The Role and Barriers of Virtual Educations and Labs During the Covid-19 Pandemic in the Educational Process

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Abstract
The Corona-Virus Disease 2019 (COVID-19) Pandemic has had a huge impact on virtual education. It is similarly challenging the educationists' ability to adapt to this whole exceptional circumstance. Considering the labs-based education and training for instance students who needs technical skills besides to their theoretical learning such as science, engineering and health professions are potential carriers. Nevertheless, the existing crisis is refreshing the need for online learning opportunities and virtual education in general and virtual lab in specific. Most education schools are chase respond to lockdown with a move to live, online or/ and video-based learning. Upholding standard in schools and universities education, preserving the teaching and learning on stream, and reducing the assessment disorder are an exceptional challenge under pandemic circumstances. Adaptation to this unusual situation is essential to formulate future laboratory studies for learning and training. This paper reviews some of a recent study that highlighted the importance of virtual education, including virtual reality and virtual ab, and the relationship of the virtual labs to e-learning, as well the potential implications of integrating virtual lab technologies into lab education for upcoming learning technical skills and assessment. Likewise, to discusses how this pandemic may influence schools and universities educational process.

Keywords— Virtual Education, Virtual Reality, Virtual lab, Simulation , COVID-19 Pandemic.

Introduction
Using the virtual learning to support teaching and learning has become a tendency in modern institutes of higher education. Virtual Reality (VR) is not a new technology, but numerous restrictions hindered its real adoption. VR is transforming the way individuals participate in events, exhibits, and experiences, as well as the environmental design process. Recent technological developments have made VR more applicable and widespread in many fields, including education. They have been resurrected along with latest undertaking used to be unimaginable.

The environment of VR promises latest teaching and learning styles for the 21st century that greater meet the learner requirements. One of the most obvious benefits of VR is transforming lectures into immersive learning experiences, enabling lecturers to truly bring their subject to life. Example of that physics students could explore the universe, and Civil engineering students could use VR to design buildings, as well history students could explore Roman ruins and so on. Currently we are on a route to re-enactment education and the most recently VR is having a moment under the COVID-19 pandemic by allowing us to feel closer to one another, moving us beyond the confines of social distancing, and connecting us to our coworkers and the world despite the necessary, however frustrating restrictions keeping us all at home and making remote working challenging. As the benefits become clearer, industry voices are taking note. The drive behind the virtual science lab was due to the limitations of the current learning environments related to science subjects' laboratories in Libyan's schools, and higher education. This paper reasons that the technology can be used innovatively to bridge this gap and report those limitations. The outcome will be a package of an educational environment for laboratory recommendations that modify the way science is taught and learned. Students interact with this ecosystem that meets their requests and delivers suitable support concluded feedback.

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In this study, the researchers investigate the need for virtual labs in schools and universities in Libya and offer some suggestions in how to propose a VL environment that enables students to conduct experiments and communicate with and access other relevant resources. All these studies, exposed several complications in performing the scientific experiments flexibly; therefore, the authors come up with the following questions: How to facilitate the education of science in Libya and make it more enjoyable? How to reduce the science laboratories' budget? How can the science education in Libya be in line with the developing technology?

The rest of this paper is arranged as follows: the second section provides background and a review of related studies. The third section presents the analysis of virtual education in further details, including the understanding the virtual reality and its uses, virtual labs, and the relationship of the virtual labs to e-learning. The fourth section shows the why virtual labs and is followed by the barriers that limit the use of the virtual lab and suggestions to, which are presented in sections five and six, respectively. Finally, the recommendations for future research are discussed in the seven section.

Related study

The usage of technology in education shows a crucial role in enhancing the education procedure and boosting its effectiveness [1,2,3,4,5,6]. It facilitates educators clarify and present material efficiently in an enjoyable manner and helps learners collaborate with their teachers, access to additional learning resources, and understand technical skills [1,2,3,4,5,6]. The VL is an educational environment that operates virtual technology and provides tools and visualizations that encourage the learners to participate and collaborate within the class. It is a good alternative for schools that cannot afford to build laboratories and provide equipment and tools.

VLs can similarly be used for training students' purpose prior to they conduct hands on experiments in real traditional labs. According to Bortnik and others study which investigated how chemistry VLs influenced student achievement level. They assessed achievement in two environments: a traditional environment (hands on experiments) and a blended environment (combination of traditional and virtual learning). The outcomes of this study mentioned that the students in the blended environment were more engaged than the other group and performing better [7]. Hence, the authors suggested using VLs as a supplementary tool to enhance students' studying and boost their investigation skills.

VLs have also been used successfully in specialized sciences, such as biology, engineering, computing, etc. An excellent example of using VLs in the pedagogical approach is MyDNA VSL. This is used for developing the concept and process of DNA fragment separation within the biomedical topic of the 'Cellular Machinery' course, which is taught at an engineering faculty in a large research university in the United States. With MyDNA VSL, students can efficiently run repeated experiments and study the effects of different variables [8].

A range of studies has shown a positive effect of virtual education experiences for learning during the COVID-19 pandemic [9,10,11,12]. According to Tabatabaei study mentioned that the pandemic has had an incredible effect on medical education. Also It is challenging the medical educationists' ability to adapt to this whole unique situation[9]. Considering the hospital-based education, clinical mentors, and students in all health professions are potential carriers. Also the author highlights the importance of virtual education and the potential implications of integrating virtual simulation technologies into medical education for the future of clinical competency learning and assessment [9].

Currently when monitoring the situation of science education in Libya these today, crucial issues can be seen, for instance the shortage of laboratory kit and the grant required to provide resources for each learner, and the risks related with conducting some technical experiments. These concerns indicate that learners rarely use their knowledge practically and tend to obtain knowledge via theoretical approaches [13]. Moreover, due to restricted lab space, learners cannot conduct experiments which forces them to just view trials rather than doing them. In brief, learners cannot perform scientific and technical experiments in a practical, enjoyable, and safe manner, hence, Libyan schools and universities require an alternative lab environment that helps learners combine the theoretical aspects with the practical ones, which should be the main concern for Libya education system during this pandemic and upcoming future of education and training.

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There is still a need for VLs that contain all the experiments found in schoolbooks. In this paper, the researchers examine the need for virtual science labs in schools and higher education in Libya and suggesting the use of available free sources and tools of learning environment that enables students to conduct experiments and communicate with and access other relevant resources. All these studies, exposed several barriers in performing the scientific experiments flexibly; so the authors come up with the following questions: How to facilitate the education of science in Libya and make it more fun? How to reduce the science laboratories' budget? How can the science education in Libya be in line with the developing technology?

Virtual education analysis

Virtual education can be defined as an instruction e-learning environment where instructors and students are separated by either time or space, or both, and the educators provide their course content through learning management system using multiple applications and multimedia resources such as communication tools, live online or videoconferencing, etc [1,2,3,4,5]. Students receive the content and communicate with the teacher via the same technologies such as live online or video-based learning [6]. Moreover, the major and unexpected benefit of virtual education can be signified as:

- It might prepare students with the skills needed for modern careers via collaborating online [20].
- An expanding classification of jobs will require employees to work in geographically distributed, virtual teams [20].
- Many students may have enough experience, focus and self-discipline to learn digitally [20].

Terminology of virtual reality

Virtual reality (VR) can be defined as a system in which users feel that they are in a virtual world with varied tools and the users interact with this world [11]. VR is a powerful tool in supporting and facilitating teaching and learning processes. Many surveys and reports show that most students remembered what they saw in VR and concluded that VR is a more memorable environment than laboratory-based demonstrations [12,13]. Basing of the wisdom of Confucius who said that "Tell me and I will forget, show me and I may remember, and involve me and I will understand". The practical part had been made a priority. Therefore, VR is very practical for many fields of activity such as education. Its applications in education enable learners to learn by doing, also Allow learners to gain experiences that are dangerous or impossible for them to obtain in real life. Based on these the goal of VR is to enhance a person's performance and perception of the world. Therefore, VR is a key innovation for future educational environments [11].

According to a study, several application domains, such as health-related, engineering, science and general-purpose educational tools, were notably more prevalent. It was noticed that this trend has been occurring up to present; thus, in this section, we present the most interesting and recent applications related to those educational non education domains as illustrated in Figure1.

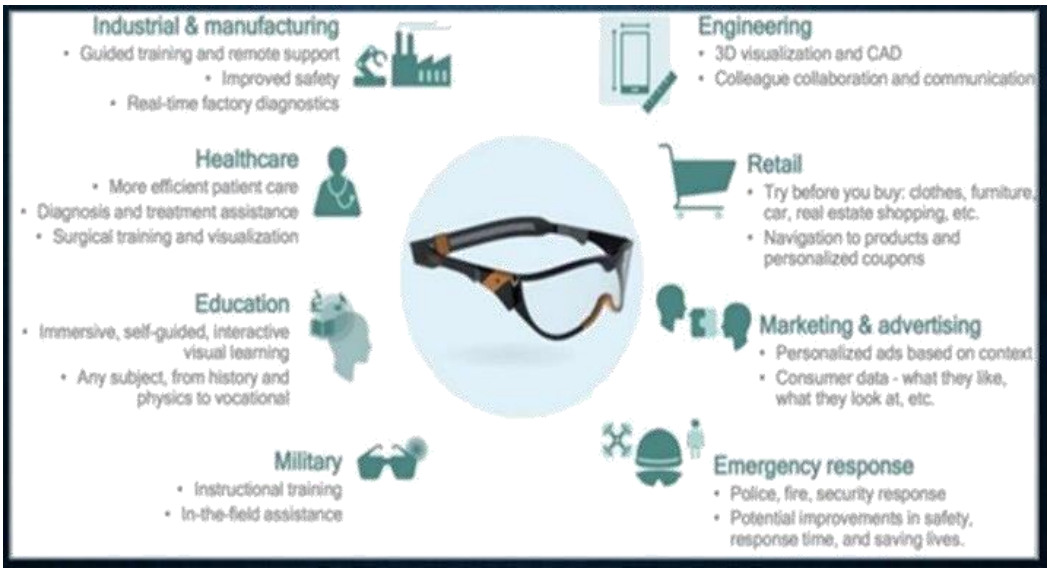

Figure1. Applications related to educational and non-education domains

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As per investigation conducted by Kavanagh and others [14] in order to investigate a total of 99 papers implementing educational VR software. Their result showed a several application domains, such as health-related, engineering, science and general-purpose educational tools, were notably more established [14]. So. It is key to present the most interesting and recent applications related to those educational domains such as (*Engineering Education, Complex Educational Topics, Space Technology, Mathematics, and General Education).*

Terminology of virtual lab

Virtual labs are simulated learning environments permit learners to carry out lab experiments online and discover principles and concepts without access to the physical sciences laboratory. Learners can experience laboratory procedures to become more familiar with advanced laboratory equipment for the first time, that may otherwise be inaccessible [15]. Through simulations, learners can look inside the machines they are operating. and discover life sciences at the molecular level. Virtual lab software creates opportunities for alternative access to science education [15]. VL can be defined as a computer simulation enables the implementation of the basic functions of laboratory experiments, which attempt to represent real laboratory experiments as closely as possible to a computer [16]. Virtual laboratory simulations are commercially available to train students; these creative resources are available to complete remotely without traditional time and safety restrictions of laboratory based practical classes [17].

A laboratory that simulates a real school / university laboratory in functions and events, and through it, the laboratory activities that usually occur in the real laboratory (physics, chemistry, biology, ... etc) can be practiced through devices, tools, and 3D virtual court materials [16]. The Virtual Science Lab (VSL) is a web-based platform designed to improve learning approaches by introducing a safe and interactive lab environment for students in middle schools in Saudi Arabia. VSL was found to be an exciting, useful, and enjoyable learning environment during user trials. It allowed users to conduct experiments individually and to repeat them multiple times if needed [18]. A type of program that allows many interactive multimedia, which may be in the form of static texts, forked texts, sounds, images, video clips, drawings and illustrations, so that they interact with each other [16].

Figure2. Examples of virtual labs

Figure 2 illustrates an example of virtual labs and shows how t computer programs that allow students to conduct laboratory experiments on a computer and provide opportunity, time, and scientific thinking skills, and focus on higher skills, such as analysis, synthesis, and evaluation [16]. Therefore, there is a need to develop practice in virtual placements. Libyan schools and higher education students need to be better prepared for the workplaces where they will earn their living, while businesses need more capable employees [19,20]. Physical placements of students in businesses depends on a network of local connections, the location of placements is restricted by the high costs of relocation and living expenses at any significant distance from the home institution. Virtual labs can overcome these limitations.

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The relationship of the virtual labs to e-learning

Virtual labs are considered one of the *virtual e-learning environments* in which the usual real school / university laboratory is simulated in its functions and events, and through which the student performs laboratory activities that usually occur in the traditional laboratory [16]. The *main pillar of e-learning* is in the practical and applied field. Various electronic programs are used to simulate computer experiments using different images and graphics that express the experience intended to be implemented and created [16].

Why virtual labs

What differentiates science from other subjects is that it is an empirical field that involves conducting experiments in science laboratories. A laboratory equipped with modern equipment increases students' motivation to learn and enhances the teaching process [21]. Virtual labs are a type of technology that needs be brought into classrooms to enhance current teaching and learning methods [22]. The current teaching and learning labs have many limitations can be classified as **:**

***Lack of Accessibility*:** Because of limited lab access many students in school and university cannot get the necessary lab equipment. Whether it is due the high cost of specific equipment, or to social distancing during the coivid-19 pandemic or many schools are unable to teach essential lab techniques.

Lack of Availability: Due to limited time of availability in traditional labs many experiments are time-consuming, and lots of time can be wasted on waiting for experiments to complete. Additionally, students sometimes finishing experiments quickly due to the pressure feel. Consequently, students' attention can shift from learning the experiment to just getting it done.

Lack of Safety A very few students have unlimited time to spend in a lab due to safety, time to repeat and cost reasons.

Low of motivation and engagement: Traditional teaching and learning with a passive learning environment dramatically reduce students' motivation to learn and engage in the content of their course. Besides, students be likely to become disengaged if they cannot see or understand the real-world relevance of what they are learning. So, this kind of teaching and learning ending up with unmotivated students, some of whom eventually drop out.

Therefore, virtual labs are a type of technology that needs to be brought into current and traditional teaching and learning classrooms in Libya to enhance current situations. Virtual labs have many advantages compared to traditional labs. The VL can be used by many students, at the same time, anytime, anywhere lab, restricted only by the computational power of the host computer. It is also more robust than real equipment; a student cannot destroy the hardware whilst adjusting some settings or failures in programming. Accessible through Internet on any PC/Laptop, Surprisingly even on your smartphone tablet. Another benefit is budgetary [23]. The system can be easily duplicated without paying additional cost. Over 100 Virtual Labs have already been developed, developed in self-learning mode with inventive experimentations.

Evidently, virtual labs also have disadvantages in comparison to real labs. A virtual lab can never perform the same as real hardware in all cases. As it is impossible to include all environmental parameters in the virtualisation, a virtual lab will sometimes react differently to a real one. Also, the internet gab is real."…That rural Internet divide is real. mean it's a real problem right now in America," says Caroline Weathers, who teaches in a small town in South Carolina. Her area provided out hot spots, although in certain locations they didn't work for the reason that there wasn't cell service from the major carriers [17]. As well as current crises of Covid-19 pandemic, and have impacted the a number of students and whole education system . According to the latest figures released by UNESCO, some 1.3 billion learners around the world were not able to attend school or university as of March 23, 2020 as illustrated in Figure 3 refer to learners enrolled at pre-primary, primary, lower-secondary, and upper-secondary levels of education, as well as at tertiary education level[16] .

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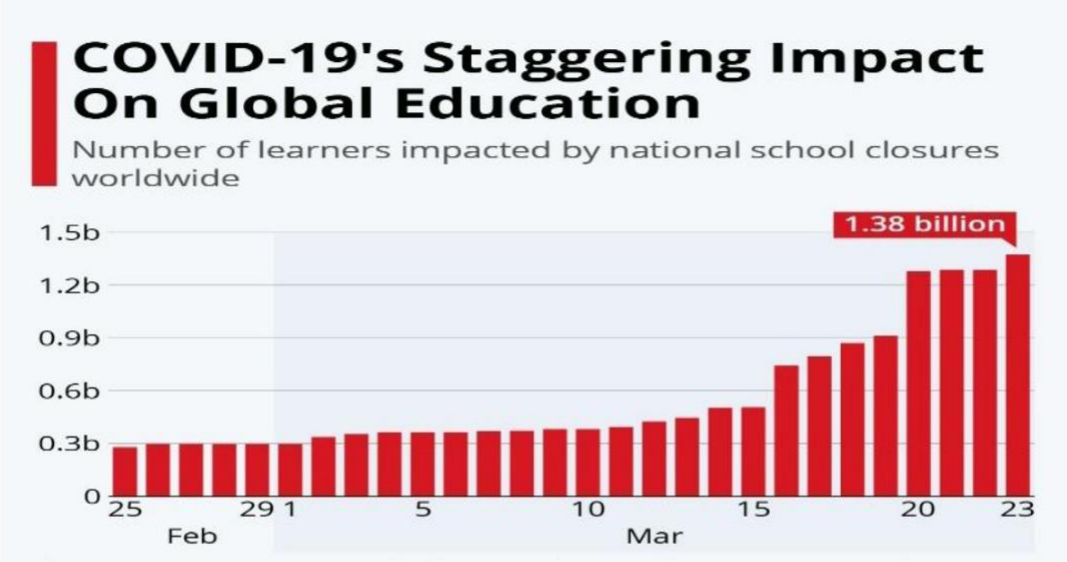

Figure 3. Number of learners impacted by national school closures [16]

Barriers that limit the use of the virtual lab

The teaching of science in Libya has many barriers that affect teaching and learning activities and reduce students' creative skills, such as the limited time of science lessons, teachers' schedules and the large number of students in the laboratory, which leads to their inability to follow up on the experiment. some of the barriers that limit the use of this technology such as in:

Infrastructures

- Internet gap is real in because there is n't cell service from the major carriers, in many cities and towns [17].
- The digital gap is still big and complex [17].
- Computers and equipment with special specifications are required to clearly represent complex phenomena.
- Its design and construction require a specialized team of programmers, teachers, curriculum experts, subject experts and psychologists.
- The lack of virtual laboratories that rely on the Arabic language to deal with them.
- Shortage of real interaction with devices, tools, materials, teacher and colleagues.

Students

- The digital gap is still big and complex "…*The National Education Association recently reported, based on pre-pandemic census data, that one quarter of households with children ages 5 to 17 lacked either high-speed Wi-Fi, a computer or both. For households near the poverty line, the number was closer to half…*" [17].
- Many Students suffer a type of unequal access whereby they lack the digital connections (Skchelak and Stack 2017).
- This outbreak expands the gap between those able to access online learning opportunities and those who are not.
- Some students are not learning much online. They 'll be playing catch-up in years to come [17].

Teachers, schools, and universities educators

- VL teaching can be good, even great with the right support for teachers. But that's far from the norm [17].
- In the state of emergency, schools and universities educators as role models are facing major challenges to train as the next generation of graduation.
- Continuing standard in medical education, keeping the clinical learning on stream, and minimizing the assessment interruptions are unique challenges under pandemic conditions.

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Suggestions

Determining schools and higher education main concern during the pandemic: As the COVID-19 outbreak has speedily transitioned, ensuing the social distancing practices, keeping students safe, supported and engaged, and helping keep education programs moving forward with high quality, are the education systems' priorities. through the following suggested steps:

How to shift to the virtual education?

Defining education main concern during the pandemic

As the COVID-19 epidemic has promptly transitioned, subsequent the practices of social distancing, preserving students safe, supported, motivated, and engaged, and assisting to continue educational process progressing ahead with quality, are the education systems' main concern.

Evaluating available resources

There are free digital learning management systems offer free platforms which help educators to manage and provide online lessons and courses. Also, massive open online courses deliver free online courses and lessons designed at the specialized enhancement of instructors. Besides, the availability of many other free tools facilitating webinars, video , chats, video communications, and audio conferencing for educators such as Skype, Zoom, and Google Hangouts Meet [2 4, 25]. These online tools help communication, collaboration, and the sharing of expertise between schools, universities and providers [1,2,3,4,5]. However, concerned their related issues.

Determining challenges and related solutions

This pandemic expands the gap between those able to access online learning opportunities and those who are not. Many Students suffer a type of unequal access whereby they lack the digital connections [28]. Maintaining performance standards and quality assurance are unprecedented challenges under pandemic conditions.

Prediction

The newest revolutions in adaptable educational technologies will shift the future of schools and universities education [29]. However, Virtual education need thoughtful thinking about how educators are equipped for the shift, in order to delivering a motivated, enjoyable, engaged and quality schools and universities education.

Preparing for future transformation after the pandemic

The long-term impact of the current pandemic on education could be considerable. To maintain quality education, administrators and educators forced to look for innovative technologies. Educationists will need to use emergent technologies which impact on the future way that their institutions will provide education [30]

Adaptation to this new situation is necessary to prepare future clinicians for practice. In this unprecedented time with continue moving forwards, we would suggest that schools and universities should have a duty to provide ongoing education to their students. The continuation of teaching is crucial to allow the future graduations into society. The evidence suggests that virtual teaching is effective, and institutions are working to develop these resources further to improve student engagement and interactivity. Moving forwards, student faculties need to adapt a more holistic approach to student education and consider the mental impact of COVID-19 on students as well as improve the security and technology of virtual platforms.

Conclusion

We must change to the new situation to prepare future education for practice under pandemic conditions. Educational approaches are changing and new fields of sciences and technological innovations, as well as educational technologies, are developing. Nowadays sciences and engineering students are digital communities and rely more and more on virtual education and virtual lab simulated experiences. Virtual lab simulation products are the bases for simulation-based virtual education that are urgently needed by many instruction programs. Simulation based virtual education has the potential to ensure that transformative developments continue to benefit education across the world. We need new innovative strategies for utilizing the education system to support uninterrupted education and assessment. Considering the benefits of virtual lab and simulation-based technologies, schools and universities administrators should invest in simulation-based virtual educational products to keep the technical competency education and assessment on stream.

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Recommendations for future researchers

The potential to overcome several of identified problems, including cost, user experience and interactivity and so on. Also, these technologies are not without their own issues. Hence here are some suggestions and techniques to potentially address them, and a prospective direction for future researchers such as

- How can the new VL capabilities make the residential knowledge more effective?
- We need new innovative strategies for utilizing the education system to support uninterrupted education and assessment
- Adapt a more holistic approach and consider the mental impact of COVID-19 on students as well as improve the security and technology of virtual platforms.
- Considering the benefits of virtual lab and simulation-based technologies, university administrators should invest in simulation-based virtual educational products to keep education and assessment on stream.

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