Exploring Students' Experiences with Online Sciences Practical Activities during the Covid-19 Pandemic: Lessons for the Future

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DOI: https://doi.org/10.47772/IJRISS.2023.7468

Received: 20 March 2023; Accepted: 28 March 2023; Published: 10 May 2023

ABSTRACT

The coming of the COVID-19 has pushed many teaching institutions to shift from face-to-face teaching mode to online mode. Practical sciences activities for undergraduate students in the field of Integrated Natural Sciences at the University of Namibia Rundu Campus have been disrupted to adapt to the sudden changes. The focus of this study was to examine students' experiences on practical distanced methods used such as in-lab sessions, remote access to in-lab equipment, take-home kits, and other online methods. A qualitative approach was adopted to generate data through semi-structured interviews, focus group interviews and narratives. The participants were 30 students in third and fourth year from science department due to the experience they had on both face to face and online practical activities. The researchers used the narrative approach for the participants to give voice and elaborate on their own experiences. The results showed that although students enjoyed working from home, the shift to online sciences laboratory activities is still a challenge to our capacities and boundaries of our collective knowledge, understanding and practices.

Key words: pandemic; experiences; sciences practical activities

INTRODUCTION

The outbreak of COVID-19 has brought many changes in the structures of education in many institutions. Measures had to be taken to accommodate the strict social distancing protocols as well as redesigning activities that were previously done on face to face to online remote delivery (Naji, et al., 2020). Although some activities such as lecturing and writing of tests can easily be shifted to distance learning, it is a challenge to organize practical work online (Gravier, Fayolle, Noyel, Leleve, & Benmohamed, 2006). To fulfill the requirements for accreditation, students must complete a fixed number of laboratory skills. This is a very challenging situation causing extreme stress and anxiety in the academic world. Experiments are a vital part of sciences, in which students can gain valuable experience in various techniques and develop the necessary skills for their future employments in industry and academia. Traditionally, laboratory classes comprise experiments that accompany the lecture and discussion portions of science courses. The laboratory class has become an established and required part of all courses o?ered in sciences at higher Education. To meet these requirements, virtual laboratories have been used as an alternative. Corter, Nickerson, Esche, & Chassapis, (2004) compared the effectiveness of remote labs to hands-on lab activities and reported that students rated their remote labs to have comparable or better effectiveness than hands-on lab activities. Nickerson, Corter, Esche, & Chassapis (2007) reported that students were found to learn equally well from remote and hands-on labs in with some even reportedly appreciating the practical advantages of remote labs. Zine, Errouha, Zamzoum, Derouich, & Talbi, (2019) looked at the advantages of remote labs to instructors and institutions and reported that they include scalability, safety, and the potential for sharing between institutions. However, students need a hands-on session to gain familiarity with processes and equipment, before fully appreciating their remote work. Students' experiences of their remote practical activities may vary depending on the activity delivery format. Therefore, this study explores the experiences of students on

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue IV April 2023

shift of practical experiment to online platforms and propose the best methods to be developed for future use.

METHODOLOGY

The focus of this study was to explore students' experiences on online practical experiments. A qualitative research design that is descriptive and explorative was used for the purpose (Greeff, 2011). To gain in-depth insight into the study, individual interviews, focus group interviews and narratives (telling stories) were conducted. To generate data, 30 students from sciences were interviewed using the individual semi-structured and the focus group interviews asking open-ended questions as well as the narrative. The semi-structured interview is a conversation with a purpose (Greef, 2011) and it is used to generate more data related to the topic Kumar (2011). Third- and fourth-year students were chosen because they have experience on virtual laboratory and normal laboratory. Therefore, this approach was to explore the participants' experiences asking them this question:

- What were your experiences on the use of different types of online practical experiments?

The profiles of the participants interviewed to generate data for this study are presented in Table 1.

Table 1: Profile of the Students interviewed

Profiles Names	Phase group	Previous online learning experience	Gender
1. Kiwi	Year3 Sciences	0-5	M
2. Pear	Year3 Sciences	0-5	M
3. Mango	Year3 Sciences	0-5	M
4. Cherry	Year3 Sciences	0-5	F
5. Pineapple	Year3 Sciences	0-5	F
6. Orange	Year3 Sciences	0-5	F
7. Peanut	Year3 Sciences	0-5	F
8. Milk	Year3 Sciences	0-5	M
9. Butter	Year3 Sciences	0-5	M
10. Bread	Year3 Sciences	0-5	F

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue IV April 2023

11. Cheese	Year3 Sciences	0-5	M
12. Sugar	Year3 Sciences	0-5	M
13. Coffee	Year3 Sciences	0-5	M
14. Tea	Year3 Sciences	0-5	F
15. Oil	Year3 Sciences	0-5	F
16. Onion	Year4 Sciences	0-5	F
17. Tomato	Year4 Sciences	0-5	F
18. Garlic	Year4 Sciences	0-5	M
19. Chicken	Year4 Sciences	0-5	M
20. Beef	Year4 Sciences	0-5	F
21. Mutton	Year4 Sciences	0-5	M
22. Goat	Year4 Sciences	0-5	M
23. Lion	Year4 Sciences	0-5	M
24. Cup	Year4 Sciences	0-5	F
25. Pot	Year4 Sciences	0-5	F
26. Pan	Year4 Sciences	0-5	F
27. Jar	Year4 Sciences	0-5	F

28. Glass	Year4 Sciences	0-5	M
29. Bottle	Year4 Sciences	0-5	M
30. Pencil	Year4 Sciences	0-5	F

In the focus group interviews, participants were divided into two different groups. The reason for doing focus group interviews was to obtain multiple viewpoints and perceptions by generating a large amount of concentrated data in a short period of time. Wessel (2008) indicates that the focus group interviews are useful because they communicate a willingness to listen, leaving the participants feeling empowered and supported in a group discussion.

Data analysis

The data generated from the interviews were prepared and organized by the researchers to facilitate coding. Then, thematic coding was used to analyze and describe data set in detail (Schumacher, 2014). The data was then transcribed into themes to make sense of and get more insight. Individual and focus group interviews data were analyzed, synthesized, summarized, and interpreted. During the narratives, the researchers focused on the context and quotations of participants by arranging the participants' statements logically aiming to minimize mistakes and give their true meaning.

RESULTS AND DISCUSSION

The data from semi-structured interviews, focus group discussions and narratives are presented. Three main themes were identified to answer the research question and were supported by verbatim quotes from the participants to elucidate and corroborate the arguments (Slavin, 2007).

THEME1: 1) Face-to-face in-lab activity with the support of lecturers and laboratory assistants

The students were able to get access to the laboratories to do some experiments but with strict social distancing restrictions as elucidated in the answers below:

Kiwi:" For us who were around town, we were allowed to do some practical experiments after requesting from the director of the campus. This was not easy as we had to wait to make turns as the capacity was greatly reduced, and students had to work individually. (probe) why do you think it was not easy? Kiwi:" well, normally we are used to work in groups, and we discuss on what we are doing and when we are stuck, we ask for support. But this time, there was little support, and the staff could only provide support from a 2 metres distance. Pear:" We could not think properly as the time was reduced to give space for those who were waiting. We had to rush to complete things even if we did not understand. There was really, little support. When the gadgets do not work, there was no one to check properly as we were interacting from distance. In my understanding, laboratory work helps us to grasp what we have done in theory for us to assimilate it correctly.

However, this was not the case as we were just working to cover the workload. I left the place without clear understanding of what I was doing". Orange" Although each student had to work alone, I liked the fact that it challenged me to be more prepared and to read ahead of the session. Usually, we relax and know that we are working in groups, we will help each other and there is a monitor who will assist us. It was a good

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VII Issue IV April 2023

experience even though I missed the usual atmosphere where we discuss with colleagues.

Theme 2: Take home kits and Use substances and devices that can be found at home

Some experiments were done at home using kits that were distributed to students as some of them explained: Peanut:" Doing experiments at home was not easy for me. It is true that I had everything I needed, but I did not know how to use them. I tried to remember the instructions of the lecturer but still did not understand. (probe): what was so challenging for you? Peanut:" well, some of the devices that they gave us, it was the first time to see them. I have never used them before and there was no one to ask questions. I tried to ask my friends; they also had the same problem. The lab assistant was also not available to attend to us when needed. Butter on contrary had a different opinion. Butter:" Although it was a challenging experience, at the same time it was exciting and enriching. (Probe) can you elaborate more on that? Butter:" Imagine we are used to do experiments in groups with the help of laboratory assistant and lecturers. This time, we had to do it alone. It helped me to do more research and check on you tube how it was done so that I can also do it. For example, in Electrolysis, we were given two gadgets, one for electrolysis of water and another for electrolysis of cupper sulphate. After doing it myself, I gained more understanding and can explain also to others". Most students enjoyed discovering that they could use substances found at home to do their experiments. Chicken: "It was very exciting for me to find out that our kitchen is really a laboratory. Most of the time when we think of chemistry, we only see toxic and dangerous chemicals by ignoring that every day we do chemical reactions at home." (Probe): tell us more about your experience. Chicken:" In Chemistry we were asked to identify substances that are acidic and basic at home. Then make our own indicators from red cabbage and some other fruits that we could get around. This was very creative and exciting. We gained a lot of skills and more understanding". Bottle also shared her experience in electricity and electrostatics. Bottle:" we always talk about electricity, and we think that it is too complicated. After working alone, I have gained the confidence and understanding of what is going around us. The small circuit that we make to test series and parallel circuits are just the same that they use at a big range to bring light in our homes and auditorium". (Probe) Tell us more about your experience. Bottle:" Now I can see that Physics and Chemistry need observation of our surroundings. What we do in the classroom is just to help us to be able to observe, explain and solve problems around us. They are so many things in our community that we neglect by ignorance while, they can be used to improve our conditions". Sugar gave suggestions on how to improve the experiments. Here are some of her comments:" I could not find all the devices that I needed to do some experiments. But still, I did not give up. I adapted what I found to meet what was needed. I would suggest that the lecturers prepare in advance the experiments that can easily be performed at home and give us clear instructions to enable us to be ready for any unforeseen circumstances".

Theme 3: Remote practical

Most of the students, did not like the watching of videos. They said that it was boring and not engaging them as from the answers below. Goat:" we are always excited to go to the laboratory because we want to touch and run the experiments ourselves. This time, it was boring and useless to watch someone doing it and then just answer questions". Mutton also commented in the same way by emphasizing on skills. Mutton:" when we go to the laboratory, it is for us to acquire skills and to know how to use different devices even if we find them elsewhere. Watching videos was boring as I could not do it myself and get to master how to use the different equipment. However, another group of students was of the view that completing experiments remotely allowed them to better manage their time in comparison to scheduled in lab-sessions. Bread:" I have enjoyed the freedom of completing this lab remotely and at my own time. There was no rush for time requirement. This module is difficult, and I need more time to go through it slowly at my own pace. This has allowed me to completely understand the content covered". Pencil:" it was a good opportunity for us to complete our experiment online during the pandemic. However, the hand on experience was missed as the setup was made for us". (Probe) elaborate more on your experience. Pencil:" we were given time slots to

use the setup individually and everyone could engage in this lab session". Jar was of the view that everything was well planned. "The instruction sheet was clear, the video containing all the steps to follow was very understandable and sufficient for us to do the lab. It was a good idea to introduce us to a virtual laboratory experience as one of the alternatives to physical laboratories". Lion who had technical hiccups responded as follow: "remote practical is good if it is well prepared and the instructions are clear to follow.

SUMMARY OF THE FINDINGS

The findings of this study reveal that the Covid-19 disturbed the normal running of many institutions and even the way practical experiments must be undertaken. Lecturers and Students had to follow strict protocols to be able to run experiments. The experiences of the students are summarized below:

The report from the students shows that they had positive as well as negative experiences. Some students reported that they had very good access to necessary resources while others could not get appropriate material.

1) face-to-face in-lab activity with the support of lecturers and laboratory assistants

It appears from the responses that hands-on practical teaching labs form an essential part of scientific courses. They allow students to develop the necessary skills for careers both in industry and academia, they enable learning-by-doing and this cannot be done with virtual labs. Students are also safe with on-campus activities as the teaching environment is well controlled when using hazardous equipment or chemicals. The results show that hand on experience was negatively affected by the sudden shift to online mode. For many students, it's only when they put theoretical concepts into physical practice in the lab that they really understand them. This is in line with R.J.Rowe, L.Koban, Davidoff, & Thompson, (2017) who showed that virtual labs are supplements to in-person lessons. They allow students to acclimate to scientific practices before performing experiment (C.P.Garris & B.Fleck, 2020).

2) Take home kits and Use substances and devices that can be found at home

The interviewed students had mixed opinions concerning experiments done at home. For instance, some saw new opportunities for teaching Physics and Chemistry when everyday material is available and could be used for conducting school experiments. They liked home experiments because it allowed them, as teachers, more flexibility, creativity, and a connection to everyday life. The general impression was that students were satisfied even though they were not able to get all the required items and help from laboratory assistants. Enrico *et al*. (2020) also reported that students appreciated working in isolation at home as it forced them to be careful on what they were doing unlike what they usually do in the lab. On the other hand, some students found the home experiments difficult because they had no suitable equipment and proper support. Parameters such as shipping time, size and weight prevented the students from getting the desired equipment on time.

3) Remote practical

Most student's critics were on videos that were too short for them and not covering the topics very well. They also reported missing in-person discussions with their peers and instructors. This did not allow them to get the help they needed. Their practical experience was mediated through a laptop and some specialized equipment such as gadgets, cameras and electronic devices. However, they clearly mentioned that it was useful for them to improve in their skills. Sauter *et al*. (2013) elucidated that students had higher engagement and get more understanding on scientific approach through virtual laboratories. Students were also found to perceive remote labs activities more reliable and easier than in lab equivalents (Zhan and Mei, 2013). Although remote practical presents some advantages, students still need a hands-on session to

familiarize with processes and equipment before engaging in remote work (Jara *et al*. 2011).

CONCLUSION

This study has shown that the COVID-19 has impacted the way in which science practical activities have been done. Students seemed to enjoy distance delivery methods such as take-home kits, remote access activities. In times of crisis, these methods can be used as an alternative of science practical activities. Group simulations and video/quiz activities have not proven to be efficient, and hence should be avoided if possible.

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