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Loving the Lab: A Phenomenological Study on Students' Conduct of Virtual Laboratory Activities

Ehlrich Ray J. Magday

Science Education Department, College of Education, Central Mindanao University, Philippines

ABSTRACT

This paper aimed to explore lived experiences of the BSED Sciences students of the College of Education, Central Mindanao University. It focused on describing the conduct of virtual laboratory activities, the challenges met and the strategies utilized to address the challenges. A qualitative research design using a phenomenological approach was employed in this paper. Data were collected through semi-structured interviews and analyzed using Colaizzi's method. The virtual laboratory activities were conducted through the use of online platforms such as Youtube for demonstration purposes, simulation-based websites such as PHET and Chemcollective were also utilized as well as home-based laboratory activities. There were a number of challenges: unfamiliarity with the online platform, the need for an instructor's presence, and limited resources. However, these were addressed by students through seeking help from former teachers, friends, and family members, doing self-learning activities to enhance conceptual understanding, and collaborating with peers using different media platforms. There is also a need to come up with a university-wide policy on the conduct of virtual laboratory activities to minimize the challenges experienced by students. The teachers may also consider utilizing updated technological delivery platforms, especially for the virtual laboratory to cope with the needs of the time.

KEYWORDS: *virtual laboratory, simulations, home-based activities, lived experiences, science*

INTRODUCTION

The unforeseen pandemic brought about by COVID-19 which started in late 2019 has severely affected the educational system around the globe. The sudden disruption of classes in 2020 forced educational institutions to transition the instructional delivery from physical modeto online platforms. While there are success stories, it was evident that there were a lot of struggles in its initial implementation for several reasons which include lack of knowledge andskills of the new platform, inadequacy of the required equipment for online learning and intermittent internet connection. It exposed the inequities and inadequacies in education systems (Kemp, 2020). With the school closures, there were courses that were heavily affected since it included experiential learning such as laboratory activities in the field of science.

Laboratory activities as supplement to lectures especially in the field of science are an integral component of instructional delivery. While theories, principles and concepts may be delivered through lectures, there is a need to expose students to hands-on activities for them to experience and make concepts more relatable. The laboratory environment gives an opportunity for students to explore methods used by scientists (Mojica & Upmacis, 2021) as well as acquire essential laboratory work skills (Alebous, 2021) necessary for their future

workin industries and academe (Nurhayati et al., 2021). Experiments play a tremendous role in the different scientific fields, thus laboratory is as important as theory (Kapilan et al, 2020).

To a Teacher Education Institution (TEI) such as the College of Education in Central Mindanao University which hones pre-service teachers specializing in sciences, it is imperativethat students are exposed to different laboratory techniques in Biology, Chemistry, Physics andEarth and Environmental Science as they will also become teachers in the future. Having the necessary set of basic and advanced science process skills will immensely contribute to their success as science teachers as they will prepare and implement laboratory activities in their future teaching stations. With all the challenges met by students in the online learning modality for the past two years, the researchers were motivated to find out how virtual laboratory activities were conducted among the major subjects of the BSED Sciences students as well as the challenges met and how they addressed these difficulties.

1. METHODOLOGY

1.1. Research Design

Phenomenological approach using descriptive phenomenology was employed in this study as the research design, to obtain the data on the process, challenges as well as the ways to address the challenges on the conduct of Virtual Laboratory Activities. Phenomenology is one of many types of qualitative research that examines the lived experiences of humans. Phenomenology is useful in the identification of variation in student experience to examine learning disparities (Newton, and Martin, 2013).

1.2. Participants

Participants of this study were six (6) Bachelor of Secondary Education Major in Sciences students of the College of Education in Central Mindanao University who were enrolled in courses with virtual laboratory activities during the pandemic.

1.3. Data Gathering Procedure

Data were collected through semi-structured interviews using the validated interview guide following the objectives of the study. The Zoom platform was used to record and later transcribed the experience of the informants. A pre-prior informed consent was sent to the informants to ensure that the data obtained in this study were authentic and valid and to ensure the confidentiality of the data collected.

1.4. Data Analysis

The data collected in this study were analyzed using Collaizzi's methods. It is a qualitative method that allows the researchers to reveal the essence of the experiences of the informants through emerging themes (Wirihana et al, 2018). To ensure the rigor of the study, member-checking was done by giving back to the respondents and checking if their responses were interpreted correctly. By citing the significant statements of the informants, the authenticity and validity of data are guaranteed.

2. RESULTS

There were three (3) major themes that emerged from the responses of the informants. The themes were formed based on the clustering of codes from the participants' answers. These themes put essence on the transcripts of interviews made as to the conduct, challenges and ways on addressing the challenges among the BSED Sciences students.

3.1. Theme 1: *Approaches in Learning in the Virtual Lab*

Based on the participants' responses, the virtual laboratory activities were delivered in several platforms and the teachers apply different strategies to teach the concepts and experiments. According to the students, they were exposed to both virtual activities in some major science courses while there were teachers who preferred students to replicate the activities in a home- based set-up.

3.1.1. Subtheme 1: Use of Demonstration Videos through YouTube

The BSED Sciences students were exposed by several instructors to different videos with demonstration of science experiments in lieu of the hands-on activities. The students were mostly exposed to Youtube as the main platform where these instructional videos are sourced out from.

- *P3: Some instructors depend largely on Youtube videos. We only watch video demonstrations that are performed by foreign content creators and scientistsperhaps. These videos I download and watch over and over.*
- *P4: "Youtube was the main instructional material for our virtual lab used by ourprofessors"*
- *P5: I watch video presentations online. My professor gives a link and I intently watchthe Youtube videos which were sent to us as links.*

These significant findings from the informants support previous studies conducted which mentioned the use of Youtube as an instructional platform. The use of Youtube videos has the potential to be a tool in stimulating the learning of students (Sethela et al, 2014), interest(Edache-Abah, 2019) and engagement (Chtouki, 2019).

3.1.2. Subtheme 2: Utilization of Online Simulations in Science

Based on students' experiences in their courses that required the laboratory component, especially in Physics and Chemistry, the professors required them to explore simulations suchas PHET and Chemcollective, both offers virtual laboratory activities that students can manipulate and perform virtually, hence, simulating the real laboratory setting.

- *P1: The name of the website is Chemcollective, it's a virtual laboratory like you can manipulate the objects like beaker and others, it's like experimenting with varied activities and materials"*
- *P2: "Like the use of micrometer sir, the teacher sends us a link for PHET and there weexplore the everything about that object and try using it online"*
- *P5: "In our class in Genetics, aside from videos, there is the use of virtual simulationsI like it since we can do trial and error in computing"*

The statements from students affirm the study of Chan et al (2021) that show that virtual labs can be more effective than passive teaching methods. substituting face-to-face theoretical preparation in the general physics lab is at least equally effective as using virtual experiments. Students with virtual components acquired deeper understanding of physics concepts and were better prepared for carrying out real experiments. (Hamed & Aljanazrah, 2020). Moreover, the study of Wijynayaka and Iqbal (2021) on Virtual Chemistry Lab Space (VCLS) revealed that of all the respondents exposed to VCLS, 70% indicated that the VCLS was helpful to understand the course content during the pandemic period, while 82% indicated that they are likely to use it in the future. The pandemic and lockdown highlighted the need for virtual simulations especially in science to perform activities needed to supplement the lecture discussions.

3.1.3. Subtheme 3: Performing Kitchen-Based DIY Experiments

According to the student-informants, aside from the utilization of online resources to augment the theoretical aspect of the course content, some teachers allowed them to conduct home-based laboratory activities using localized materials readily available at home. As this would only entail the most basic materials, there are only limited activities that may be conducted.

- *P1: In our Genetics class we performed DNA extraction using the materials at home, it was fun, I followed the instruction given to us and it was successful*
- *P2: Doing the experiments at home was okay, I repeated the activity because I got lost and did not follow, however, eventually I got it correctly"*
- *P3: Yes, sir, what we can only perform are activities that does not need a lot of equipment and hard to find ingredients or materials"*

Mojica and Upmacis (2022) mentioned that kitchen-based experiments allowed students to perform hands-on activities and by doing so, helped them relate the concepts learned in the lecture portion of the course. Working in isolation at home, even if they were supported online by tutors and teachers, forced the students to think about what they were doing more carefully and deeply than they usually do in the lab. (Campari et al., 2021). The need for students to conduct hands on laboratory experiment is a must especially for BSED Sciences as they will also be teaching the same laboratory techniques to their future students.

3.2. Theme 2. *Challenges in the Conduct of Virtual Laboratory Activities*

Student-informants had faced a number of challenges along the implementation of virtual laboratory activities. The sudden shift from the traditional experimentation conducted in the science laboratories to online platforms and Home-Based Experiments have caused uneasiness among them. Further, while the university is still using online learning as the main mode of instructional delivery, students are forced to cope with the laboratory requirements of their professors.

3.2.1. Subtheme 1: Unfamiliarity with the Online Platform

The use of technology is of utmost importance today, as the COVID-19 virus still poses a threat, the professors are given the freedom to use resources that they think will best benefit the students. However, aside from the perennial problem on internet connectivity, another

concern that students are facing is the unfamiliarity of the platforms used for some virtual activities.

- *P1: "In the Chemcollective sir, we just explore and explore but I do not know if I amdone with the experiment or I have a mistake because I am not oriented about it"*
- *P4: "The teacher just uploaded the link but since I am not very good with technology,I was not able to perform the activity plus the connection in our area is not good, once I stop the virtual experiment, I need to go back to the starting point"*
- *P6: "We had an activity on Electromagnetism, I was alone in using the virtual simulation, I am not sure if I was doing it right. Do guideline on how to use or operate it."*

In a study conducted by Byungura et al. (2018) on students' familiarity with technology results indicate that the majority of participants are not familiar with technology and never had any previous exposure to eLearning systems. Mercado (2021) mentioned that despite efforts from students in coping with the learning situation today, there are challenges namely: networkissues, time constraints, and distractions in the learning environment.

3.2.2. Subtheme 2: Lack of Instructor's Presence

Another challenge mentioned by students is the lack on instructors' presence during the conduct of virtual laboratory activities. In a traditional setting, students are guided by the teacher in the laboratory. They can communicate before, during and after the experimentation process. Meanwhile in an online learning scenario, students mostly explore among themselvesthe provided materials and work on it either individually or as a team.

- *P2: "Sometimes, we need to ask questions on things we can't understand but the instructor is not around during the activity even when it is our laboratory time"*
- *P4: "In this virtual laboratory, we do trial and error like problem solving, mixing chemicals, we need guidance. There are terms new to us but we can't understand."*
- *P5: "The instructor's instruction sometimes is not understandable, but we are shy to ask and at the end of the class we are left clueless on what to do. It's also not easy to contact the teacher"*

The importance of teaching and social presence, driven by the instructor, appears to be an important factor driving learning quality (Ladyshewsky, 2013). Research has consistently support the importance of instructor presence in achieving learning outcomes as well as student satisfaction and engagement. Moreover, instructors must communicate with their students andvice versa in more informal channels (Alawamleh, 2020). With the absence of the instructor during when students perform virtual and home-based laboratory activities, it creates a problemin terms of student- teacher interaction.

3.2.3. Subtheme 3: Limited Resources and Equipment for Experimentation

Students conducting home-based laboratory activities are given instructions to perform experiments with available materials at home. However, there are far more complicated experiments that students missed to perform due to unavailability of materials and the lack

of equipment. Teachers tend to localize and contextualize the activities yet considering not all students can manage to provide the necessary resources, the conduct of experiments is put on halt.

- *P1: "There are lab equipment we can have substitute like beaker, test tube, however, there are others like the pipet which is hard to substitute. We cannot represent it with an object at home, it becomes a problem."*
- *P4: In the DNA extraction activity, we needed to buy some materials on our own expense, we contributed as a group so we can obtain the much needed reagent.*
- *P6: In our Physics class, we were not able to conduct, we don't have a micrometer to use, in chemistry there are some classmates with apparatus like thermometer, we borrow from them but only when they are done"*

The Philippines even before the pandemic had already the difficulty in providing laboratory equipment to supplement classroom instruction for the field of science. Science and technology will not advance unless appropriate materials and laboratory facilities will be provided (de Borja & Marasigan, 2020). In addition, Abas and Marasigan (2020) mentioned that lack of a laboratory room, the inadequacy of laboratory facilities and science equipment, defective laboratory equipment, the inadequacy of learning materials, lack of water supply, lack of electricity are common issues in the two schools they studied. This would remain a challenge even in college since although these facilities are available; students are not able to use them due to the mode of instructional delivery.

3.3. Theme 3: Strategies in Dealing with Challenges

Despite the challenges posed by the current scenario, student-informants shared the ways of coping with the problems encountered. As future educators, they conveyed different strategies to still be successful in the conduct of laboratory activities whether through virtual or home-based methods.

3.3.1: Subtheme 1: Tapping More Knowledgeable Others (MKO's)

Several student participants shared that they employ the technique of tapping the expertise of others who are more knowledgeable on the concepts that they are having confusions with. These MKO's include former science teachers, friends and even family members.

- *P1: "For me sir, there are instances when I reach out to my former teachers in highschool and they are more than willing to help"*
- *P5: "My brother is an engineering graduate, at times, he teaches me on how to manipulate the virtual simulations and he explains to me how it works."*
- *P6: "I have a friend who helps me especially with formula derivation, I always refer toher if I can't understand the topic"*

These instances manifest that learning can be a shared responsibility between students and individuals who are capable of helping in terms of clarifying content, problem solving, and other scientific laboratory procedures.

3.3.2. Subtheme 2: Putting in Extra Effort

The informants mentioned that aside from the learning materials provided by the teachers, they also do their own research to supplement the learning gained from interacting with the instructional materials. As they claim, some of the videos provided are highly complexed in terms of content while others are not of good quality video or audio-wise.

- *P2: I" don't rely only on the materials uploaded in the Google Class, I look and searchfor more like more videos for me to better understand the topic"*
- *P4: "In our class, the teacher provides additional links or us to read, I download thePDF and read it, it serves as my study guide as well. I do more readings."*
- *P6: I spend extra time in doing virtual simulations so I can familiarize the process.*

These statements are consistent with the findings of Xiao et al. (2018) that students can regulate their learning and one's efforts to reach the goal which includes performing well in virtual laboratory activities. Reflecting on their own practice, students can develop self-relianceand other skills equally important in the field of science teaching.

3.3.3. Subtheme 3: Fostering Collaboration

Students practice collaboration and learning from peers during the conduct of virtual laboratory activities. These peers are the classmates who interacts using different platforms such as Google Meet, Facebook Messenger or simply through text.

- *P3: "In my own experience, I utilize the strategy of reaching out classmates and ask them to teach me how to solve and arrive at a correct answer in a simulation activity"*
- *P4: I have a close friend from Block B, we do Google Meet together with other Sciencesstudents and discuss how the activity should be conducted.*
- *P5: After the discussion and prior to the conduct of the activity, I text or chat my groupmates so our ideas will be heard. Since it is a group activity, collaboration is key.*

As the shared experiences of the student-informants show, not even the pandemic can stop them from collaborating with peers. It is imperative that BSED Sciences students, as future teachers, need to value the essence of collaborations and the value of learning from each other.Collaboration provides a venue simulating more creative ideas (Makransky & Wismer, 2019).

3. SUMMARY AND CONCLUSION

This phenomenological study focused on the lived experiences of Bachelor of Secondary Education major in Sciences of one university in the Philippines regarding the conduct of virtual laboratory activities during the COVID-19 pandemic. It aimed to (1) describe how virtual science laboratory activities are conducted; (2) identify the challenges faced by students in performing virtual laboratory activities; and (3) document the ways on how students address the challenges.

The study employed phenomenological approach using descriptive phenomenology as the research design. Purposive sampling was employed and identified six student participants. Data were collected through semi-structured interviews using the validated interview guide The Zoom platform was used to record and later transcribed the experience of the informants.

Results of the study revealed that the virtual laboratory activities were conducted through the use of online platforms such as Youtube for demonstration purposes, meanwhile select simulation-based websites such as PHET and Chemcollective were also utilized for students to feel the virtual laboratory set-up by manipulating the variables. Home-based laboratory activities were also conducted by the BSED Sciences students using localized and readily available materials at home. There are a number of challenges encountered by the students which include unfamiliarity with the online platform which leads to confusion and unfinished activities, the need for instructor's presence before, during and after the activity to guide the students if they are on the right track and limited resources that can be a factor in the conduct of home-based laboratory activities as it may limit the opportunity for the students to perform the assigned tasks.

However, students were able to strategize on ways on how to minimize the impacts of the challenges. They seek help from More Knowledgeable Others (MKO's) which include former teachers, friends and family members, they put extra effort in looking for additional resources and do self-learning activities to enhance their knowledge on the content and concepts and lastly, they collaborate with peers using different media platforms to the nitty-gritty of the experimentations.

The study is limited only to describing the experiences of BSED Sciences students in the conduct of virtual laboratory activities. Given this, the university may conduct studies across the colleges to also check on the experiences of students with laboratory courses offered through online platform. There is also a need to come up with a university-wide policy on the conduct of virtual laboratory activities to minimize the challenges experienced by students. The teachers may also consider utilizing updated technological delivery platforms especially for virtual laboratory to cope with the needs of time. Lastly, the administration may revisit the policy on the conduct of face to face laboratory activities to give the future Science teachers enough experience in performing essential laboratory techniques needed for high school instruction.

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