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Utilization of Student-Created Videos for Laboratory Activities in Physics

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ABSTRACT

The shift from a traditional to an online mode of learning due to COVID-19 pandemic led the researchers to conceptualize and create videos for students who have no access to a laboratory facility. This research assessed the effect of student-created videos to the academic performance of fifty-three (53) Bachelor of Secondary Education (BSED) students in Physics 1 (Electromagnetism) and 4 (Waves and Optics). The student-created videos served as the intervention of this research. Laboratory worksheets and survey tools were used for data gathering. The paired samples T-Test was utilized to determine the significant difference in the test scores before and after the intervention. Results showed that academic performance in Physics improved when coupled with student-created videos. Laboratory videos helped enhance the quality of the learning process. Therefore, this may be adopted in science subjects with laboratory component.

INTRODUCTION

The widespread outbreak of the COVID-19 pandemic has put education in a more complex and new teaching and learning environment. Every student tried to adjust to the new normal, particularly science students who are required to perform laboratory activities that can enhance the learners' knowledge and skills. Along with the continuous growth of technology, video and multimedia play a significant role in the rapid increase in secondary and higher education. Educators learned to utilize videos from various websites and social media platforms to enable the students to comprehend the concepts deeply. Student-created videos are undeniably helpful for the implementation of laboratory experiments.

Conducting experiments play in the holistic development of a student and the society at large. United Nations Educational Scientific and Cultural Organization (UNESCO, 2014) encourages schools to improve instruction to make Science and Mathematics more appealing and increase the interest of more learners to venture in these fields. Educational institutions are anchored in transforming learners to possess skills, thus, students are involved in doing PBL (Project Based Learning) to cultivate their interest and strengthen their attitude toward learning science and technology. In this study, the researchers designed videos as supplementary tools for laboratory activities in Physics 1 (Electromagnetism) and 4 (Waves and Optics).

The shift from a traditional to an online mode of learning due to COVID-19 pandemic led the researchers to conceptualize and create videos for students who have no access to a laboratory facility. In March 15, 2020, national and local governments in the Philippines imposed community quarantine as a measure to limit the spread of the virus (Olanday and Rigby, 2020). The

suspension of face-to-face classes is a significant issue in science education, particularly in Physics, because it requires experiments that should be conducted in a laboratory facility. Experiments in Science stimulate the mind through exploration and discovery, promoting critical thinking. Teaching science without experiments would not be as practical as teaching with it (Lindstorm, 1994 cited by DeWitt *et al.* (2013). In the same paper, it was stated that learners remember and understand better when they see, hear, and do. The author also mentioned that the level of a student's understanding of a subject during instruction is higher (75%) when they see, hear, and produce materials compared to students who only see during instruction (20%) and see and hear only (40%). Amidst the restrictions to conduct face-to-face classes due to the Covid-19 pandemic, the Laguna University (LU) continued the teaching-learning process by implementing the Seamless Blended Digital Learning Program (SBDLP) since the Summer Term, 2020 until at present. Through the university's learning management system all courses are delivered using digital modules that are made available to the students. All the learning resources such as files, power points, videos, and major examinations are uploaded through it as well.

The researchers having analyzed the problem came up with the idea of developing student-created videos by creating through a step-by-step procedure to follow that may help teachers and students develop, guide, and stimulate their interest in scientific inquiry. The challenges that this research tried to solve is not an isolated case. The results of the experiment conducted by researchers at Harvard University showed that using YouTube as an alternative is as effective and even more effective than live demonstrations (Fiorentino, 2020). Concerning that matter, a research published in 2015 investigated the

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effects of using digital video as an enhancing tool for teaching students' laboratory-based lessons. The benefits of using video are the development of more autonomous learners; more time to pool and analyses class data; demonstrators' time used for higher-level interaction with students, and the production of reusable learning objects forming the basis of more inquiry-based laboratory learning (Croker *et al.*, 2015).

This research assessed the effect of student-created videos to the academic performance in Physics 1 and 4. In the study of Smith (2016), student-created reflective videos contributed significant learning that can "count" as a creative form of self-expression as well as an alternative method of measuring the learning process throughout Project Based Learning (PBL).

Objectives of the Study

This study specifically sought:

- 1) To identify the challenges encountered by science students in conducting laboratory activities;
- 2) To design student-created videos as learning tools to conduct laboratory activities in Physics;
- 3) To assess the academic performance of the respondents before and after the intervention; and
- 4) To determine the effectiveness of the intervention in terms of: a) Suitability b) Relevance c) Level of engagement d) Audio-visual quality.

LITERATURE REVIEW

According to Jackman (2019), YouTube is one of the modern e-resources that can be utilized in the modern tertiary instructional method. Jackman (2019) added that it is the foremost broadly used view facilitating site, as seen as noticeable modern e-resources with various benefits within the college classroom too. As stated by Seilstad (2009) YouTube clips are fair a basic way to form the instructing fabric related and indicated. The results display the effectiveness of utilizing YouTube recordings on the accomplishment of understudies and individual reflection on their learning advance (Almurashi, 2016). However, one of the most significant obstacles for students in efficiently using the internet is information overload, which may necessitate students allocating time to select the helpful and acceptable material (Dubovi & Tabak, 2020). This action is stern when new or inexperienced users seek to validate and analyze the dependability of resources. Dubovi & Tabak (2020) also stated another issue that YouTube users have while using videos for learning: the uneven quality of the accessible videos. Since You tube is well-known for its simplicity of use, especially for youngsters, the aspect of perceived ease of use in examining it may be meaningless for adult students (Ponce et.al, 2017). YouTube offers a low barrier to entry for children due to its basic and straightforward UI (User Interface). To avoid problems with the use of videos for teaching and learning, it is necessary to customize videos based on the needs of the learners.

This study is anchored on the Cognitive Theory of

Multimedia Learning by Mayer and Moreno (2002), active learning is more efficient when both auditory and visual channels are activated simultaneously under the principle that we have in auditory and visual channels for information processing and memory building. Furthermore, Eick and King (2012) stated that the use of instructional videos demonstrates that videos attract visual learners. This supports the cognitive theory of multimedia learning. Moreover, Buzzetto-More (2014) stated that viewing videos from YouTube has been found to hold students' attention. Lastly, Youtube videos boost the learning process and make learning more meaningful (Buzzetto-More, 2013).

Another well-known network learning theories built for e-learning environments is Connectivism. According to Siemens (2006), Connectivism is a philosophical paradigm that views learning as perceived as a network phenomenon mediated by technology and socialization. In Connectivism, the starting point for learning occurs when learners connect with and engage in a learning environment to act on knowledge. Clustering similar areas of interest that enables interaction, sharing, dialog, and thinking together is known as "learning communities" (Siemens, 2006). Thus, as stated by Milligan (2006) learners can now build personal learning environments that allow them to generate as well as consume learning. Since knowledge is continuously evolving, new additions to the field can influence its importance. Based on the information learned, students need to access new information, determine its importance, and make decisions. Significant skills that contribute to learning are the ability to search out current knowledge and process secondary and international information.

Studies on the relationship of student-created videos to the academic performance of Physics students are still limited. The study results will benefit both students and teachers because teaching and learning laboratory-related topics can be effective without complicated equipment. Moreover, this study is beneficial because it proposed some guidelines for making compelling videos for teaching Physics, particularly in laboratory activities.

METHODOLOGY

Research Design

The research study is a quasi-experimental design based on data collection, analysis, and interpretation. In this study, the quasi-experimental research allowed the researchers to draw more unambiguous conclusions about the causal relationship between two variables (Marsden & Torgerson, 2012). Moreover, in the quasi-experimental design, pre-test and post-test were used to examine the effectiveness of the student-created videos for laboratory activities in Physics 1 and 4. It assessed the academic performance of BSED Students at Laguna University after implementing the student-created videos for laboratory activities in Physics. The study covered Physics 1 (Electromagnetism) and Physics 4 (Waves and Optics).

Worksheets and survey tools were used in collecting data.

This method served as an opportunity to share their experiences across the research process. In addition, this enriched their ability and allowed the respondents to answer the questions profoundly. The research design improved the understanding of the causal effects of various educational policies and interventions by focusing on internal validity—did the policy or intervention being studied cause a significant change in the observed outcome (and if so, by how much)—thereby yielding an unbiased estimate of the average treatment effect (Campbell, 1957).

Lastly, the data were gathered, summarized, and analyzed to achieve the study's objectives.

Research Locale

The study was conducted at the College of Education of Laguna University located at Brgy. Bubukal, Santa Cruz, Laguna Sports Complex. It offers Bachelor of Secondary Education (BSEd) Program major in science. This institution was selected to determine the effect of student-created videos to the academic performance of BSEd Physics students.

Population of the Study

Thirty-five (35) BSEd-2 Science students were selected as respondents for Physics 1 (Electricity and Magnetism) course, and eighteen (18) students from BSEd-3 Science were selected as respondents for Physics 4 (Waves and Optics) in the first semester A.Y. 2021-22 (September to October). A total of fifty-three (53) students participated in the study.

Research Instruments

A survey form was used to identify the challenges encountered by the students in courses with laboratories. The study underwent three stages towards completion:

Planning Stage

The digital modules uploaded in the Learning Management System of Laguna University, ilearnu, served as the basis to develop the video content and laboratory worksheets (pre-test and post-test). The two modules developed by Science teachers were: Physics 1 (Electricity and Magnetism) and Physics 4 (Waves and Optics).

Development Stage

An outline on video content was prepared by the researchers and was validated by two Science teachers with doctorate degree and with ten years of teaching experience. Actual materials were used to enhance the video content. The videos were uploaded to the Youtube Channel, IlabUAgam TECH which can be accessed via this link: <https://www.youtube.com/channel/UCEJ0gBsEuvwAM9pv5q2tx2g>. Laboratory worksheets parallel to the student-created videos were created for Physics 1 and Physics 4. The topics in Physics 1 were Series and Parallel Circuit and Magnetism to Electricity while Physics 4 included topics on Real and Virtual Images and

Behavior of Light. To determine the perceptions of the students on the student-created videos, the researchers used a survey tool that was administered using google form. The first part of the questionnaire was the respondents' baseline information. The second part consists of questions about the respondents' experiences in utilizing student-created videos on YouTube that were designed to conduct laboratory activities. The last part assessed the perceptions or opinions on the student-created videos.

Validation Stage

This stage includes the assessment of the student-created videos of two chosen experts. Revisions on the videos were done based on their evaluation, comments, and suggestions to further improve the material. The laboratory worksheets and evaluation form on the perception on the student-created videos were also validated by the experts.

Data Gathering

The challenges encountered by the students in terms of courses with laboratories were gathered with the use of Google forms. The data was obtained from students' scores in their laboratory activities in the pre-test and post-test. In the pre-test, the researchers provided the digital modules of Laguna University as a basis to answer laboratory worksheets. For the post-intervention stage, worksheets were coupled with student-created videos in Physics 1 and 4. After that, a post-test was administered. The researchers also conducted online surveys through structured questionnaires using Google Docs that focused on the student's perceptions of using student-created videos for conducting laboratory activities in Physics. To evaluate the effectiveness of the intervention the following criteria were included in the survey:

- a. Suitability (fitness of the intervention that meets the students' needs)
- b. Audio-visual quality (quality of the sound that is aligned to the sequence of visuals being shown)
- c. Level of engagement (describes the level of motivation of the students that includes positive emotional connection)
- d. Relevance (appropriateness of intervention and parallelism to the worksheets)

Treatment of the Data

The performance of Physics students before the intervention was measured by conducting a pre-test. The student-created videos were shown to the students before giving the post-test. The result of the pre-test and post-test served as a basis to determine if the academic performance improved after the intervention (student-created videos).

The raw scores in the pre-test and post-test were recorded and subjected to statistical analysis. Descriptive statistics such as frequency distribution and means were computed. The Paired Sample T-test (alpha of 0.05) was used to

determine if there was a significant difference in the test scores in the pre-intervention and post-intervention stages. Parallel to the average pre-test and post-test scores, a proficiency scale from Sabales (2018) was adopted and modified and was utilized for data interpretation. For the survey tool, a likert scale from 1-5 was used for the evaluation of student-created videos. The corresponding interpretation were as follows: outstanding, above average, average, below average, and needs improvement.

RESULTS AND DISCUSSION

Before the pandemic, laboratory activities in Physics were conducted inside the university, However, when the pandemic started, students conducted their experiments at home. The researchers thought of creating videos to address this concern. This study showed the effect of utilizing student-created videos to the academic performance in Physics 1 and 4. The respondents' level of academic performance was higher in the post-intervention stage. Moreover, these findings were similar to the study by (Nadelson, Scaggs, Sheffield, and McDougal, 2014), who found an increase in knowledge and performance in the laboratory, after exposure to the

videos, to the reiteration of content. Learning tools in the form of videos were helpful due to their authentic content. Another study by Richtberg and Girwidz (2019) stated that students show a positive attitude toward educational videos on YouTube. Also, 76% of the students rated the quality of the educational videos as good and very good.

Challenges Encountered in Science Courses in Conducting Laboratory Activities

Table 1 shows the challenges encountered by Physics students with their laboratory courses. Majority (90%) of the respondents said that lack of laboratory materials and equipment is the first in rank when it comes to their Physics laboratory. Half of the respondents (55%) stated that lack of money to buy the required materials are one of the challenges they encountered. Some (45%) stated that one video or reference is not enough to answer all the questions in the worksheet. Thirty-five percent of the respondents (35%) encountered difficulty in following the procedure in their laboratory courses. Thirty percent of the respondents (30%) experienced difficulty in finding references to answer the worksheets while few (15%) have other reasons.

Table 1: Challenges encountered in Physics Courses when Conducting Laboratory Activities

Challenges Encountered	Number of Respondents	Percentage
Lack of laboratory materials and equipment	18	90%
Lack of money to buy the required materials	11	55%
Difficulty in following the procedure	7	35%
Difficulty in finding references to answer the worksheets	6	30%
One video/reference is not enough to answer all the questions in the worksheet	9	45%
Others	3	15%

The challenges encountered by the students in courses with laboratory were (from greatest to least):

1. lack of laboratory materials and equipment;
2. lack of money to buy the required materials;
3. one video/reference is not enough to answer all the questions in the worksheet;
4. difficulty in following the procedure;
5. difficulty in finding references to answer the worksheets

The result of the survey served as the basis for creating videos as supplementary tools in Physics 1 and 4.

Academic performance in Physics

Table 2 shows the results of the average scores of the respondents before and after the intervention. The data from the given set of scores in the pre-test shows that in PHY1- Series and Parallel Circuit, the respondents

achieved “Proficient level” with an average score of 16.31 and in PHY1- Magnetism to Electricity the respondents achieved “Approaching Proficiency” level with an average score of 9.54. The respondents in PHY4-Real and Virtual Image achieved developing level with an average of 8.83 and PHY4-Behavior of Light respondents achieved approaching proficiency level with an average of 15.67.

The data obtained from the scores of the post-test of BSEd reveals that the respondents in PHY1-Series and Parallel Circuit achieved “Proficient level” with an average score of 18.6 and PHY1-Magnetism to electricity achieved “Proficient level” with an average score of 12.4. The respondents in PHY4-Real and Virtual Images achieved “Approaching Proficiency” level with an average score of 13.28 and PHY4-Behavior of Light respondents achieved “Proficient level” with an average score of 17.83.

Table 2: Summary of the Average Scores of all the Respondents Before and After the Intervention

Topics	Pre-test Score	*Proficiency Level	Post-test Score	*Proficiency Level
PHY1-Series and Parallel Circuit	16.31	Proficient	18.6	Proficient
PHY1- Magnetism to Electricity	9.54	Approaching Proficient	12.4	Proficient

PHY4-Real and Virtual Images	8.83	Developing	13.28	Approaching Proficiency
PHY4-Behavior of Light	15.67	Approaching Proficiency	17.83	Proficient

*Source: Scale adopted and modified from Sabales (2018)

Table 3 shows the p-value for each topic in Physics. The lower the p-value (less than 0.5), the higher the significant difference between the pre-test and post-test scores. Pace and Jones (2009) pointed out that viewing videos incorporating contextual examples provide an opportunity to build scientific literacy, a common goal of curricula. Table 3 shows that the topic in Physics 4- Behavior of Light had the lowest p-value meaning the student-created video had a significant difference in improving the proficiency of the students. This was followed by the

Table 3: Summary of the results of t-Test: Paired two sample for means

Topic	P-Value
Physics 4: Behavior of Light	0.000197957
Physics 1: Magnetism to Electricity	0.000269751
Physics 4: Real and Virtual Images	0.000811789
Physics 1: Series and Parallel Circuit	0.025634798

topic, Physics 1-Magnetism and Electricity and topic on Physics 4- Real and Virtual Images, respectively. The topic wherein the proficiency level had the least significant difference was related to Physics 1- Series and Parallel Circuit. This study is similar to the study of Al Musleh (2017) wherein about 92% of the students agree that the laboratory videos helped them prepare for laboratory activities ahead of time. In the same study, approximately 80% of the students prefer to watch the laboratory videos rather than read the traditional laboratory sheets, while these videos do not cover all the information supplied in the laboratory hand out nor the theory part of the experiment. Ninety percent (90%) of the respondents of Al Musleh agree that the videos helped them make better use of their time during the actual laboratory activity, and to get more accurate results.

Students' Perception on the student- created videos Suitability

Table 4 shows the percentage of the responses from 53 students of selected BSEd Science majors about the

Table 4: Suitability of the student-created video in Physics

Scale	Number of Respondents	Percentage
Outstanding	23	43.4%
Above average	21	39.6%
Average	8	15.1%
Below Average	1	1.9%
Needs Improvement	0	0%

suitability of student-created videos as a learning tool for conducting laboratory activities in Physics. Less than half of the respondents (43.4%) strongly agree, and some (39.6%) answered agree. Still, there were some respondents (15.1%) in a neutral state.

Audio-Visual Quality

Table 5 shows the percentage of the responses from 53 respondents of selected BSEd Science major on the audio-visual quality of student-created videos. Some respondents (35.8%) gave above average while 35.8% gave average rate too. Meanwhile, some respondents (28.3%) gave an outstanding rate.

Table 5: Student-created videos in terms of audio-visual quality

Scale	Number of Respondents	Percentage
Outstanding	15	28.3%
Above Average	19	35.8%
Average	19	35.8%
Below Average	0	0%
Needs Improvement	0	0%

Level of Engagement

Table 6 shows the percentage of the responses from 53 respondents of the selected BSEd Science major in terms of the level of engagement with the video. Some respondents (35.8%) gave an outstanding rate, and 34% gave an above-average rate. Meanwhile, some respondents gave an average rate of 28.3%.

Table 6: Student-created videos in terms of being engaging

Scale	Number of Respondents	Percentage
Outstanding	19	35.8%
Above Average	18	34%
Average	15	28.3%
Below Average	1	1.9%
Needs Improvement	0	0%

Relevance

Student-created videos allow the users to watch and analyze the videos ranging from 5 to 10 minutes. Bos *et al.* (2016) stated that watching recorded videos as a supplement in class heightened the efficiency of the knowledge base of the learners compared to simply watching videos of lectures that did not contribute to learning. Arifin *et al.* (2020) stated that watching YouTube

videos in class enhances the ability of the learner to comprehend and elicit information. It enables the learner to grasp the lesson efficiently and lively manner. It can make the learning process more delightful and meaningful. Furthermore, YouTube videos depict more realistically and comprehensively than conventional teaching methods. Yaacob & Md Saad (2020) also stated that using YouTube as a learning platform can help users accomplish various learning objectives, including cognitive, social, emotional, and behavioral. Videos on Youtube related to certain topics may be able to assist users in improving their cognitive abilities.

Table 7 shows that more than half of the respondents (54.7%) gave outstanding rate, while 26.4% gave an above-average rate. Meanwhile, some respondents (18.9%) gave an average rate of 28.3%.

Brame (2016) stated in her article that the effective use of video as an educational tool is increased once instructors consider three elements which are the following: managing a cognitive feature load of the video; increasing

Table 7: Relevance of the student-created videos to the topic

Scale	Number of Respondents	Percentage
Outstanding	29	54.7%
Above Average	14	26.4%
Average	10	18.9%
Below Average	0	0%
Needs Improvement	0	0%

student engagement with the video and promoting active learning from the video. Brame (2016) added that a few recommendations considering these three elements are keeping videos brief and centered on learning objectives, using audio-visual elements to deliver suitable explanations, making these elements balanced instead of redundant, emphasizing significant ideas and concepts, using a casual style to enrich engagement, and embed videos of active learning with guide questions, interactive elements, or supplementary assignments. The student-created videos were suitable learning tools for conducting laboratory activities in Physics. For the videos to be effective, they should be relevant to the topic, engaging, and possess a pleasing audio-visual quality.

The role of Science teachers in creating their own material for instruction and assessments is as critical as their techniques and strategies provide the medium to design learning tools. As such, it is very significant to consider their competencies to develop students' research skills, helping them refine their projects, and training them to become problem-solvers, critical thinkers, and creative thinkers (DOST-SEI & UPNISMED, 2011).

Based on the data analysis, these were the significant findings:

1. The challenges encountered by the students in courses with laboratory were (from greatest to least):

- a. lack of laboratory materials and equipment;
- b. lack of money to buy the required materials;
- c. one video/reference is not enough to answer all the questions in the worksheet;
- d. difficulty in following the procedure;
- e. difficulty in finding references to answer the worksheets

2. The pre-test average score of the students in PHY1-Series and Parallel Circuit is 16.31 with a rating of "proficient" while the average post-test score is 18.6 with a rating of "proficient." The average pre-test score of the students in PHY1-Magnetism and Electricity is 9.54 with a rating of "approaching proficiency," while the post-test average score is 12.4 with a rating of "proficient."

3. The average pre-test score of the students in PHY4-Real and Virtual Images is 8.83 has a rating of "developing level" while the average post-test score is 13.28 with a rating of "approaching proficiency." The pre-test average score of the students in PHY4-Behavior of Light is 15.67 with a rating of "approaching proficiency" while the post-test average score is 17.83 with a rating of "proficient."

4. The topic in Physics 4-Behavior of Light had the lowest p-value meaning the student-created video had a significant difference in improving the proficiency of the students. This was followed by the topic in Physics 1-Magnetism and Electricity and the topic in Physics 4-Real and Virtual Images, respectively. The topic wherein the proficiency level had the least significant difference was related to Physics 1- Series and Parallel Circuit.

5. The students' overall satisfaction with the student-created videos used as a learning tool for conducting laboratory activities in Physics is high (47.2%) with a description of "strongly agree."

6. The students' rate in the suitability of the student-created videos as a learning tool for conducting laboratory activities in Physics is high (43.4%), with a description of "outstanding." The students' rate in the relevance of the student-created videos to the topic is high (54.7%) with a description of "outstanding." The students' rate in the engagement level of the student-created videos is high (35.8%) with a description of "outstanding." The students rate of the audio-visual quality of the student-created videos is high (35.8%), "above average."

CONCLUSION

Based on the findings of the study the following conclusions were obtained:

- Lack of laboratory materials and equipment was the first in rank regarding the challenges encountered by the students in science courses with laboratory.
- Laboratory activities in Physics were effective if coupled with student-created videos.
- The respondents' level of academic performance with the use of student-created videos was higher in the post-intervention stage.
- The topic in Physics 4- Behavior of Light had the lowest p-value meaning the student-created video significantly improved the students' proficiency. This

was followed by the topic, Physics 1-Magnetism and Electricity and the topic in Physics 4- Real and Virtual Images. In contrast, the topic in Physics 1: Series and Parallel Circuit had the least significant difference in improving the proficiency level.

- The student-created videos were suitable learning tools for conducting laboratory activities in Physics. According to the respondents, the videos were relevant to the topic, engaging, and have a pleasing audio-visual quality.

RECOMMENDATIONS

Considering the conclusions drawn from the findings, the recommendations of the study are as follows:

- 1) Science teachers may integrate learning tools into their teaching strategy to help solve the lack of access to laboratory materials and equipment, especially during a pandemic. The components of an effective learning tool included in this study may be used as a basis for the implementation.

- 2) The student-created video should be concise, but to the point, focusing on the most relevant aspects of the experiment to facilitate the learning process.

- 3) Other researchers can also assess the effectiveness of student-created videos across different topics.

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