

The Enhancement of Students' Teachers Skills by Virtual Laboratory for Physics: A Qualitative Study of Students' Teachers Experiences - Faculty of Education- Sudan University of Science and Technology from 2022 to 2023.

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Abstract

This study aims to investigate teachers' views on the use of the Virtual Laboratory (VL) for physics at the Sudan University of Science and Technology (SUST), focusing on the main campus in Khartoum. Virtual laboratories act as valuable educational tools within different universities by providing an interactive and flexible atmosphere for students and teachers as well. A qualitative approach was adopted, with interviews serving as the main method of data collection. The participants were undergraduate-level instructors from the Faculty of Education at Sudan University of Science and Technology within the faculty of Education, specifically those involved in the academic year 2021–2022. Participants were selected through purposive sampling. The results revealed several challenges affecting the successful implementation of the Virtual Laboratory software in physics instruction, such as limited awareness among educators. Moreover, female instructors expressed a mix of positive and negative attitudes toward integrating Virtual Laboratory into physics teaching.

Key Words: Virtual lab, tertiary education, students' teachers, practical skills.

1. Introduction

The 21st century is widely recognized as a period marked by significant advancements in the World Wide Web (WWW). The rapid development of Information and Communications Technology (ICT) has permitted various domains, including medicine, engineering, and education. It is evident that the internet has transformed the dynamics between educators and students within the educational landscape. Distance education facilitates interaction between instructors and learners in diverse settings, whether within traditional classrooms or alternative environments such

as cafés, libraries, or offices (Mustafa & Mubarak, 2022). Notably, distance learning is often equated with synchronous or online learning, allowing students to engage in their educational pursuits without the necessity of physical presence in schools or colleges. Educators can deliver courses from their homes or offices using various devices, including smartphones, tablets and through platforms such as Google Classroom or Google Zoom Meeting. Researchers have proposed multiple definitions for Virtual Laboratory (VL), describing it as a digital environment where students can conduct simulated experiments via the internet using various applications. Today, virtual laboratory software has become a prevalent tool, encompassing virtual universities and classes that integrate multiple platforms, including applets, flash-based demonstrations and animations enabling students to conduct experiments remotely at any time and from any location, all while eliminating chemical hazards. Furthermore, the absence of maintenance requirements for laboratory equipment positions the VL as a virtual learning environment that effectively replicates the experience of a physical laboratory for its users. The virtual laboratory offers students and users access to a diverse array of laboratory equipment via computer, facilitating the management of experiments both individually and collaboratively, regardless of location or time (Juškaite, 2019). Numerous studies have confirmed that virtual laboratories present various advantages by incorporating instructional technology applications, computerized models and simulations, enabling users to conduct experiments in a safe environment. This digital setting ensures that experimentation poses no risk to users or the surrounding participants, including students and teachers involved in the study. Moreover, students can engage in independent work with readily available equipment (Ramadhan & Irwanto, 2017). The virtual laboratory actively engages students in their learning process, providing them with opportunities to grasp and construct complex concepts more effectively, whether in physics or other fields. It also allows learners to rectify errors that may arise from laboratory conditions or improper use, thereby helping them navigate potential hazards typically associated with real laboratories, ultimately leading to improved learning outcomes for students.

According to the researcher, physics is one of the important branch of science that studies the universe and everything that occurs within it. Since the universe we inhabit is filled with challenges, all that we know today is the result of discoveries made by the past researchers and scientists.

The virtual laboratory is designed to be inclusive and to enhance student. Furthermore, it provides a practical interactive setting that enables students to conduct simulated scientific experiments, as discussed by Abdelmoneim and Radwan (2022). Also simulations are widely utilized technologies that facilitate the transition from abstract concepts to practical skills, effectively transforming theoretical knowledge into applicable expertise, according to Aiksoy and Islek (2017).

This section presents a review of prior research related to virtual laboratories (VL) in the field of physics and the perceptions of student teachers within faculties of education, aiming to enhance their skills and understanding of scientific concepts. An empirical study indicated that VL positively impacted students' understanding of direct current electric circuits, with the experimental group demonstrating superior performance compared to the control group. However, regarding users' attitudes towards physics, no significant differences were observed, as noted by Faour and Ayoubi (2018).

A study conducted by Ojo and Owolabi in 2020 within a secondary school context observed a positive impact of virtual laboratories on students' performance and attitudes towards practical physics. However, the results also indicated a lack of practicality and negative student attitudes towards virtual laboratories, as discussed by Santos and Prudente(2022). Similarly, a research by Bai, Peng, and Yang in 2019 demonstrated that virtual physics experiments enabled students to perform experimental operations at various levels and times, thereby enhancing their knowledge acquisition and practical skills. Consequently, the body of research presents both positive and negative attitudes towards virtual laboratories across different educational levels, while also highlighting their potential to improve students' skills and practical knowledge. In contrast, virtual laboratories represent an advanced online application tool that facilitates experiential learning, allowing students to actively engage in the construction of knowledge and enhance their skills. It is essential to emphasize the perceptions of students regarding the virtual laboratory platform for physics at the Faculty of Education, Sudan University of Science and Technology.

Purpose of the study

The main purpose of this study was to carried out with the following objectives to identify Virtual laboratory practical skills in the virtual physics laboratory and to identify gender differences students' teachers' perceptions toward the virtual laboratory in physics sessions at faculty of education – SUST.

Significance of the Study

By clarifying students' teachers perceptions toward the virtual laboratory of physics, and how it can be changed via the implementation of virtual laboratory, improvements can be made to meet teachers' students attitudes. Additionally, the process of this article can be repeated to determine the effect on students' teachers perceptions towards adapting with the virtual laboratory of physics. However, virtual labs of physics may be a good or a bad alternative when equipment or supplies are not available as a result of space or budget. The potential benefit to use virtual labs must be considered in entire tertiary applied disciplines.

2. Methodology

To understand in-depth attitudes of participants toward Virtual laboratory in physics in tertiary education faculty of education – SUST in particular, this study adopts a qualitative research method -phenomenological research approach.

Participants and ethical considerations

First ethical, participants were selected based on their presence on the main campus of Sudan University for Science and Technology (SUST) ; they agreed voluntarily to participate in this study . Participants were chosen purposively and where contacted via WhatsApp and by Google Zoom. Pertaining to ethical considerations of selection participants was based on the availability . Second ethical is that ,the researcher provided participants with sufficient information about the research objectives . Third ethical consideration is that the actual names of the participants were coded to keep their personal identity confidential .Fourth ethical is that during the first meeting the researcher was committed that all information will be kept confidentially and to ensure privacy and information will be deleted after completion of this study.. This section, consists of a total ofstudents' teachers enrolled in the final semester in department of physics at faculty of education -Sudan University for Science and Technology (SUST) the main campus intake 2022- 2023. They submitting the partial thesis as requirements of Bachelor degree. The interviewees were selected purposively: 5 females and 2 males average age,19 -21years old and they were Sudanese.

Instrumentation and data collection procedures

In this study a semi-structured interview was carried out in order to determine participants experiences on the practical skills that have been acquired through the VL in the physics courses at faculty of education -SUST. The researcher constructed semi -structured interviews before graduation ceremony and 7 volunteer respondents participated and they were asked to reflect their own perceptions on practical skills that have been gained from the VL in physics at faculty of education – SUST. To make sure that there was no loss of the data during the interview process. Over all, the participants views were written and recorded; coded and transcribed precisely. The philosophy beyond that to keep privacy of participants' identities.

3. Results

The data of this study had been transcribed in word program; pertaining to the analyses and the result were formed through a transparent interview. There are two major themes that have been shaded participants' experiences toward the VL software enhances students' skills according to social transaction theory at faculty of education at Sudan University for Science and Technology. Main themes of this study are the following: 1: Students' teachers perceptions toward the VL of physics course. 2: The Virtual laboratory of physics enhances students' skills. Details of themes were in light of the social transaction theory are as follows :

Theme 1: Students' perceptions

This theme showed various participants experiences toward the virtual laboratory in physics at faculty of education – (SUST). 100% of explanations narrated by participants personally or point of view were as follows: Some students' teachers believe that “ We only conduct that week's experiment in the virtual physics laboratory , whereas, we would like to conduct other experiments even outside college . They had added that , we had finished an experiment within a week but we couldn't understand over and over again and a supervisor was monitored us to gain good results. Moreover, they emphasized that another advantage of the virtual laboratory was that, we had changed data and getting immediate feedback while we were running an experiment.

We were conducting several experiments in the virtual physics laboratories and must record; measuring and gain data simultaneously that could lead us to make some mistakes in absentee of supervisors . Nevertheless, the virtual laboratory are some examples of negative students teachers statements for instance “ We prefer to conduct an experiment in physics virtual laboratory where we can not touch the equipment that was providing in the physical laboratory. Someone emphasized that “I couldn't focus on the experiments during the first week because I was spending my time trying to learn how to use the platform that I'm not familiar with . Moreover, some students' teachers said that “the majority of us would like the virtual physics laboratory activities ”. Therefore, participants preferred the virtual laboratory which enhances students skills such as recoding data ; rereading an experiment results and summarizing main ideas.

Data of this study have been transcribed in the word program; pertaining to the analysis the result was formed through a transparent interview. There are three major themes that have reflected participants experiences toward students' teachers of physics environment at Sudan University for Science and Technology (SUST), the themes are the following :1- Teachers students' perceptions towards the virtual physics laboratory 2- The virtual physics laboratory software enhances students' teachers skills. Details of themes in light of social transaction theory are the following:

In light of participants narrations, it is obvious that participants responses had shown various experiences towards different factors such as time is not enough that given to a session . Whereas, some parents believed science teaching is fruitful as well as the principal he believed that have opportunities to move record , but absentee of physical practice might not make pupils satisfied .Science teacher showed positive perceptions Teaching science has two parts , theoretical part and physical / practical explanations to the pupils , In contrast , some pupils are not interested in online science classes and that may refer to lockdown them for long period of time . The result agrees with the findings of; Ojo & Owolabi ,2020 ; Santos & Prudente,2022 ; Peng & Yang, 2019 .

Theme 2: The Virtual laboratory of physics enhances students' skills

This section shows theme two that reflects various participants experiences towards the virtual laboratory in physics at faculty of education - SUST. All explanations narrated by students' teachers directly and these are some examples of positive and negative participants' statements that provided towards the VL lab platform for instance she narrated that "When we used VL software we gained enough time during the lab sessions and precise information , beside that it allows us to setting up an experiment , moreover, it is not time-consuming in the virtual physics laboratory as it existed . In fact that, it takes a few minutes on a computer to set up an experiment . Therefore, I could also design different experiments in the virtual physics laboratory, someone emphasized that I'd like to conduct experiments alone virtual physic laboratory because is the easiest way to conduct several of experiments individually. We prefer to work together on the same experiment. From my own experiences using the virtual physics laboratory because it was more fun and wonderful in terms of insert data and rereading results. She narrated that I find myself more conscious and I have been able to increase awareness of accessing the virtual laboratory platform of college, as well I understood experiments better than by practicing with physical experiments for example by trying the effect of changing the type of fluid and seeing the result. We could engage in discussion about the effectiveness of virtual laboratory in physics. .In fact that, I have learned several ways to measure graphics and data .We believe that virtual laboratories are very helpful and could repeat an experiment to ensure it. Females said " they learned from the virtual laboratory and mentioned being able to connect the physics concepts by seeing the representations in the virtual laboratory software setting.

She believes that VL in physics is a powerful platform and most of colleagues gain a deeper understanding of the scientific principles presented in addition to enhancing engagement through the virtual laboratory software in physics at college environment . it affords the learners some opportunities to overcome mistakes that occur as a result of such laboratory conditions.

In light of students' teachers narrations, it is obvious that they had responded and they had shown various experiences towards the virtual laboratory software in physics at Sudan University for Science and Technology (SUST) -Khartoum the western campus. It seems that students' teachers have shown different perceptions towards the virtual laboratory software in physics .Some emphasized positive attitudes because VL allows them to replace the experiments in a secure situation and it provides enough time to users to summarize and give comments for whatever they produced that given to a session. Whereas, some students teachers have shown different attitudes towards the virtual laboratory software in physics some said that couldn't focus on the experiments during the first week because I was spending time trying to learn use the platform but I'm not familiar with this platform. The result of this study agrees with Ojo & Owolabi ,2020 ; Santos & Prudente,2022 ; Peng & Yang, 2019 and Abou Faour & Ayoubi, 2018.

4. Conclusion

Primary data demonstrate the perceptions that students' teachers and gender female – male successfully shown their own perceptions towards the virtual laboratory software in physics at Sudan University for Science and Technology (SUST)-Khartoum the western campus thereby confirming findings of this study that conducted in some African and Asian countries. Some factors limit adapting with the virtual laboratory software in physics at Sudan University for Science and Technology-Khartoum (SUST)- western campus for instance unawareness of VL in physics session also females students' teachers have both negative and positive perceptions towards VL in physics such as it consumes time and we can 't touch the equipment that were providing in the physical laboratory. Further research studies are crucial and needed to explore the nature of male and female perceptions towards VL software in physics and different applied science at Sudan University for Science and Technology-(SUST). However, this study cannot be generalized because it was conducted specifically in one college at Sudan University of Science and Technology- (SUST).

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