Virtual Reality Technologies For E-Learning Framework

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Abstract- E-learning can be defined as one of the ways of teaching with the use of the latest means of communication, remote as well as in classrooms. The E-learning Platform helps the learners to learn in anytime and from anywhere also includes educational material that expands the learners' knowledge. The existing tools of learning are 2-D visualization tools, and that is complicating to the construction of the mental models of the 3-D anatomical structures which consist of elements of width, depth, and breadth. For the sake of overcoming this issue, a virtual 3-D tool of the anatomical visualization has been advanced and assessed according to the technology of the virtual reality which runs on the web. In this study, an E-learning platform for anatomy laboratories has been built depending on the webGL and ADDIE model to be used for the Higher Health Professions Institute. The proposed platform contains many pages that include many learning resources to the learners such as E-books, video lectures, documents, 3D images, 3D models for human organs and students can interact with those organs, in addition to that, it provides the ability of communications between instructors and other learners, through the chats. The platform has been tested and evaluated by 20 teachers and 87 students from the Higher Health Professions Institute in Iraq and the results showed that the platform motives them toward their lessons and increase their understanding of human anatomy.

Keywords: E-learning Platform, Anatomy learning, Virtual Reality, ADDIE Model

I. INTRODUCTION

Generally, E-learning is one of the crucial trends in numerous disciplines. Students are capable of using there sources of e-learning whenever they require, and adjust the system to their objectives of learning [1].

Learning can be defined as the act of the acquisition of skills or knowledge via studies, experiences or being taught. It presents a platform in which the person obtains a customized package which is associated with fundamental thematic fields, via a self-guided procedure. Which means that it is a combination of pedagogy, technology and accreditation for coming up with the appealing learning concept, which is referred to as the e-Learning. It provides a technology enabled learning by using supportable platform and a variety of resources like visual content, text content, and audio content. In addition to that, it provides us with the blended learning via a combination of on-line lectures and self-paced learning. Students won’t miss the support of the knowledgeable teachers as well as their guidance and along with extra content for his reference [2].

E-learning is a teaching way with the use of the innovative mechanisms of communication, remote as well as in classrooms. It is important using all technology types for delivering data to the student in a more timely manner, with greater benefit and less effort. E-learning is capable of changing the way learning experience is delivered to the
learners across time or space, which resulted in E-learning evolution [3]. On-line learning can be considered as a coherent method for the modern education; none-the-less, some researches have shown that it can have a few weaknesses which may be addressed for the sake of enhancing its potential. Using the virtual reality (VR) for improving on-line learning in some of the aspects, like bringing a new way of the interaction between the teachers and the classmates when they aren’t in the same location [4]. The platform is also used as an electronic library that provides important books and resources that are difficult to obtain by students without subscribing to discreet international magazines such as ELSEVIER, IEEE[5].

Use virtual reality (VR) in E-learning provides the students with the ability of the visualization, dissection and interaction with the simulated objects in artificial 3-D space [6]. The use of the VR is commonly utilized in a variety of areas, particularly, computer science, medicine, and engineering [7].

II. RELATED WORKS

The present research has not been intended for surveying all of the published work on VR, instead it is solely focused on the educational methods.

In regards to geo-science education, Jiayan Zhao et al. [8] have created massive environment platform for the students with the use of the technology of Li-DAR (Light Detection And Ranging) and images for the reconstruction of Iceland’s Thrihnukar volcano. Data which has been imported from the OpenTopography.org portal has been transcribed afterwards to Unity-3D. The result of the simulation have been rendered and viewed in the HTC Vive headset. The 3-D volcano model has been produced in AgisoftPhotoScan Pro. This research has described in full details the required steps for getting the data, constructing the models and putting them to the VR environment. Moreover, this study gas leveraged the available progressive technology for the enhancement of the process of student learning without the need to go to dangerous places like within an active volcano.

M. T. Valdez et. al. [9], the authors present desktop VR for engineering applications, it has been mainly based on Wirefusion® software, and a VR platform which is referred to as the VEMA. Their project has been intended for improving the teaching and learning efficiency in higher education via sufficient application of the information technologies and learning sciences. The conclusions have shown the advantages of the integration of this novel model in one of the engineering courses, those methods might play a role in creating new learning environments, fostering collaboration and interaction and, in general, facilitating learning and teaching.

M. Chandramouli and J. Heffron [10], applied desktop virtual reality, research functionalities are utilized where students are capable of dynamically interacting with virtual worlds and learning programming in a step-by-step way. Therefore, for the sake of facilitating the fun-filled and interactive learning, this paper employed a user-friendly, learner-centric Virtual Environment (VE) for the sake of teaching the concepts of programming. The effect of this study has extended over the engineering and technology education due to the fact that this model can play a role of a tool for strengthening the STEM education and enhancing the overall literacy of programming.

L. Sharma et. al. [11], this study has presented an immersive application of virtual reality to teach the students about one of those complicated DNA structureconcepts. Building VEs showing DNA’s double helix structure and providing the students with the ability of interacting with it, offers an engaging and illustrative experience.

Grigoris Tziallas, Athanasios Kontogeorgos [12] designed and implemented an E-learning platform which utilizes the information of the departmental data-base for the automatic registering of students in classes, and the teachers as courses instructors. This platform enables the students to obtain information such as the passed course, the degrees of the past exams, also enables the teachers to obtain the statistical data about their students’ achievement.

Marek K. et. al. [13] presented the way VR technology and Computer Graphics (CG) is utilized presently by the industry for reducing the costs of production and eliminating the risky situations. Operator Training Simulators and Synthetic Environmental Trainers keep evaluating and monitoring the actions of every individual student, quickly characterizing the weak spots requiring extra attention while they teach the most efficient way and optimal working practices. VR simulators can enhance the cycle of training at the same time as providing a quite a high standard concerning safety consciousness and the enhancement of skills.

III. E-LEARNING IN MEDICINE

The utilization of the resources in the digital format is aimed at improving information access, particularly for the users who are in remote locations, which allows the scientific and academic community to share data at any time and in any place [14]. E-learning “is learning facilitated by means of the use of ICT (information and
communication technologies) social technologies, communication technologies, online learning platforms and other multimedia devices”. E-learning may be implemented in a global manner as a result of the increased availability of Internet in the majority of the businesses and homes and this may be made more affordable with bandwidth enhancements and improved platforms of e-learning [15].

In Medicine, Cadaver-based instruction survived as the basic instructional tool for centuries, none-the-less, there is a variety of viewpoints on whether the full dissection cadaver is still suitable for the modern training of the undergraduates. Limitations on the curricular time, resources, and trained anatomy faculty for beginner courses of anatomy in system-based or/and integrated curricula, resulted in numerous medical schools to discard the time-consuming and expensive dissection-based instructions in favour of some substitute approaches of instructions, which include medical imaging, multi-media resources, and living anatomy. Up until now, no sole tool of teaching was found to satisfy the requirements of a curriculum. The optimal way for teaching innovative anatomy is through the combination of several resources of pedagogy for complementing each other, students seem to be learning with higher effectiveness in the case of the integration of the multi-modal and the system-based methods [5].

IV. BACKGROUND OF VR APPLICATIONS

Virtual-reality (VR) has been used to train professional in many different domains (e.g., medicine, military, and fire fighting) since its early years[16].

Applications of VR in education may be categorized based on the visualization and interaction devices into two general classes: (a) non-immersive(the common "window in the world"), where user’s vision of the world is through the computer’s flat screen which acts like a “window”; and (b) immersive, entirely presenting the virtual world to the user through the use of the glasses with 2 small screens that are located before user’s eyes. Every one of the previous classes is divided as well to the sub-categories below. On one hand, non-immersive resources are categorized based on the type of the device which is utilized to interact with virtual world: (a) through the use of the traditional computer peripherals, such keyboard or mouse. and(b) through the use of specially devices of interaction, which are similar to the devices that are utilized in real controls, such as the vehicle control cockpits and machine operation consoles. However, the Virtual Reality immersive applications are sub-divided as well to 2 sub-categories, based on the system of visualization of virtual world: (a) the head-mounted display (HMD), consisting of the active glasses with a small monitor which is properly located in front of every eye]; and (b) the virtual CAVE(cave automatic virtual environment), in which the virtual world is displayed on ceiling, walls, and floor of the room through a variety of stereoscopic projectors. In this case, the user has to wear passive stereo glasses for the sake of achieving a 3-D virtual worldview. [6]. Desktop VR may be implemented with WebGL, WebGL short for Web Graphics Library, is an innovative API, which is based on the standard of the Open-GL ES2.0 combining HTML-5 with Java-Script and providing a 3-D accelerated Canvas rendering elements in the HTML-5 with the use of OpenGL Shader Language (GLSL ES) [17].Figure1 show VR resource classification.
V. PROPOSED PLATFORM

The proposed platform is an E-learning platform for the anatomy laboratories that contain pages which are classified into public and private pages, these pages have been built by depending on the instructional design model (ADDIE).

The users of the proposed platform which are visitors, teachers, students, and admin have several responsibilities that is determined by the platform as illustrated below:

- **Admin**: The admin is the user that is given the highest level of responsibility to enable him to manage the Platform and the Database.
- **Teacher**: The teacher has been given the responsibility that enables him to add course, delete course, edit course, add exam, evaluation, and chat.
- **Student**: The student has been given the responsibility that enables him to view course and 3d models, give exam, chat, and evaluation.
- **Visitor**: The visitor has been given the responsibility that enables him to view and read the information about the content of the platform.

VI. ADDIE MODEL

The proposed platform built depending on the ADDIE model, the five phases of ADDIE model will be explained in details as follows:

6.1. *Analysis phase*

The phase of the analysis will be split to the following stages:

- **First Step**: in this step, interviews are made with the teaching staff for collecting more information on their goals, needs, problems, challenges, and the teaching materials are gathered and arranged to be inserted in the suggested platform.
- **Second Step**: in this step, most widely used platforms of E-learning are analyzed and compared among them for obtaining beneficial data which helps preparing the proposed platform. (Analyze the platform environment, and what are the negative and positive aspects to be able to deal with).

6.2. *Design Phase*

In this phase, the E-learning platform is being drawn by using Sitemap diagram which specify the structure of the platform.

Figures 2, 3 and 4 show the pages that the visitor, teacher, and student can reach.
6.3. Development Phase

In this phase, the platform will be changed from a layout to a real platform by using (Html, CSS, JavaScript and ASP.) in Front-End, (IIS,C#) in Back-End, Sql-server for DataBase and (C4d,webGL) for virtual-reality. Figures 5, 6, 7, 8, 9, 10, 11, 12 and 13 show the some details of the contents of the platform.
Figure 5. Header and First Sections of body for the Public Home Page

Figure 6. Header and First Sections of body for the Public Home Page for teacher
Figure 7. Header and First Sections of body for the Public Home Page for student

Figure 8. The different viewpoints of skeleton Modeling in VR page: front, back, top, bottom, right, and left
Figure 9. The different viewpoints of heart Modeling in VR page: front, back, top, bottom, right, and left.

Figure 10. The different viewpoints of brain Modeling in VR page: front, back, top, bottom, right, and left.
Figure 11. The different viewpoints of skull modeling in VR: front, back, top, bottom, right, and left.

Figure 12. The different viewpoints of stomach modeling in VR: front, back, top, bottom, right, and left.
Figures 14, 15 and 16 show flowchart of platform users (Visitor, Teacher and Student).
6.4. Implementation Phase

the Implementation stage alludes to the real conveyance of the direction. At this stage, the proposed platform has been transferred from local web server into public web hosting server for the experiment to work properly on the
Internet And use the Web Hosting Services (SmarterAsp.Net) that has been chosen depending on the following factors (Bandwidth, Compatibility, Reliability and Availability, Security). After the platform was available on the Internet, teachers and students were trained on how to use the platform and take advantage of its materials.

6.5. Evaluation Phase

In this phase, two kinds of evaluation are done:

- Formative evaluation, where in which the evaluation is done during the phases, and between phases for improving all the phases prior to the implementation.
- Summative evaluation, where in which the evaluation is performed after the implementation phase for measuring the whole platform. In this evaluation, the proposed E-learning platform has been presented to a group of teachers and students in of Higher Health Professions Institute to evaluate the effectiveness of the platform as shown in the fig.17 and fig.18

![Teachers Evaluation](image1.png)

Figure 17. percentage of Teachers Evaluation

![Students Evaluation](image2.png)

Figure 18. percentage of Students Evaluation

VII. CONCLUSIONS

- The proposed platform can be used as a blended-learning environment for the human anatomy laboratory based on the desktop virtual reality.
- VR-assisted learning has been found to be much more effective, compared to current practices, which rely on two-dimensional approaches, in helping students to examine and understand the complexity of anatomy.
- The proposed system increases student interest and motivation towards learning and understanding the exact details of human anatomy and encourages teamwork.
- The proposed platform supports the development of the e-learning platform in Iraq by designing the platform to help students visualize the anatomy structure through 3D models, 3D images, video lectures, e-books and communication opportunities between teachers and students anytime, anywhere.
REFERENCES


