and fresh learning moments that draw in students and pique their interest as they actively explore and exercise their curiosity. So, it's an opportunity for the students to address typically geographic and topographic such boring subjects or low appeal subject areas in an innovative way.

Authentic learning may help students to value the authentic subject importance and relevancy, which may lead to higher motivation and engagement in finding the solution for the topographic and geologic problems in the study area, ensuring also interactive and self-learning. By enveloping students in an authentic and multi-sensory experience, using VR scenario will make the subject area become alive, especially in geographic and geological topics, where reality can help students to understand and imagine the involved topics. (e.g. students have the opportunity to navigate through the area and the hydrology cycles through the process).

The Methodologies of the VR utilization in classroom

Deeper learning approaches using critical thinking, problem solving, and game fiction are used in the integrated activities in the scenario to encourage the students to interact and make smart decisions. In the scenario, the activities present problems and analysis. They encourage students to suggest solutions by calculating and planning geometric and mathematical concepts and values. Games were also set in the activities to motivate the students to interact and collaborate. Technology Enhanced Learning (TEL) through a VR environment provides the tool which can facilitate the constructional values and provides the 3D environment in the treated geographic areas and the problems there. Education would be much better served if computer scientists tried to make VR environment to support learning more than reflective of the way human learning operates, especially when VR will create the 3D surface of the study area of teaching earth science and related subjects that will be presented and discussed clearly and interactively.

Using the scenario's activities as required to solve real presented problem such as the colors game in the activity No. 3 that will ensure understanding the basics of the theory of remote sensing. Another kind of problems was presented as a real danger that needs a smart solution and decision such as the Dead Sea proceeding. In both cases the motivation enhancement in education through the use of game mechanics and elements has been used in innovative activities in the discussion fields.

4 CONCLUSIONS

Virtual reality is obviously a popular innovative technology used in education, especially in medicine, law, criminology, business, forensic sciences and technologies. Many EU countries have already been experimenting the benefits of VR in many aspects including education and environmental awareness, promoting digital culture and reducing the gap between students and technologies. The TESLA project enables Palestinian HEIs to offer higher capabilities in translating some major key-concept into a dynamic and a fully interactive VR component. Considering the special geopolitical context of the Palestinian territories and restrictions imposed by occupation, VR will offer students, researchers and academic staff in the Palestinian Universities the ability to conduct research in simulated virtual labs. This will help avoiding several problems related to mobility issues, access to material, lack of specialized laboratories, and the expensive character of such experiences.

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