

Physics Virtual Laboratory: Challenges Encountered By College of Education Science Students

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Abstract: *The primary purpose of this study is to determine the challenges encountered by the students in conducting virtual laboratories in physics in connection to their profiles, if their academic performance is affected by these challenges, and if there is a significant relationship between the challenges they encounter and their academic performance in terms of the given variables from Caraga State University, Amazon, Butuan City. A descriptive-correlational research design was used in this study and was conducted among 3rd year BSEd Science College students of the said university. Simple random sampling was applied upon selecting the participants, who were given a survey questionnaire through Google form as the research instrument. The gathered data were then tallied, analyzed, and interpreted. It was found that the identified challenges, in general, were described as somewhat challenging. In addition, the results also revealed that the major challenge encountered by the participants was mainly because of the distraction brought by social media and other websites. And the underlying problems were the gadgets they used and internet connectivity, which includes cell phones and mobile data. Also, it was found that the challenges they encountered had a positive relationship with their academic performance, although it did not warrant a significant relationship. Thus, an enrichment program is suggested in the latter part of this paper.*

Keywords: Academic performance, enrichment program, online distance learning.

1.0 Introduction

Physics is a natural science, which involves laws and properties of matters and forces. Learning physics is dealing with a complicated understanding of the various fundamental concepts that enable a person to know when, how, and why physics can be applied. One of the attributes of physics is Experiment. Gaining knowledge through experiments motivates students to bring scientific thinking to the systematic process of the strong, creative, and logical way between concepts and phenomena. According to (Matthew T. Sabasales, 2018) Physics teaching is not limited to learning theories and facts about various physical discoveries. In addition, to effectively teach physics that allows students to have a practical activity on the concepts for students to attain the most effective learning. John Dewey (1933) became very famous for his learning by doing concepts stating that students will learn much if they will be exposed to hands-on activities where their manipulative skills of the different variables in science experiments will be engaged in the learning process.

Due to the unforeseen spread of the Corona Virus (Covid-19), many had changed, especially in the field of education, Teacher and Students are forced to adjust to the new normal. Physics was one of the affected subjects by this new normal and laboratory activities are the most affected in this situation. To replace the traditional hands-on laboratory activities the current technology developed an enhanced computer-based resource called a Virtual Lab.

A virtual lab or Virtual Laboratory is a website or software for interactive learning based on the simulation of real phenomena. It allows the students to learn and understand the experiment using the internet. According to (Zaytoun,2005), virtual laboratories should contain computers with high speed, storage with a lot of capacity, relevant scientific software, and communications with the global network. According to (Mojica and Upmaci, 2022), Students believe that the primary role of a teaching laboratory is to provide hands-on experience and that, overall, the online modalities do not compare favorably to the traditional in-person laboratory approach. In the traditional way of experiments or hands-on experiments, the students will experience the first-hand experiment and students will enhance their collaborative skills, additionally, it is more enjoyable than the virtual laboratory.

According to (Mojica and Upmaci, 2022), In a study assessing affective measures (such as anxiety, emotional satisfaction, intellectual accessibility, and usefulness of the lab) in a traditional hands-on laboratory compared to a virtual environment, it was found that a decisive factor contributing to student success (regardless of the modality) was the instructor. In student learning, it depends on the instructor's method of teaching whether the imparted learning would be effective or not.

Although there is a system of ideas intended to explain this, the researchers desire to conduct this study to evaluate the challenges and identify its significant effects on learning physics through conducting Virtual Laboratories by the students in Caraga State University during this new normal online distance learning.

Furthermore, the purpose of this study is to determine the challenges that may be encountered by the students in conducting Virtual Laboratory in Physics and how this challenge affects students' performance in Physics subjects. Moreover, this study is beneficial to the students, instructors, and university and future researchers.

Statement of the Problem

This study aims to figure out the challenges encountered by college science education students in conducting virtual laboratories in physics. Specifically, the study sought answers to the following problem:

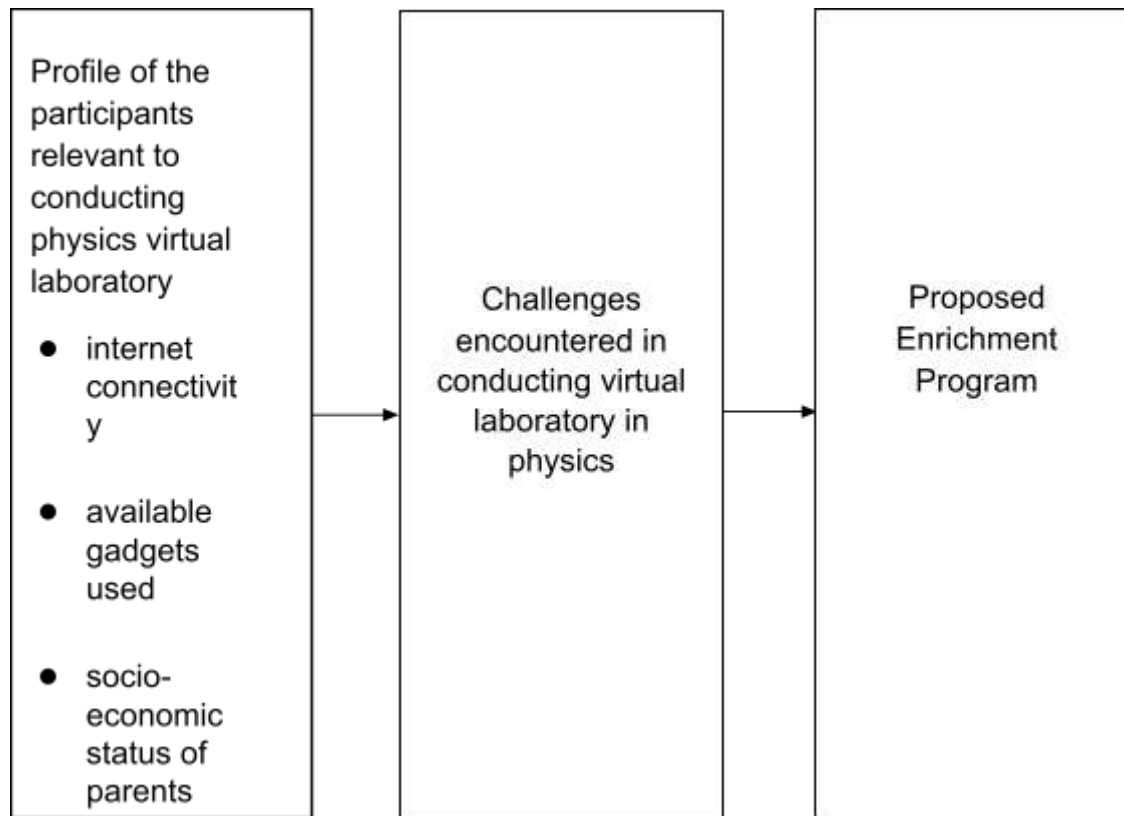
1. What is the profile of the participants relevant to conducting physics virtual laboratory in terms of :
 - 1.1 Internet connectivity.
 - 1.2 Available gadgets used; and
 - 1.3 Socio-economic status of parents?
2. What are the challenges encountered in conducting virtual laboratories in physics?
3. What is the academic performance of the participants in Physics?
4. Is there a significant relationship between the challenges encountered by the participants and their academic performance?
5. Based on the findings of the study, what enrichment program can be developed?

Theoretical and Conceptual Framework of the Study

This research is primarily based on two learning theories: social cognitive theory and social interaction theory. From the social cognitive perspective, cooperation involves modeling, coaching, and scaffolding (i.e., conceptual frameworks that provide an understanding of what is being learned) (Lave and Wenger, 1991). Ideally, the learner will cognitively rehearse and restructure information for it to be retained in memory and incorporated into existing cognitive structures (Wittrock, 1990). An effective way of doing so is by explaining the material being learned to a collaborator. Finally, social cognitive theory places cooperation at the center of a community of practice, a group of people who share a craft or a profession.

The theory Technology Acceptance Model (TAM) was propounded by Davis in 1989. The Technology Acceptance Model (TAM) is an information systems theory that models how users come to accept and use technology. The model suggests that when users are presented with new technology, several factors influence their decision about how and when they will use it. These factors are behavioral intentions, attitude and perceived usefulness of the system, perceived ease of use of the system, individual intention, and facilitating or organization condition.

Schematic Diagram of the Study



2.0 Methodology

This study used the descriptive-correlational research design employing the focused online survey procedure. It is a quantitative analysis because the nature of the study seeks to find the challenges encountered by the BSEd Science students in conducting virtual laboratories in Physics subjects. The researchers used an online survey questionnaire as the research instrument in gathering reliable data about the challenges encountered by the students.

This study used a simple random sampling design to draw a more precise sample size from the overall population. Simple random sampling is a probability sampling technique used to randomly select a sample size from a larger population to draw generalizations about the larger group. Since the researchers use random sampling, the population will have an equal opportunity to be part of the sample. Based on Slovin's formula, 86 sample size was obtained from 110 students which is the total population of Third year BSEd Science Students from Caraga State University-Main Campus.

The researchers made online survey questionnaires to gather the data from 3rd year BSEd Science students of Caraga State University-Main Campus, Amazon, Butuan City. The survey questionnaire is composed of three parts. The first part will be the participants' profiles relevant to conducting virtual laboratories. The second part contains pre-assumed challenges based on the experiences of the proponents that answer the questions as a significant data collection instrument. Moreover, the researchers use a five-point Likert scale survey questionnaire that answers the 23 surveys by indicating the level of consideration (generally, from 'Very much a Challenge', 'Somewhat Challenge', 'Neutral', 'Somewhat not Challenge', 'Not a challenge at all). And Part III is about the student's academic performance in physics subject. The questions on the questionnaire will give quantitative information about the challenges encountered among the Bachelor of Secondary Education Science students.

3.0 Results and Discussion

This chapter contains the results of the study conducted and a discussion of the findings based on the data gathered.

Problem 1: What is the profile of the participants relevant to conducting a physics virtual laboratory in terms of:

1.1 Internet connectivity;

Table 4 shows the percentage of the type of internet connectivity the students have in conducting virtual laboratories in physics. As indicated, mobile data gathered the greatest percentage, 52.3%, Wi-Fi gained the second Internet connectivity Frequency Percent Wi-Fi/broadband 35 40.7 Mobile Data 45 52.3 Piconet 4 4.7 Internet café 2 2.3 Total 86 100.0 27 highest with 40.7%, and then Piconet placed in the third rank of highest percentage with 4.7%, and the Internet café is the lowest with 2.3%.

The result shows that most of the BSEd science 3rd-year college students used mobile data as their main source of internet connectivity with a percentage of more than half. The result also shows that only a few of the students use an internet cafe. Thus, it indicates in concluding online laboratories most of the students use mobile data. In addition, it shows that mobile data is more affordable for the students than installing Wi-Fi /fiber at home or going to Piconet and internet café. Mobile data is cheaper than the rest of said sources of internet.

1.2 Available gadgets used

Table 5 shows the percentage of the types of available gadgets the students use in conducting virtual laboratories in physics. As indicated in table 5, the cellphone gathered the greatest percentage, 62.8%, followed by the use of laptops at 24.4%, then computer desktops at 10.5%, and lastly, the use of tablets, with only 2.3%. The result shows that most of the students used their cell phones as their instruments in conducting virtual laboratories, with a high percentage of more than half. Also, the result reveals that only a few students use tablets in conducting 28 virtual laboratories. The result simply implies that the most common instrument used in conducting virtual laboratories is the cellphone, in parallel to most of the students' type of internet connectivity, which is mobile data.

Even without COVID-19, students still use cell phones as their source of communication, and, used for educational purposes, it is more affordable to buy than laptops, tablets, and desktops. A cellphone is a multi-purpose gadget. There are many things you can do with it. You can also take it anywhere without a hustle.

1.3 Socio-economic Status of the parents

The table above shows the percentage of the socio-economic income of the student's parents. As indicated, 43.0% of the students' parents' socioeconomic income is around P10, 000.00 and below, followed by 19.8% with socio-economic status between P10,001.00 and \$15,000.00, then 16.35% with socio-economic status between P15,001.00 and 20,000.00, and lastly 5.8% with the socio-economic status of P25, 000 and above.

Based on the result, it indicates that most of the students' parents' socioeconomic income is around 10,000.00 and below. Also, it reveals that only a few of the students' parents' socio-economic status is above 25,000.00. Thus, based on the result, where most of the parents of students have a P 10,000 or below income, which simply means that not all of their parents can afford to buy a WiFi/Fiber or let their child go to piconet and internet café every time they conduct a study because it costs a lot of money, unlike with mobile data, which is much cheaper than the rest of that. You can buy a load for only 50 pesos, and it is good for 3 days, and buy a load worth 100 pesos good for 7 days. Also, you can buy a load worth 500 pesos good for 1 month. That's why most students used mobile data as their main source of internet in conducting virtual laboratories. In addition to the gadgets they used, it demonstrates that the majority of students use cell phones because not all parents can afford to buy a tablet, laptop, or desktop computer for their child because their socioeconomic status is insufficient to meet all of their needs.

According to the study by Barrot, Llenares, and Rosario (2021), Low-income families have limited access to good Internet service, online learning tools, and learning space at home. These learners usually described their lack of access to the Internet, materials, and other resources necessary for online learning as a result of their financial circumstances.

Problem 2: What are the challenges encountered in conducting a virtual laboratory in physics?

Table 7 shows the challenges encountered in conducting virtual laboratories in physics by the college of education science students. As shown in the table, four (4) out of twenty (20) given challenges encountered in conducting virtual laboratories were

labeled neutral or undetermined, namely: Slow internet connection due to geographic location with a weighted mean of 3.38; far and away from home internet café with a weighted mean of 3.08; lack of gadget to perform virtual laboratory with a weighted mean of 3.26; and rest were labeled somewhat challenging, namely: Difficulty in finishing virtual laboratory activities due to poor internet connection with a weighted mean of 3.59; Unstable internet access intended for conducting virtual laboratory activities with a weighted mean of 3.63; Insufficient amount of data in performing virtual laboratory with a weighted mean of 3.55; Difficulty in conducting virtual laboratory due to frequent brownouts with a weighted mean of 3.76; Insufficient phone internal storage required to conduct virtual simulations with a weighted mean of 3.60; Difficulty in understanding the concept in performing virtual laboratory with a weighted mean of 3.50; Difficulty in demonstrating knowledge and skills in the virtual laboratory with a weighted mean of 3.54; Difficulty in solving all the problems encountered in the virtual laboratory with a weighted mean of 3.62; Difficulty in understanding virtual laboratory simulation process instructions with a weighted mean of 3.50; Difficulty in a weighted mean of 3.62; Difficulty in understanding virtual laboratory simulation process instructions with a weighted mean of 3.50; Diff Distractions from social media and other websites with a weighted mean of 4.22; distraction from home (house chores, noises, etc.) with a weighted mean of 4.14; distraction 32 from peers with a weighted mean of 3.52; distraction from online games with a weighted mean of 3.65; and lastly, distraction from online entertainment/advertisement with a weighted mean of 3.67.

Based on the result, the overall weighted mean on the challenges encountered in conducting virtual laboratory in physics is 3.60, which is described as somewhat challenging. This simply indicates that the students encountered difficulties in conducting virtual laboratories in physics. In addition, the highest identified challenge identified by the participants as shown in the findings is statement no sixteen (16) which is a distraction from social media with a weighted mean of 4.22. Social media sites like Facebook, Twitter, Instagram, Tiktok, and Snapchat are widely used by students. Furthermore, the result also shows that the least considered challenge identified by the participants is statement number six (6), the distance from home to internet café, the statement with a weighted mean of 3.08. This is more likely due to what is reflected in the result in the participants' profiles, where most of the students use mobile data as their main source of internet connection and the mobile phone as their main instrument used in conducting virtual laboratories, which means that the students no longer need to go to an internet cafe to conduct virtual laboratories. Also, considering most of the student parents' socioeconomic status, which is around 10,000.00 and below, it is more efficient to use mobile data rather than go to an internet café for internet access, which is more costly compared to using mobile data.

According to Juškaite (2019), the findings demonstrate that it is possible to use the virtual laboratory to enhance students' ability to read and analyze graphic information, although traditional approaches are preferable for teaching students to interact with text and comprehend the context. However, in the study of Santos and Prudente (2022), there have been some criticisms of virtual laboratory activities due to difficulties in integrating the learning process, lack of practicality, and unfavorable student attitudes.

According to Ong, Prasetyo, Chuenvindee, Young, Doma, Caballes, Centeno, Morfe, and Bautista (2022), their data shows most students do not favor virtual laboratories because students do not experience the actual setting of experimenting with the online learning setup, which supports the detrimental effects on students of virtual laboratories (Ong et al., 2022)

Problem 3: What is the academic performance of the participants in Physics?

Table 8 shows the academic performance in physics by the college of education science students. According to table 8, the numerical grade range of 1.75- 2.00 gathered the greatest percentage 47.7% described as very good, followed by the numerical grade range of 1.00 -1.50 with 28% described as excellent, then the numerical grade range of 2.25-2.50 garnering 11.6% described as above average next, is the numerical grade of 3.00 second lowest percentage with 9.3% and finally the numerical grade of 2.75 as the lowest percentage with only 2.3%. While there is no student whose grades are 4.00 labeled as conditional; 5.00 labeled as failing, INC for incomplete, DRP for dropped and W labeled as withdrawn.

Based on the result, indicates that most of the student's academic performances describe as very good with a numerical grade range of 1.75-2.00 which gathered the greatest percentage of 47.7%. It also reveals that the numerical grade of 2.75 is the lowest percentage, with only 2.3% described as average, and no student has a failing grade, conditional or INC. Thus, the challenge encountered by the students in conducting virtual laboratory does not affect the student's academic performance due to the identified challenges which are the distractions from social media or other websites, followed by the distraction from home, games, and advertisements not strong enough to hinder student accomplish the activities in a virtual laboratory.

Abdillahi (2015), in his work, claims that virtual laboratories for teaching physics have an improvement in academic performance and attitude among students. The virtual laboratory may have a good effect on the academic 35 performance of students in physics but the challenges they encountered as said in this study shows that there is no negative impact on the academic performance of the BSEd science student.

Problem 4: Is there a significant relationship between the challenges encountered by the participants and their academic performance?

Table 9 shows the result of the correlation analysis between the challenges encountered by the participants in conducting virtual laboratories in physics and their academic performance. The table shows a correlation value of 0.051 and a p-value of 0.639, which indicates that there is a positive relationship between the two variables. However, the data did not warrant the significance of this relationship. Thus, the null hypothesis is not rejected.

Based on the result, it means that the challenges encountered by the students did not have a significant relationship to the student's academic performance, as evidenced by the p-value of 0.639, which is greater than 0.05, and concludes that there is no correlation between the two variables. According to Ambusaidi, Musawi, Lasisi, Al-Balushi, and K. Al-Balushi (2018), although utilizing the virtual laboratory changed the students' attitude towards the 36 virtual laboratories, it does not change or is less likely, to affect the academic performance of the students. Thus, despite numerous challenges such as a slow internet connection, the gadgets they use, and the destruction, they maintain a high level of performance in their academic physics subject.

In addition, the result reveals that there is no significant difference between the virtual laboratory and their academic performance due to the grading system of the physics subject because the laboratory has only 40% of the grade, compared to the lecture which has 60% of their grade.

Problem 5: Based on the findings of the study, what enrichment program can be developed?

The researchers found that the majority of the student's main source of internet connectivity is mobile data, and their main instrument used is the cellphone, which is directed to their parents' socio-economic income of around P10,000.00 and below. With this profile, the students encounter challenges in conducting virtual laboratory, which includes distraction from social media, which is identified as the highest challenge. However, the identified challenge does not affect the student's academic performance. With these findings, the researchers proposed an enrichment program entitled "Project PLACS-CVL: Physics Learning Assistance for College Students in Conducting Virtual Laboratory". This enrichment program, which refers to a suggested solution to the identified problem based on the findings of the study, aims to provide science education to 37 students with learning assistance that might help in overcoming the identified challenges. Caraga State University-Main Campus students are the beneficiaries of the said project to help the students who encounter challenges in conducting virtual laboratories.

Furthermore, the researchers did not include the physics virtual laboratory content because the researchers only aim at the challenges they faced during the virtual laboratory, their experiences while conducting it, such as the loss of internet connection, how durable their gadgets were, the instructions they provided, and the destruction (social media, house chores, etc.). In addition, the enrichment program contains 3 different enrichment activities such as peer tutorials, webinars for time management and goal-setting, and lastly the multimedia literacy tutorial. The enrichment program is a two-page document with three main enrichment activities. Each activity targets different challenges as identified by the participants of the study

4.0 Conclusions

The following conclusion was made based on the findings.

According to the study, many students use mobile data as their primary source of internet connection and, among the available gadgets, many students use mobile phones/cellphones as their primary medium in conducting virtual laboratories majority of students' parents have a P 10,000 or below income. The reason most students encounter challenges is that they can't afford to buy a WiFi or broadband connection or that they don't have the proper gadgets to use.

In terms of the challenges encountered by the students, the findings indicate that the main reasons students struggle in the virtual laboratory are due to distractions on social media, at home, and in games, as well as a slow internet connection and insufficient load, which can be attributed to the student's profile.

In terms of students' academic performance, it shows that the challenges they face during the virtual laboratory that students encounter do not affect their performance in physics. It means that despite the challenges they encountered, there is still excellent work being done during this virtual laboratory.

Further, there is no significant relationship between their grades and the virtual laboratory because of the grading system of the physics department at Caraga State University. Only 40% of the laboratory will count towards the grade in physics, while the lecture accounts for 60% of the grade. The challenges such as poor internet connectivity, the availability of gadgets, and instructional materials in the virtual laboratory, and destructions from doing virtual laboratory, while indicating that it is somewhat challenging, have no bearing on the academic performance of Caraga State University's BSEd Science students.

Lastly, the researchers conducted an enrichment program based on the results of this study. The enrichment program is "Project PLACS-CVL: Physics Learning Assistance for College Students in Conducting Virtual Laboratory" because the result of

this study reveals that conducting virtual laboratories in physics was somewhat challenging for the students. That's why the researchers want to help the students who were the most affected by the said challenges.

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