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Virtual reality environments as a tool for teaching Engineering. Educational and Psychological issues

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Abstract. Virtual reality is widely used in the sector and is getting cheaper for consumers every day. Students want to be well-prepared for their professional careers while also anticipating additional courses that will allow them to put the theoretical knowledge they have acquired during their studies into practice. They also gain significantly from the chance to develop their soft skills. In specifics, around half of all VR resources are used by engineering applications that rely on VR (considering the research works published up to latest years). This essay outlines the instructional strategy for a graduate and undergraduate level practical virtual reality course. In this essay, we argue and provide data from extensive study to support the claim that VR is a great teaching tool for engineering. As a result of our analysis, we concluded that VR has advantageous cognitive and pedagogical effects on engineering education, which ultimately enhances students' performance and grades as well as their educational experience. Through the employment of VR as a substitute for physical laboratories, the university, the institution or professional school also reaps benefits in terms of decreased responsibility, infrastructure, and expense. Additionally, kids with special needs and those who learn remotely and don't have access to physical laboratories can both benefit from an equal educational experience. The paper is structured to emphasize learning about virtual reality through the simulation of multidisciplinary industrial projects and seeks to foster skills like cooperation, working in interdisciplinary groups, time management, and taking a logical approach to real-world engineering challenges. It is important to note that the results of this study may be generalized to other knowledge domains with ease and without losing any generality, as opposed to being based on applications employed in the engineering profession.

Keywords. virtual reality; engineering; VR labs; education; soft skills; special needs; simulation

1. Introduction

Since its inception in the 1960s (Sutherland, 1965), virtual reality (VR) has been used in a wide range of industries. The amount of research articles that include the term "VR" as their primary study topic is a straightforward sign of this expanding use of VR. Particularly in three separate fields, computer science, engineering, and medicine a definite upward tendency is seen. The engineering discipline has the greatest number of VR applications that have been reported in academic publications among these fields.

In the field of engineering, VR is currently being used successfully in engineering education due to its many benefits, including: i) allowing for the real-time simulation of the use of otherwise unavailable expensive laboratory equipment (Vergara D., Rubio M.P., et al., 2016); (ii) preventing potential damage to a real machine from student misuse during practical classes (Vergara D., Rubio M.P., et al., 2016); (iii) VR addresses the challenge of creating practical lessons in a real laboratory setting when the groups are crowded (Vergara D., Rubio M.P., et al., 2016); (iii) VR enhances the prevention of occupational hazards (Tuan Q., Pedro A., Rok, et al., 2015); and (iv) VR enables the students to interact with complete manufacturing processes, which would be practically impossible in any other setting (Batista C., Seshadri V., Rabelo R.A., et al., 2017).

Additionally, VR is appealing as a cost-effective replacement or supplementary solution to the more expensive and sophisticated laboratories used in education due to the reduction in costs from an expensive technology available to a niche of researchers (Zinchenko Y.P., Khoroshikh P.P., Sergievich A.A., et al. 2020) to one that is available to consumers at an affordable price. As a result, this research examines data from several publications, including some that use VR laboratories and contend that the learning experience is superior than traditional (Winkelmann, K.; Keeney-Kennicutt, W., et al., 2020) while others contend that it is at least comparable (AlAwadhi S., AlHabib N., Murad D., et al., 2017). Last but not least, the benefits of being both cost-efficient and equally effective as the physical laboratory opens up new opportunities for improving distant and remote learning, giving institutions a competitive edge in their use of technology in education and global offers (Marios A. Pappas, Eleftheria Demertzi, Drigas, A., et al., 2019).

Despite this, incorporating VR into university/professional schools curricula has tremendous pedagogical and financial potential benefits, particularly when you consider the improvements to learning and the possible cost savings and extension of experimental offers. Therefore, this study carefully gathers, researches, and evaluates the most recent publications in terms of VR application in education, benefits, downsides, and research gaps, and utilizes them as justification for the usefulness of VR for engineering education (Papoutsi C., Drigas A. & Skianis C.,2021). The results are important because systematic reviews that are analyzed indicate that there is a lack of VR technology deployment, which significantly limits the educational advantages for students in general education and engineering education in particular. As a result, this review study confidently recommends a theoretical strategy to narrowing the gap and realizing the full potential of VR in engineering education based on an analysis of existing research publications using inclusion and exclusion criteria.

2. Application History of VR

Three-dimensional VR applications range widely in complexity, from the comparatively straightforward, e.g., didactic virtual labs (Drigas, A.S., Vrettaros, J., et al., 2005) to the extremely sophisticated (e.g., immersive virtual reality training for military personnel. Generally speaking, VR applications for education can be divided into two broad categories based on visualization and interaction tools (Wang P., Wu P., Wang J., et al., 2018): i) non-immersive (the well-known window in the world), where the user's vision to the outside world is through the flat screen of a computer acting as a "window" and (ii) immersive, which fully immerses the user into a virtual world by using glasses with two small screens placed in front of the user's eyes (Figure 1).

The following subcategories are also separated into each of the preceding groups. On the one hand, non-immersive resources are divided into two categories based on the type of device used to interact with the virtual world: i) by using traditional computer peripheral devices, such as a mouse, keyboard, etc. (Arnay R., Hernández-Aceituno J., et al.,2017; Batista C., Seshadri V., et al., 2017) and (ii) by using specially designed interaction devices that are similar to the ones used in real control, such as machine operation consoles or vehicle control cockpits. The virtual world's visualization system, on the other hand, further divides VR immersive applications into two subcategories: i) the head-mounted display (HMD), which consists of active spectacles with a tiny screen placed appropriately in front of each eye (Figure 1) (Górski F., Bun P., et al., 2015) and (ii) the virtual

CAVE (cave automatic virtual environment), where the virtual world is projected on the walls, ceiling, and floor of a room by diverse stereoscopic projectors (Figure 1).

In this final instance, the user needs passive stereo glasses to get a 3D perspective of the virtual environment. The primary drawback of the virtual caves is their expensive price, which limits the application of this sort of immersive VR. On the other side, using an HMD frequently results in some form of cyber sickness.

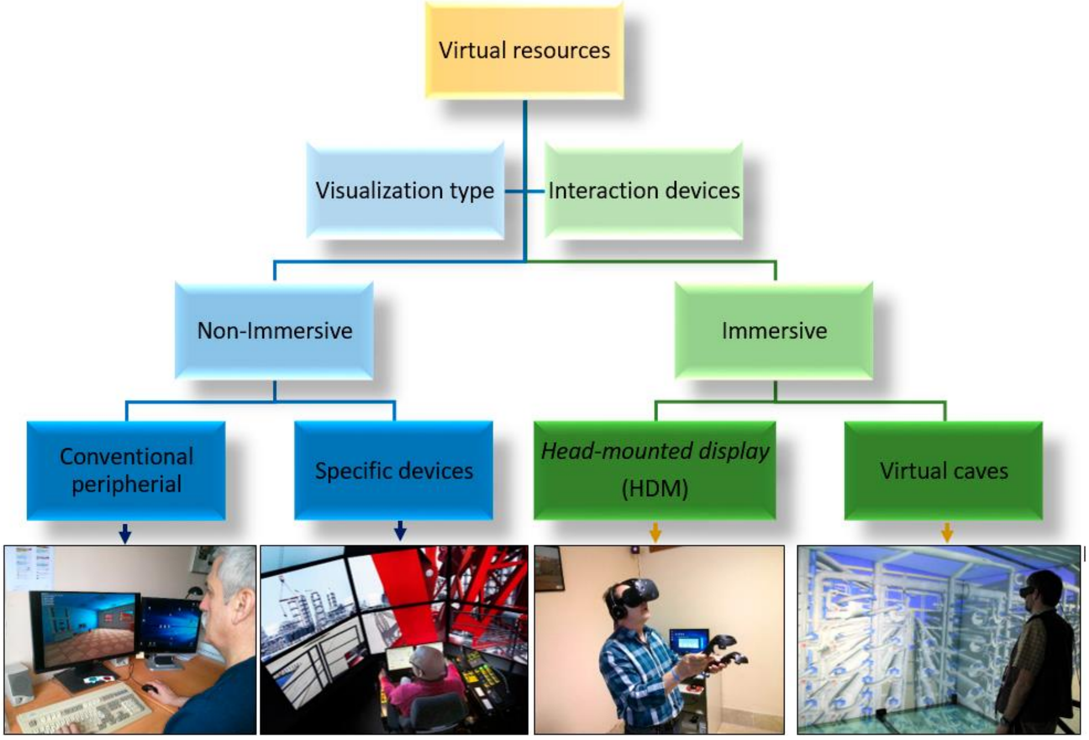

Figure 1. Classification of VR materials based on interaction and viewing methods.

The most popular resources recently developed in the field of engineering education are based on 3D Virtual Laboratories (3D-VLs) (Vergara D., Rubio M.P., et al., 2016) as these tools address several issues frequently associated with practical classes in engineering laboratories, such as i) the risk of using products or machines, (ii) crowded classes, and (iii) timetable availability of the laboratory. As a result, 3D-VLs let each learner to complete their individual practice and acquire an experience that is quite similar to the actual one. Additionally, many 3D-VLs allow for the inclusion of questions or exercises in order to assess the teaching-learning process and offer technical results that are comparable to those attained in a real practice.

Although 3D-VLs are still used, VR is more often used in engineering education. On the one hand, VR applications concentrate on the design and simulation of an engineering project, which are based on both the interactive verification of the generated results and the usage of methodologies (Drigas, A.S., Vrettaros J., et al., 2005). However, additional VR applications work to enhance understanding of a variety of topics, including spatial comprehension of abstract concepts, complicated three-dimensional graphics, manufacturing, operation procedures, assembly, etc. Last but not least, beginning almost 20 years ago, serious games have also been connected to VR learning settings, and as a result, these environments have been shown to increase student motivation by gamifying the teaching-learning process. Additionally, VR supports kinaesthetic learning and other embodied learning components.

3. User Interaction and Control Level

A VR application's interface and design challenge may be divided into three categories: i) passive; (ii) exploratory; and (iii) interactive (Aukstakalnis S., Blatner D. and Silicon M., 1992).

- Passive: User engagement with the VR environment is minimal. Such a setting is comparable to a movie but in an immersive 3D setting. The user has no influence over what takes place. However, the interaction can involve several senses, including sight, hearing, and even touch, and the user is free to choose where to gaze (feeling what is happening around him). 360-degree videos are the most typical form of passive VR (Borisov, N., Smolin A., Stolyarov D., et al., 2017).
- Exploratory: The user may roam around the virtual world and pick where to gaze in this interaction type thanks to the VR environment. Although functioning and immersion appear to have greatly improved at this level, little interaction and environment control are available. In the virtual environment, users can move around and see where they are, but they cannot touch. For illustration, one may cite architectural tours or the most basic virtual museums (Kabassi, K., 2017).
- Interactive: High levels of user involvement are present in the VR experience. Users may explore, manage, and even change the virtual environment in such a setting. The degree of interaction can differ significantly based on the I goals that are meant to be achieved, (ii) number of senses that are engaged, (iii) hardware that is available, and (iv) programming software that is being utilized. This level includes most of the current VR apps.

4. Design of VR Applications

Some important concerns should be through before starting the design and development of a VR application: The utilization of such a VR resource must i) increase motivational behaviors that result in more effective learning, and (ii) the work necessary to design such a tool must be worthwhile (in essence, it depends on the computational advances of the moment). The VR resource shouldn't be created in this situation if the response to either of the above queries is no. Because of this, not all knowledge domains have specialized applications, and as a result, the utility of VR has not yet been properly investigated in many sectors. The 3D simulation of environments and processes is the current primary use of VR technology in engineering, and it is the emphasis of this study (Pappas M., Demertzi E., Drigas A., et al., 2018).

The first stage in creating a VR application is defining and choosing the precise goals that the technology will be used to accomplish. Then, only those desired goals that might be achieved by computer simulation are chosen out of all possible goals. Choosing which of the targeted goals might benefit from a 3D interactive simulation is the next stage. In this manner, the VR will be useless if none of the goals are achieved. The following phases make up the process of developing a VR application when the viability of using VR to explore the selected topic has been determined (Figure 2):

- Choosing the appropriate amount of realism for attaining each goal, ranging from very symbolic or schematic to very realistic.
- The degree of user involvement with the VR environment defines i) the senses engaged (e.g., tactile, acoustic, or visual alone), and (ii) the level of control and immersion that the user will have.

- Choosing the hardware and software programming that, in light of the alternatives chosen in the preceding phases, best meet the objectives suggested.
- The virtual environment is then designed, the interactive elements are developed, and a VR application is created. For a VR experience to be as authentic as possible and to prevent cyber sickness, it must be taken into account that speeding up response time is crucial (as in any computer program).
- A group of test subjects uses the VR equipment to evaluate it. The test's outcome enables verification of whether the targeted objectives have been met and, if not, provides for the required adjustments.

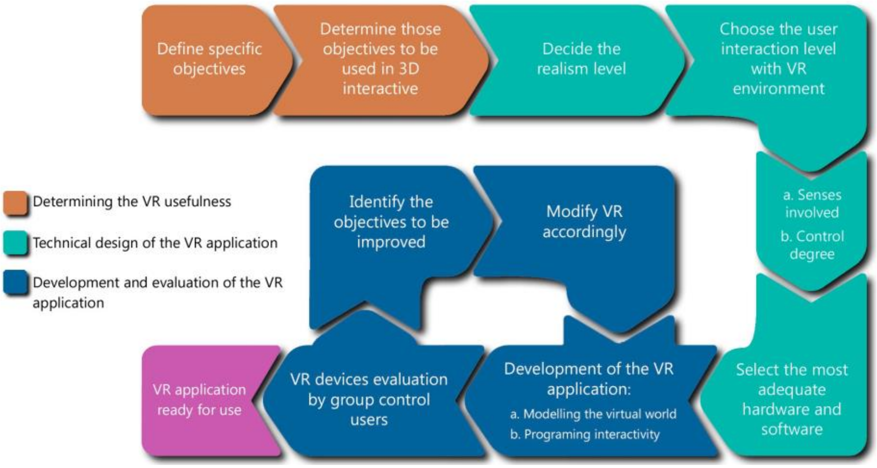

Figure 2. Diagram of the general design process for a VR application.

Following the discussion of the basic method for creating a VR application (Figure 3), the key technical parts of the development process are described as follows: User control, interaction levels, hardware and VR programming software.

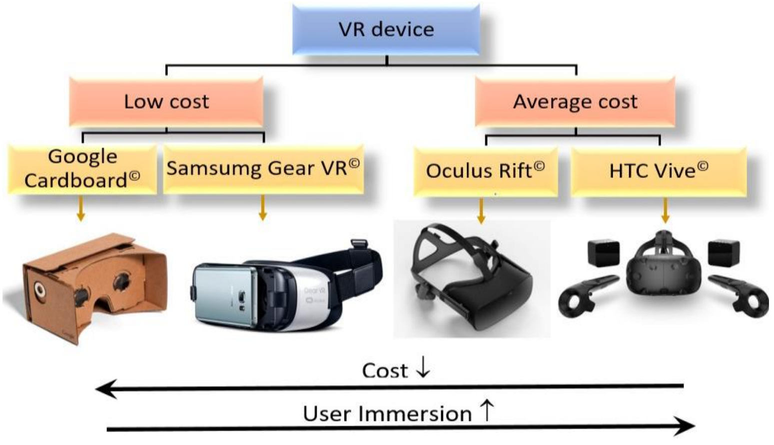

Figure 3. Low-cost VR headsets include Google Cardboard and Samsung Gear VR (www.samsung.com/global/galaxy/gear-vr); average-cost headsets include the Oculus Rift and HTC Vive.

5. Methods for Learning

The existing engineering education delivery method(s), also referred to as the traditional learning technique in this research, must be carefully examined before we can begin to grasp the uses of VR in engineering education.

5.1 Prospects for VR and Current Delivery Method

Engineering students are often taught using a standard lecture/seminar format in a classroom or auditorium, where the lecturer teaches the necessary content to a range of pupils. A white/black/digital board, a digital overhead projector, a computer or laptop, and other teaching aids are frequently used in conjunction with spoken explanation and instruction. In an ideal scenario, the teacher accesses digital content, such as multimedia or PowerPoint presentations, using their laptop or computer and projects it onto the white board using a digital projector (Gatsakou C., Bardis N. & Drigas A., 2022). When necessary, the educator will solve a problem or provide an example using white board markers or digital pens. Such a teaching strategy involves the instructor being active while the pupil being passive (Mitsea E., & Drigas A., 2019). Additionally, many colleges and organizations are starting to adopt the practice of offering courses entirely or in part online, allowing students to access the content from anywhere. Blended Learning Approach (BLA) (Rahman A., 2017) is the term for combining conventional and online learning, and it results in the establishment of a number of technologies, such the software packages Moodle and Blackboard. However, BLA's "definition has expanded to cover a mix of other learning methodologies" or ideas like problem-based learning, cognitive flexibility theory, anchored teaching, etc. (Rahman A., 2017) have been incorporated into BLA.

The usage of technology-enabled active learning (TEAL) at Massachusetts Institute of Technology (MIT) is a notable example of how this method increases students' learning opportunities and theoretical thinking. According to Dori and Belcher's study, this is caused by three things: (1) inquiry-based scientific education (2) technology-enhanced learning (3) visualization and engagement from learning and phenomena visualization and (4) hands-on experimentation and interaction (Mackin K.J., Cook-Smith N., et al., 2012). The fact that the pupils' learning state shifts from passive to active produces beneficial cognitive and pedagogical benefits is a key finding. Therefore, we contend that VR will actively engage the students and have beneficial cognitive and pedagogical effects when utilized as an educational tool in conjunction with conventional and e-learning in a BLA form (Drigas A.S., and Kouremenos D., 2005; Charami F and Drigas A., 2014).

Students get more actively involved in their education through the utilization of immersive VR situations, shifting their learning from a passive to an active state. Thus, a student-centered strategy like this one improves the real-world problem-solving abilities that are crucial for engineering students (Rahman A., 2017). Numerous studies on the subject of engineering education demonstrate the educational and cognitive advantages of adopting VR. Berthoud and Walsh created a VR application for the purpose of teaching fluid mechanics, a subject that is intimidating to students because it is one of the hardest courses in engineering school (Rahman A., 2017). This application was incredibly successful in improving their students' understanding of complex fluid mechanics problems (Berthou L. and Walsh J., 2020). They also emphasized the limitations of the conventional learning method, which relies on "2D graphics and verbal explanation to completely depict the 3D motion of bodies across space", emphasizing the value of VR as an instructional tool (Papoutsi C., Drigas A. & Skianis C.,2021).

Additionally, a VR research that examined the use of VR in Nigerian universities for the teaching and learning of electrical and electronic technology discovered that "VR favorably enhanced students' academic accomplishment, learning interest, and engagement... in electronics technology" (Ogbuanya T.C. and Onele, N.O., 2018). Last but not least, research by Astuti demonstrates improved outcomes in "critical thinking abilities, and scientifical attitudes" (Astuti T.N., Sugiyarto K.H. and Ikhsan J., 2020) as observed from students who utilized 3D visualization tools. Additionally, "normal screen experiences rather leave a sensation of familiarity" in contrast to "the encoding technique in [VR] which] could closely mimic real-life memory processing (Kisker J., Gruber T. and Schöne B., 2019). This demonstrates that, in contrast to seeing it on a projector in a classroom, utilizing VR has an autobiographical memory that is akin to conducting the experiment in real life. This brings up the necessity of labs and hands-on learning in engineering education. Finally, the advantages are not just restricted to higher education. Rahman-Shams (Rahman-Shams S., 2019) evaluated the impact of employing 3D VR technologies on the learning outcomes of post graduate education and discovered that the majority of the results were favorable, as well as the quality of the learning (Drigas A. S., J.Vrettaros et al., 2004).

5.2 Education-related labs and the potential of VR labs

This brings up the subject of labs, workshops, and practical work, which are a crucial component of a student's contact hours at practically all universities/isntitutions/schools and help them acquire the necessary information (Drigas, A.S., Vrettaros, J., et al., 2005). A lot of emphasis is placed on the significance of laboratories as a vital and distinctive role in scientific education because of the numerous advantages of learning that come from laboratory activities. The involvement of the students in the inquiry and research process places lab sessions in a crucial position in scientific education (Drigas, A.S., Ioannidou, R.E., et al., 2014). Baldock and Chanson's evidence that problem-based and project-based learning may be combined to create high-quality professional reports for the field of fluid mechanics is persuasive (Baldock T.E. & Chanson H., 2006). Additionally, Chanson's research demonstrates that students at an Australian institution had better results when they combined classroom instruction with fieldwork to learn hydraulics, a topic that belongs to the fluid mechanics category. The significance of an active, student-centered approach is demonstrated by these instances, when students' comprehension of difficult concepts learned in the classroom is improved and they get a better knowledge of the subject matter being taught (Gatsakou C., Bardis N. and Drigas A., 2022).

For any organization, there are a number of disadvantages when it comes to physically demanding operations like lab research, including safety (liability), infrastructure, and capital. Since student safety is a key concern for any university/school, lab activities must be conducted safely. Additionally, lab activities are constrained by the infrastructure that is available at the institution; as a result, universities with inadequate resources, facilities, and budgets will restrict the amount of time that students may spend in the lab. Students' academic success at universities is hampered by "safety considerations, a lack of proper facilities and equipment, and restrictions in terms of time and space available," according to Henderson and the United Nations Task Force on Habitat III (Cruz D.R.D. &Mendoza D.M.M., 2018).

Furthermore, costly materials might be a barrier for some institutions, and risky errors can result in catastrophic injuries in "chemical interactions and electrical experiments" (AlAwadhi S., AlHabib N., Murad D., et al., 2017). Zinchenko and AlAwadhi, propose the use of VR in the creation of Virtual Laboratories to overcome these challenges and enhance students' learning experience and knowledge (Zinchenko Y.P., Khoroshikh P.P., et al. 2020; AlAwadhi S., AlHabib N., et al., 2017). Additionally, the United Kingdom's student population "limits the opportunity for educators to provide an active learning experience for all" and that it is "essential for education providers to investigate... innovative new teaching methodologies to provide a more satisfying learning experience in circumstances of limited space and resources" (Cobb S., Heaney R., Corcoran O. and Henderson-Begg S., 2009; (Papoutsi C., Drigas A. & Skianis C.,2021)).

Students with particular needs (disabilities), distance learners, and university personnel all enjoy additional benefits (Kontopoulou MT., Papageorgiou V., Drigas A., et al., 2022). Laboratory work is now required to be device-oriented rather than location-oriented thanks to VR applications. Distance learners can gain from being able to obtain the same quality of education as full-time students on campus if they have the money to purchase their own VR HMD. Students' short- and long-term memory, were compared to those in a typical lab, which involved creating an organic chemistry virtual laboratory (Dunnagan C.L., Dannenberg D.A., et. al., 2020). The findings indicate that there is no statistically significant difference between the two groups' learning outcomes and student memories, proving that students enrolled in distance learning can take advantage of the opportunity to carry out laboratory experiments and benefit from having the same educational experience as full-time on-campus students. There is no difference between VR learning and video learning (Makransky G., Andreasen N.K., et al., 2020). That bolsters the claim that VR may be used to give distance learning students the same quality education and educational experience as full-time on-campus students. This may also be a differentiating aspect that offers the institution implementing the VR lab an advantage over other universities and draws more distant learners to their courses.

However, the expense of high-end VR setup and equipment might be an additional financial strain and a barrier for distance learning students. Shuo, method must be imitated since it makes use of low- to medium-end mobile VR to enable affordable and practical experimentation for distance learners (Shuo R., Zelin Z., et al., 2018). Radianti, assert that this, however, is at the expense of the immersive quality, (Radianti J., Majchrzak T.A., et al., 2020). The learner or user does not need to be standing, however, in order to utilize this program (Drigas A. & Kostas I., 2014). Therefore, having the option to participate in an immersive industrial virtual experience and navigate the space with touch controllers is advantageous for students with special needs. Without lifting or exerting themselves physically, they will be able to engage with the models online (Kontopoulou MT., Papageorgiou V., Drigas A., et al., 2022). The video may be changed to include subtitles for pupils who have hearing impairments. The pupil can also profit from the same experience. The experience involves the use of an HMD, which is mostly visual, therefore it is not appropriate for students who are blind or visually impaired, despite the fact that it is extremely enticing to children with special needs (Drigas, A. & Dourou, A., 2013).

Benefits of VR labs extend beyond the institution or university to the students' learning processes, cognitive development, and pedagogy. The excellence and promise of this technology in education are highlighted by evidence from several study articles that created and implemented VR applications. In order to improve their practical and safety experience, Hai Chien, created and verified a virtual reality (VR) program that simulates a construction site (Hai Chien P., Nhu-Ngoc D.A.O., et al., 2018). This application enables the students to remotely enter that environment (in a secure classroom setting). The usage of VR has been demonstrated to be a "strong educational" technique to improve students' learning (Hai Chien P., Nhu-Ngoc D.A.O., et al., 2018; Pappas M., Demertzi E., Drigas A., et al., 2018). In order to help pupils better see and comprehend complicated 3D geometries, Gargrish created an Augmented Reality (AR) application (Gargrish S., Mantri A. and Kaur D.P., 2020). Although the application is AR-based, it uses a visualization tool comparable to VR and demonstrates the potential advantages and applications where both technologies might be employed. Also, VR has not yet caught up in areas that are important for engineering education (Jin Rong, Y., Tan F.H., et al., 2017; Drigas A. S., J.Vrettaros et al., 2004). They designed a VR application for the historic building techniques of the Great Wall of China. A crucial educational benefit and a blatant example of the potential of VR technology in education is the capacity to see such antiquated buildings.

AlAwadhi, designed a virtual lab for electrical engineering students that is a replica of a real lab and where they can interact with a virtual environment's equipment and conduct hands-on experiments in a safe manner after researching virtual labs for engineering education in depth in several research papers. The prototype, known as Virtual Electric Manual (VEMA), was used to enhance the regular classroom instruction. With the help of VEMA, students may learn Electrical Circuit Theory in a secure environment without risking their own safety or the property's. In their design, AlAwadhi, used a variety of learning theories, such as inquiry-based, passive and active, synchronous and asynchronous, and hybrid approach learnings (AlAwadhi S., AlHabib N., et al., 2017).

In a similar vein, Zacharia and de Jong compared test results from students taking an introductory physics course in traditional labs versus virtual labs, and discovered that students using the virtual lab had similar understanding of complex circuits and had developed more suitable conceptual models than the students taking the course in traditional labs (Zacharia Z.C. and de Jong, T., 2014). Similar to this, Winkelmann, examined students conducting chemical experiments at a public institution in both a standard lab and a virtual environment called Second Life (SL) (Winkelmann, K., Keeney-Kennicutt, W., et al., 2020). They came to the conclusion that students performed better and had positive opinions of their experiences in Second Life based on their grades, questionnaires, and feedback from other students. Furthermore, they draw the conclusion that "SL setting eliminated distractions and made certain components of the tasks simpler to accomplish" and add that there is no discernible difference in performance or attitudes between the sexes. Finally, a virtual seismic engineering lab has been created with the intention of enhancing students' academic and research abilities (Mitsea E., & Drigas A., 2019; Guerrero-Mosquera L.F., Gómez D. and Thomson P., 2018). The SUSMULAB lab received a lot of excellent comments for its usefulness in visualizing and explaining engineering earthquake principles, as well as for its interpretation of the findings. As a result, the students can comprehend and implement many essential principles in earthquake engineering (Gatsakou C., Bardis N. and Drigas A., 2022).

Contrarily, the usage of the virtual environment Second Life (SL) to carry out an experiment for Biotechnology Masters students at the University of East London came to the conclusion that there was no significant difference in the results (Cobb S., Heaney R., et al., 2009). After finishing the experiment in the virtual lab, the students needed less help to carry it out in the actual lab. They also discovered that the students gave the experiment favorable feedback and asked for additional virtual lab experiments. On the other hand, they draw the following conclusion: "No difference in gains between the two groups" and "both groups demonstrated a considerable increase in learning gain" (Drigas A. and Koukianakis L., 2004). The poll included 50 engineering students in total, and the results indicate that the students prefer a traditional laboratory to a virtual one because it is simpler to use, more flexible, and more satisfying. However, the experiment was carried out on virtual labs in the very beginning of VR technology, and only a small sample size was used to collect the replies.

6. Conclusion

Concluding we underline the importance of all digital technologies in education domain and engineering training that is very productive and successful, facilitates and improves the assessment, the intervention and the educational procedures via Mobiles which brings educational activities everywhere [52-61], various ICTs applications which are the core supporters of education [62-90], AI, STEM & ROBOTICS which raise educational procedures into new levers of performance [91-107], and games which transforms the education in a very friendly and enjoyable interaction [108-116]. Additionally the enhancement and combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation [117-161] as well as with environmental factors and nutrition [48-51], accelerates and improves more over the educational practices and results, especially in the engineering education domain taking into account all the special technical and psychological demands of the engineering domain and of the engineers.

More specifically the usage of VR is ultimately shown to be advantageous for both students and the institution. Gains in pedagogy and cognition among the pupils boost their performance and academic results. This is a direct outcome of the learning objectives and learning theories being included into the design of the VR application. Furthermore, employing VR to actively engage students is a student-centered approach and a component of BLA, which is preferable to passive and traditional learning methods. The university or institution gains from lower costs by substituting expensive existing laboratories with VR, as well as from fewer infrastructure requirements for lab spaces, safer lab working environments for the students, and a competitive advantage in terms of support for VR in distance learning and students with special needs. Despite the technology's alleged shortcomings, all of them can be highlighted with careful design.

VR is a cutting-edge educational technology that, in the grand scheme of things, has the potential to change the way that education is delivered. The use of virtual reality is not a passing fad in education; rather, it is a new instrument whose significance will likely become increasingly more clear in the years to come given the COVID-19 Pandemic, the need for social distance, and distant learning. The usage of technologies like VR will play a significant role in the race to give university students with the best continuity of an extraordinary education, and the institutions that adopt these technologies first will gain an advantage and guarantee their students' access to an excellent education.

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