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VIRTUAL CAPSTONE WORKSPACE

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Abstract - Virtual reality aims at immersing a user in a virtual environment. Dedicated virtual reality technologies of human-computer interaction enables linking the user and a virtual environment in capturing the user's motion.

Our primary purpose is to improve communication between the students, especially the team members in STEM schools in Egypt. The application supports students in the capstone project for each grade. It is supported by tools to make a simulation for the project. Also, it is supported by a virtual reality headset. As we mentioned, VR is used in many fields, and it isolates the person from the surrounded environment altogether. VR is used instead of Anesthesia because of its effect in isolating humans from the surrounded environment. That will increase communication and concentration between the team members and make them feel that they are in an actual meeting. Every person will have an avatar in the application represent him. This avatar will translate every member's motion in the meeting by the sensor in the VR headset. A mic supports the VR headset. Every team will have a specific room, this room is where they can make all meetings, and all the work, achievements, and updates of the group will save in this room. Also, the application work as a director for the work.

Index Terms- Virtual Reality, Unity, 3D environment, VR Headset, capstone director, prototype simulation tools, strengthen communication, sketch up, PhET.

I. INTRODUCTION

A year ago, the world faced one of the biggest challenges, that is COVID-19 pandemic. The virus has enormous effects in different fields especially learning. To be more specific, we will discuss learning in STEM schools and how the virus affects it. This year, STEM students' schools can't go to school all the weeks. So, one of the hard challenges to each capstone group this semester is to meet according to everyone from different government. Online meetings are done, but it is the weakest benefit option. We need a real interaction to discuss the shape of the prototype, test plan, results, and materials. We attempt to solve one

of the biggest challenges in the period of COVID-19 to STEM schools' students by creating a "virtual capstone workspace" mobile application. The application supports capstone work in many different ways.

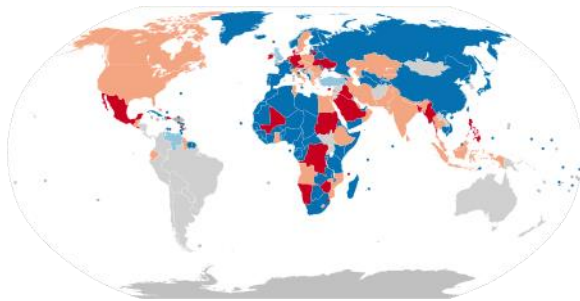
II. PROBLEM

In response to the covid-19 pandemic, most governments refuge to temporarily close the schools and universities attempting to reduce the spread of the virus. Fig (1) demonstrates the impaction of the pandemic on education in different countries around the world. Approximately 825 million learners are currently affected due to the pandemic. Moreover, this educational crisis leads to far-reaching economic and societal consequences.

To address this problem, the world has been directed to online learning as the only option for students to learn over distances. Digital learning has proved many advantages and allowed students to study on their own for free. However, E-learning is challenging for students in concern of experiential learning. A study was done in Pakistani highlighted that online learning cannot produce desired results in most of the countries due to a bunch of reasons; the lack of face-to-face interaction with the instructor, response time, and absence of traditional classroom socialization.

An online Idea social survey we made on a sample of 30 students in STEM schools in Egypt, who depend primarily on experiential learning and capstone projects, showed that 96.6% of students face difficulties through their online classes and capstone meetings. Their problems due to lack of real interaction and surrounding distractions result in a little comprehension and weak follow-up for their project's advancements. These students have depended primarily on the Zoom platform to meet and social media applications like WhatsApp to discuss during the pandemic. Students' general performance in accomplishing the engineering design process during this period was extremely low with many problems due to the lack of real sense in video calls meetings ultimately. Besides, they were unable to deliver their ideas and imaginations through traditional online learning apps.

In analyzing the problem factors to resolve, we worked on three main components and integrated them on a software platform to act as a Workspace that students could work through. First, offering the real sense interaction by virtual reality technology. Second, enhancing the communication between students by setting the required tools. Third, backing up students by the scientific tools they need to can utilize to perform their capstone projects each semester.



(Figure1)

Learners affected by school closures caused by COVID-19 as of February 2021



III. BACKGROUND

Virtual reality is an artificial environment that could bring an individual into a virtual world that simulates or even superior to the real world. Immersive 3D VLE's allow learners to explore environments and situations that would be impossible to visit in the real world (e.g. the abstract—non-Euclidean geometry, or the physically impossible—the surface of Venus) or even to collaborate at different scales (Irawati et al. 2008). Virtual reality could do so through achieving immersion, Presence, and Embodiment. Immersion describes what technology transfer from an objective point of view. The greater the number of technologies that cover various sensory modalities, in relation to equivalent human real-world senses, the more that it is immersive (Bowman and McMahan, 2007). For instance, a VR display supported with HMD is more immersive than a 2D scene. Presence is the degree at

which a person begins to accept an artificial reality as a reality. Embodiment refers to the visualization of the body within space. The three main components of embodiment are (1) body ownership (sense that the body inhabited is one's own), (2) self-location (being in the place where one's body is located), and (3) agency (that an individual can move and sense their own body) (Borrego et al. 2019). A study done in Massachusetts Institute of Technology Age Lab investigated the impact of Virtual reality on older adults' well-being estimated that virtual reality has the potential to improve the quality of life for people getting them more socially engaging. In the context of school closures by Coronavirus, the technology of virtual reality could be utilized to make a virtual world supported with scientific digital tools, workspaces environments propped with the communication tools covering various sensory modalities of students allowing them to integrate and work on their projects. This capstone virtual workspace could open the gate for an evolutionary epoch of educational advancements where you could travel by your brain and visualize your imaginations to accomplish scientific projects.

IV. IDEA

As the problem is identified concerning experiential learning and doing capstone projects in STEM during the pandemic, the solution is set to deal with the problem achieving each component of real capstone meetings supported with higher accuracy in a virtual world. We built a mobile application that involves a meeting room for every grade in STEM high schools in Egypt. The room will integrate each capstone group in the destined Workspace. Team members are entirely immersed in their Workspace. An Avatar represents each member. They could talk and hear each other. Their motion also is transmitted by the Avatar via the VR finger tracking, which supports their VR world besides the Head Mounted displays, shown in fig (2), which they wear.

In the project's implementation, the Virtual reality Workspace environment, the user avatar, and the 3D simulation tools were built using Unity operating system. Second, virtual meeting rooms are supported with HMD, VR finger tracking, and other tools that enhance the interaction between team members. Third, the Workspace was supported by the digital scientific tools required for each grade. For instance, As the Capstone project in grade 10 requires a foundation in Engineering hence, the engineering design tools in programs like SketchUp and AutoCAD would be inserted and created in G10 capstone workspaces.

Similarly, since the capstone project of Grade 11 deals with water pollution challenges, their capstone workspace would be propped with chemical applications required to evaluate water parameters like PhET applications that simulate measuring water PH.



(Figure 2)

V. CONCLUSION

From the results and search, we can conclude:

1. We can test the application using a VR headset and compare the concentration and communication between students in regular meeting applications and our application. As a result, the communication rate increases approximately 47%, from 50% to 97%, the rate of concentration increases approximately 25%.
2. Virtual reality workspace can solve the problem of poor connection between students and strengthen communication and concentration.
3. Also, it is the capstone director. It works as a guide for students, and it reviews the work that the group achieves with EDP steps. Then, it saves the updates and allows each member of the group to reach these updates.

Table -1 Experiment Result:

The application efficiency has been proved by comparing students' performance in traditional online sessions and our application. These results have been calculated averagely by handing students some tasks and evaluate their comprehension.

	In traditional online sessions	Through "VCW" application
Efficiency of concentration	60%	92%
Efficiency of communication	25%-35%	85%-95%

Table-1 show the development in presents of focus and concentration in make a comprehension between the result of them in normal online session (zoom-google meet) and how the present raise in "Virtual Capstone Workspace" application.

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