American Journal of Educational Research, 2022, Vol. 10, No. 4, 194-200
Available online at http://pubs.sciepub.com/education/10/4/6
Published by Science and Education Publishing
DOI:10.12691/education-10-4-6

Design, Development, and Validation of Phenomenon-Based Learning Video for Asynchronous Remote Instruction

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Received March 04, 2022; Revised April 06, 2022; Accepted April 12, 2022

Abstract Todays' educational landscape is continuously changing and becoming more complex. Thus, educators, who are in the frontline in coping up to this ever-changing landscape of education, should also continuously innovate new pedagogy to improve the quality of learning and produce globally competitive individuals. The goal of this research is to design, develop, and validate the phenomenon-based learning videos in Calculus for asynchronous remote instruction. Descriptive research design and a validated researcher-made instrument were used in this study. Thirty mathematics experts in mathematics or mathematics education evaluated the phenomenon-based learning videos based on three categories: subject, content, and technical aspect. Results showed that every indicator under each category is highly acceptable. This implies that the overall design and development of the phenomenon-based learning videos are highly acceptable. Hence, these videos are recommended to be used in Calculus especially in asynchronous remote instruction.

Keywords: *learning video material, educational video, instructional material, development and validation, mathematics education, asynchronous remote instruction, phenomenon-based learning*

Cite This Article: Jenny C. Cano, and Laila S. Lomibao, "Design, Development, and Validation of Phenomenon-Based Learning Video for Asynchronous Remote Instruction." *American Journal of Educational Research*, vol. 10, no. 4 (2022): 194-200. doi: 10.12691/education-10-4-6.

1. Introduction

With the constantly increasing advancement in education and technology, the method and practice of teaching and learning have also continuously restructured and more innovations have been designed to cope up and adapt to the ever-changing educational landscape. Educators are undeniably the frontrunners of this movement as they are primarily one of those who know what is best for a productive learning environment. Accordingly, productive learning environment is a representation of all of the important elements that go into making a successful educational program [1].

Having served the needs of an expanding population of nontraditional students who find education crucial for jobs in today's digital age, distance learning is becoming an increasingly important element of higher education [2]. More so with the rise of Covid-19 pandemic, distance online learning education (both synchronous and asynchronous) has been the best resort of many higher education in the world, especially in the Philippines, to continue and facilitate student learning activities [3,4].

Online asynchronous learning can be as excellent as, if not better than, face-to-face instruction when courses are well-designed and contain intentional student-centered pedagogies such as active learning [5]. Thus, educators should carefully prepare varied online activities to promote active online participation and post video clips or online class recording so that students will have enough time to process the information [6]. Several studies have shown that the use of instructor-generated video or short video lectures for synchronous/asynchronous online learning positively influenced the overall performance of students [7,8,9].

In 2016, a phenomenon-based learning pedagogy was officially launched at Finland educational system. It is a form of learning anchored on the theory of constructivism where students learn about real-world topic in a multidisciplinary way rather than in a subject-based approach [10]. More precisely, this learning pedagogy encourages students to apply what they have learned in the classroom to real-world phenomena and to learn by understanding what they are doing, thus, learners' learning is focused rather than the teacher's teaching [11].

Hence, based on the gathered literatures showing that most of the videos used in asynchronous online learning are short-video lectures or instructor-generated videos, it prompted the researchers to develop a phenomenon-based learning video in order to support and integrate phenomena which have been previously overlooked in

mathematics education [11]. It is believed that when students' interests are given importance and real-world phenomena are used, they will learn in a more meaningful way [12].

The goal of this research was to design, develop, and validate phenomenon-based learning videos for asynchronous remote instruction. These video learning materials aim to facilitate more meaningful students' learning experiences promoting deep learning and understanding by integrating real-world phenomena in relation to certain topics in Calculus.

2. Materials and Methods

This research utilized descriptive research design. Quantitative data were collected to describe the level of acceptability of the phenomenon-based learning videos in terms of its subject, content, and technical aspect. Comments and feedbacks, embedded in the researcher-made instrument, were also gathered from the respondents to support the findings and describe further the characteristics of the phenomenon-based learning videos, thus, giving a deeper understanding of the respondents' insights on the design of the developed materials. According to Dulock as cited by [13], when describing events, the descriptive research design is most useful.

The respondents of this research were the mathematics experts handling mathematics subjects for more than five years and with masters or doctorate degrees in mathematics or mathematics education. A total of thirty (30) mathematics experts assessed and evaluated the phenomenon-based learning videos for its acceptability level; 1 from Thailand, 1 from USA, and 28 from Philippines (Regions 10, 11, 12, and 13).

A researcher-made 5-point Likert scale was used as instrument of this study. It was validated by six (6) experts with doctorate degrees in mathematics and information technology for face and content validity. As a result, the instrument got a perfect content validity index (CVI) of 1.00 which is greater than the acceptable CVI value of 0.83 [14].

The phenomenon-based learning videos presented different real-world phenomena with connection to topics in derivatives in Calculus for college or university students. The researchers surveyed existing educational videos used for inputs in designing and developing the phenomenon-based learning videos.

During the analysis stage, the researchers conducted a thorough analysis on some gaps in improving students' performance in mathematics using videos and making their learning in mathematics more meaningful in their lives and in the community as well. Further, the researchers carefully reviewed previous and existing articles and theories of learning as these are very crucial in making new innovations to improve the teaching and learning process in mathematics. After having identified the needs to create a learning video that integrates real-world phenomena, the researchers identified five (5) basic principles in designing the so-called phenomenon-based learning videos as shown in Figure 1. Next, the researchers determined the flow of the video and created a sample video depicting the real-world phenomenon HIV. The created sample video was assessed and validated by six (6) mathematics professors with doctorate degrees in mathematics education and applied mathematics from a certain state university. Then, comments and suggestions were incorporated in making the final phenomenon-based learning video.

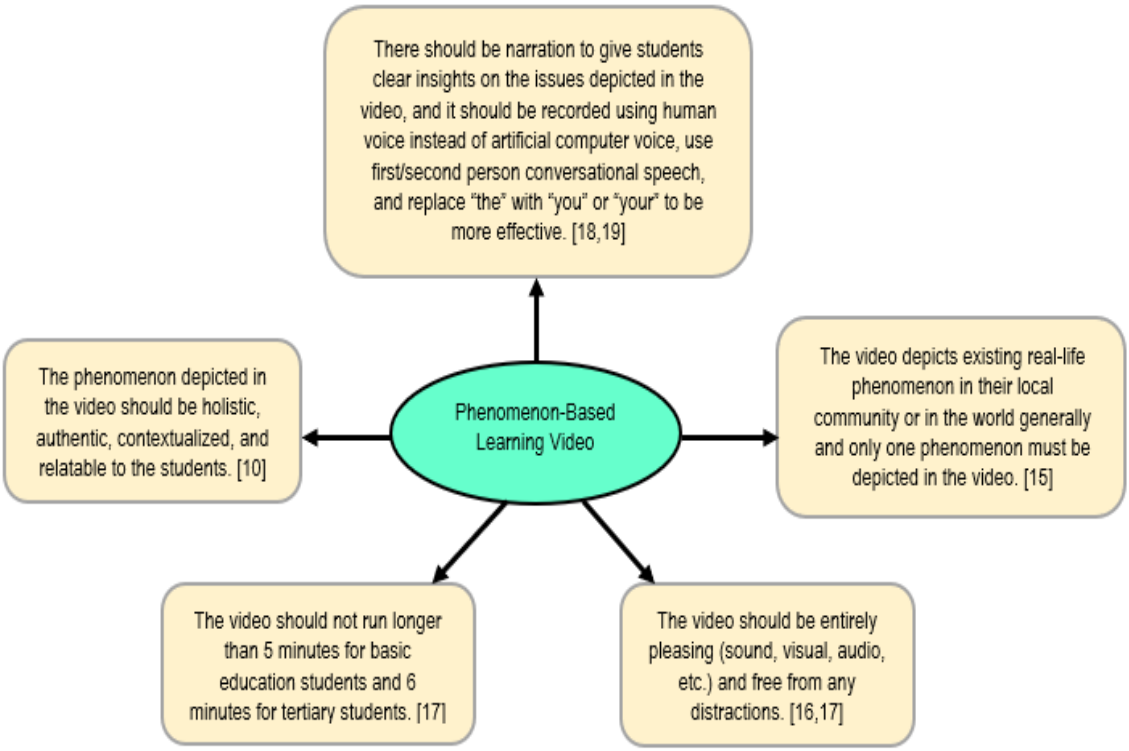

Figure 1. Five Basic Principles of Phenomenon-Based Learning Videos

The researchers created eight phenomenon-based learning videos integrating the following real-world phenomena: HIV, Covid-19, 2022 Philippine Election, Flooding, Sea-Level Rise, Unemployment Rate, Investment Scam, and Traffic Congestion. The phenomenon-based learning video started by presenting a certain phenomenon, followed by how Calculus relates to the phenomena showing a sample problem, and lastly, presentation of the student's task. In this case, the student's task is to create their own problem based on the phenomena and find a solution for this problem by applying what they have learned from the discussion during the week. It should be noted also that references of the images or videos used in the phenomenon-based learning video must be cited accordingly. Before the evaluation phase, the eight phenomenon-based learning videos developed by the researchers were forwarded to the six mathematics professors to check and verify if comments and suggestions were incorporated. Thirty mathematics experts evaluated the phenomenon-based learning videos developed by the researchers.

The researchers identified the names and contact information of the thirty (30) mathematics educators who teach mathematics for more than five years whether in high school or tertiary schools. These mathematics educators have at least master's degree or doctorate degree in mathematics or mathematics education. Then, an invitation letter was sent to their email address inviting them as one of the mathematics experts who will evaluate the phenomenon-based learning videos and all of them willingly responded. The phenomenon-based learning videos were saved in a google drive and the link was included in the invitation letter so that the respondents can access the videos anytime. The validated researcher-made checklist for the evaluation of the videos was also sent via email together with the invitation letter. The evaluators were also informed to give their comments or feedbacks on the phenomenon-based learning videos in terms of the subject (phenomena), content, and technical aspect. After one week, the researchers started the retrieval of the results of the evaluation from the mathematics experts, and these results were recorded. The respondents in this study were told that their responses would be kept confidential, that their privacy would be protected, and that their responses would only be utilized for the purposes of the study.

Since a 5-point Likert scale was used in this study, the researchers employed mean and standard deviation to analyze the data. These statistical tools are deemed appropriate because the gathered data are continuous. According to Chris Dewberry as cited by [13], if the data is continuous, the mean is the appropriate measure of central tendency to use because every data value contributes to the calculation of the mean. Further, standard deviation (SD) is used to get an information of how far the individual responses to a question or statement vary or deviate from the mean.

3. Results and Discussion

The phenomenon-based learning videos were evaluated in three categories, namely, subject, content, and technical aspect. The *subject* criterion refers to the authenticity, contextuality, and relatability of the phenomena depicted in the video. *Content* refers to how the images, graphics, narration, and language are used effectively in relation to the subject, including the clarity and time duration of the video. The *technical aspect* refers to how the audio, transitions, animations, colors, and images are composed and used effectively.

Table 1 presents the descriptive statistics of the mathematics experts' evaluation of the phenomenon-based learning videos in terms of the subject which is the presentation of phenomena. It can be seen that all indicators are highly acceptable. As a result, the overall rating is highly acceptable with grand mean of 4.87 and standard deviation of 0.36. Thus, the average distance from the left of the grand mean lies to the right of 4.50 which implies that the mathematics experts have generally agreed the excellent presentation of the different phenomena in the videos in terms of authenticity, contextuality, relatability, and curiosity for meaningful exploration. This is very crucial since the primary goal of the phenomenon-based learning is to use the phenomenon as a source for exploration of students to gain practical learning and develop the competencies they need for their lives [10]. With excellent presentation of the phenomenon, students can do deep and meaningful observation and gather valuable experiences related to the phenomenon under investigation [20]. The phenomenon-based learning video, specifically the phenomenon presented in the video, is the material that students will use for learning and therefore, its systematic arrangement and presentation will help students understand it better and use it efficiently [21,22].

Moreover, comments and feedback from the mathematics experts support these findings on the phenomenon-based learning videos in terms of the subject. They have noted that the phenomena presented in the videos were well researched and very relevant and timely which everyone, especially the government, must resolve. The following respondents narrated that:

> **Verbatim:** *"The subjects presented are real-world problems that are applications of Differential Calculus. The presentation could be easily understood and grasped by the learners since these subjects are in local setting familiar to them."* **(R1)**
>
> **Verbatim:** *"The phenomenon presented were timely and relatable. They can ignite students' curiosity about how they can see or apply mathematics on those phenomenon."* **(R2)**
>
> **Verbatim:** *"The phenomena presented were well researched and covering topics which need attention and solution in our present time. Also, these topics must be addressed by the Philippine government."* **(R5)**

The evaluators also said that the phenomena presented are not just relevant but also appropriate for the learners to watch and analyze. Hence, the presentation of the different phenomena in the videos really promotes a thorough and systematic examination of current, authentic, and real-life issues.

Figure 2 shows a collage of screenshots of the video presenting the phenomenon COVID-19. The phenomenon COVID-19 is being depicted by narrating relevant and up-to-date information or data accompanied by appropriate images to make it realistic and more relatable to the

students. Then, the video describes how Calculus is related and become relevant in solving problems related to COVID-19. A specific task for students is then given where they can apply their knowledge on Calculus. Lastly, sources of data and images are cited or acknowledged. As reported, videos should always be targeted to the learning goals and must be embedded with guiding questions or tasks to promote active learning [23]. Further, in designing a video, one must give more attention in writing the video concept such as content, description, text, and duration in order to achieve its purpose and make students' learning more successful and meaningful [24].

Table 1. Mathematics Experts' Evaluation of Phenomenon-Based Learning Videos in terms of Subject

Indicators	Mean	SD	Description
1. The phenomena presented are authentic.	4.97	0.18	Highly Acceptable
2. The phenomena presented are contextualized.	4.90	0.31	Highly Acceptable
3. The presentation of phenomena develops curiosity.	4.77	0.43	Highly Acceptable
4. The video encourages systematic and comprehensive exploration of current and actual events in the real world.	4.80	0.48	Highly Acceptable
5. The video presents relatable real-life situations.	4.90	0.31	Highly Acceptable
Grand Mean	4.87	0.36	Highly Acceptable

Legend:

Mean Interval	Description
4.50 – 5.00	Highly Acceptable
3.50 – 4.49	Acceptable
2.50 – 3.49	Moderately Acceptable
1.50 – 2.49	Least Acceptable
1.00 – 1.49	Not Acceptable

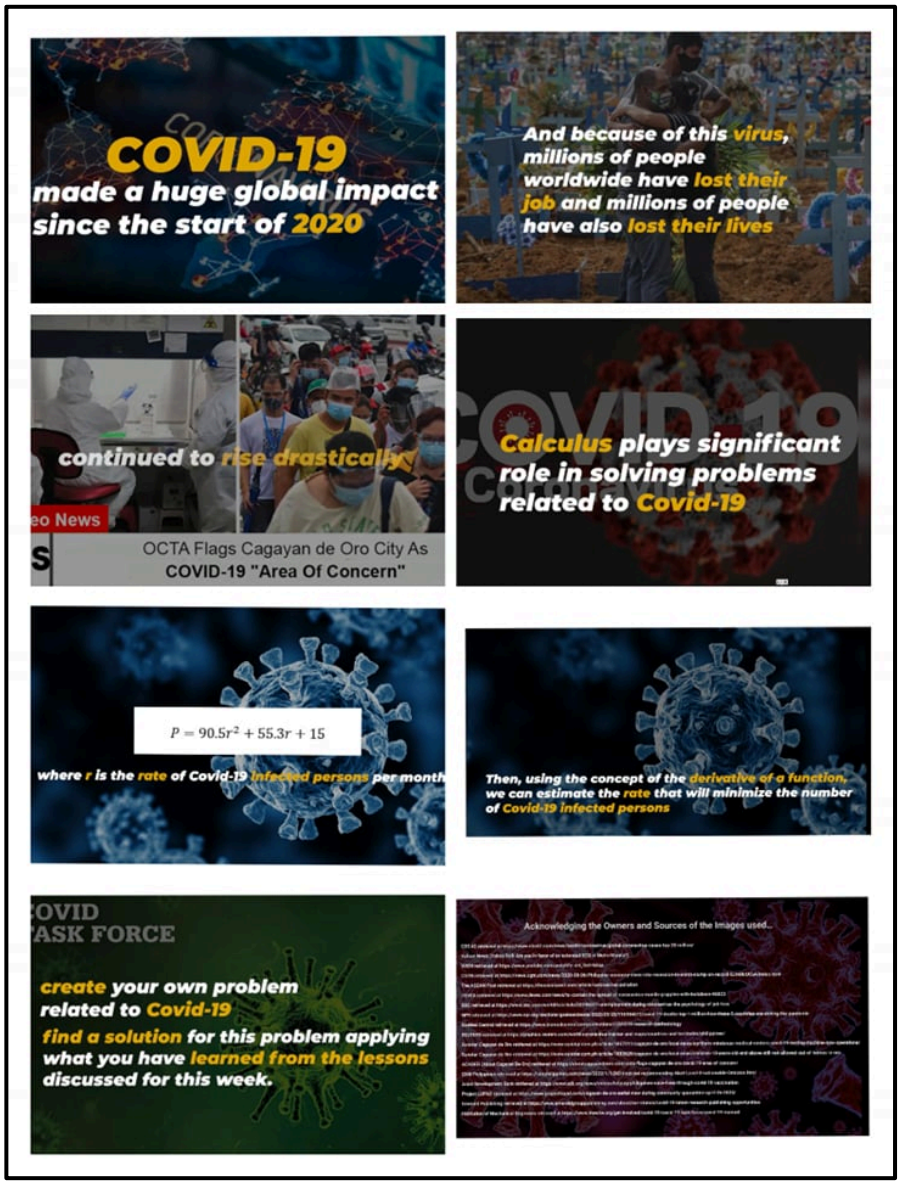

Figure 2. Screenshots of Phenomenon-Based Learning Video on COVID-19

Table 2 presents the descriptive statistics of the mathematics experts' evaluation of the phenomenon-based learning videos in terms of content. Based on the results, the phenomenon-based learning videos are generally highly acceptable with grand mean of 4.82 and standard deviation of 0.47. None of the six indicators scored below 4.50, i.e., all indicators are highly acceptable with indicator 1 as the most excellently worked out. The use of images and graphics in the videos were carefully reviewed, making sure that they are appropriate to the learners and all are significantly related and relevant to the phenomena presented. The following respondents stated that:

Verbatim: *"The videos, texts, and images were explicitly exhibited in which the learners can easily understood the topics. There was a high interconnectedness and coherence of the topic in Calculus."* **(R6)**

Verbatim: *"The video is fascinating, as it depicts something that is actually occurring in the locality. It's explained thoroughly."* **(R9)**

Verbatim: *"The pictures and video clips selected where easy to grasp and follow. The texts were informative and easy to understand."* **(R10)**

In addition, the evaluators said that the videos have portrayed facts and actuals situations which will give the students an idea on how to relate the phenomena to a certain topic in Calculus. This will help the students to become more interested in discovering and exploring the real-world phenomenon presented through investigation or inquiry-based learning. Another evaluator noted that the videos are generally informative and comprehensive; the overall contents were good and rich, and carefully crafted by the researchers. According to [16] and [17], effectively designed videos can facilitate greater learning and increase students' satisfaction, motivation, and self-reflection. Hence, in the development of the videos, one should carefully consider the use of images, graphics, language, and other materials [23]. All of these should be directly related to the key learning goal and must help ignite students' interest in watching the videos.

Table 3 presents the descriptive statistics of the mathematics experts' evaluation of the phenomenon-based learning videos in terms of technical aspect. It was found out that, among the three identified criteria, the technical aspect got the highest grand mean of 4.93 with lowest standard deviation of 0.28. This implies that the evaluators were most impressed by how the technicalities in crafting a video were worked out by the researchers. Indicator 7 from Table 3 got a perfect mean of 5.00 with 0.00 standard deviation which implies that all phenomenon-based learning videos run only within the required number of minutes, i.e., maximum of 6 minutes only for tertiary students [17]. As emphasized, when designing and developing instructional videos, the production style or the overall visual presentation of the videos must be carefully planned and worked out as it can significantly affect students' learning [25]. The following respondents stated that:

Verbatim: *"The technical aspect of the video is excellent, and I have no suggestions for its improvement."* **(R3)**

Verbatim: *"It is extremely nice in terms of technical features, and the transitions between the images are properly structured. It is in sync with the sounds and graphics."* **(R4)**

Verbatim: *"This is an excellent video! Transitions and animations are well-done. The visuals are well-presented, as are the narrations."* **(R9)**

Hence, the phenomenon-based learning videos were evaluated by the mathematics experts in terms of its technical aspect to be highly acceptable, i.e., the videos are well designed and developed as to how the transitions and animations are applied, how the visuals and narrations are presented at the same time, how the warm and high saturation colors are used, and how the audio was organized in a way that it does not distract or interfere the narrator's voice. Accordingly, learning videos can make learning more enjoyable and meaningful as the teachers can integrate real-life activities related to the topics, however, quality of images, music and sound effects in the video should really be strictly observed. This is to make sure that students' concentration is not disrupted as they are usually focused or vulnerable on the music or sound [26].

Furthermore, the evaluators mentioned that the way the videos were created, it is research-based and systematically arranged. The excellence in the technical aspect makes the video more engaging and interesting. According to a respondent **(R8)**:

Verbatim: *"Ang naghimo ug video naka research ged ug maaayo ug systematically arranged. Naa idea kung paunsa niya kwaon ang attention sa estudyante."*

English Translation: *"The one who created the video was able to research well that makes the outcome of the video to be systematically arranged. The idea was there on how to get the attention of the students."*

Table 2. Mathematics Experts' Evaluation of Phenomenon-Based Learning Videos in terms of Content

Indicators	Mean	SD	Description
1. Images and graphics are appropriate in the context of the subject.	4.97	0.18	Highly Acceptable
2. Materials that are interesting but unnecessary in the name of entertainment or advertising are avoided.	4.77	0.50	Highly Acceptable
3. Language is used properly and effectively.	4.90	0.31	Highly Acceptable
4. The subject is presented appropriately considering the level of understanding of the viewers.	4.77	0.63	Highly Acceptable
5. The video is not confusing.	4.73	0.52	Highly Acceptable
6. The video is not boring.	4.77	0.50	Highly Acceptable
Grand Mean	4.82	0.47	Highly Acceptable

Table 3. Mathematics Experts' Evaluation of Phenomenon-Based Learning Videos in terms of Technical Aspect

Indicators	Mean	SD	Description
1. The audio is clear with no distracting hissing or interference.	4.93	0.25	Highly Acceptable
2. Transitions and animations are properly applied in the video.	4.87	0.35	Highly Acceptable
3. Images used are high in quality.	4.87	0.35	Highly Acceptable
4. Warm and high saturation colors are used effectively.	4.97	0.18	Highly Acceptable
5. Narrations are kept short and recorded in human voice rather than synthesized machine voice.	4.93	0.37	Highly Acceptable
6. Related elements such as narration and visuals are presented at the same time.	4.93	0.25	Highly Acceptable
7. The video runs within the required number of minutes (maximum of six minutes).	5.00	0.00	Highly Acceptable
Grand Mean	4.93	0.28	Highly Acceptable

Table 4. Mathematics Experts' Overall Evaluation of Phenomenon-Based Learning Videos

Category	Mean	SD	Description
Subject	4.87	0.36	Highly Acceptable
Content	4.82	0.47	Highly Acceptable
Technical Aspect	4.93	0.28	Highly Acceptable
Overall Mean	4.87	0.37	Highly Acceptable

Table 4 presents the overall result of the evaluation of the mathematics experts of the phenomenon-based learning videos. The overall acceptability level of the phenomenon-based learning videos is high (the highest acceptability level) with overall mean of 4.87 and standard deviation of 0.37. The evaluators have endorsed the use of phenomenon-based learning videos in Calculus with the hope to make students' learning productive and more meaningful. On the other hand, some evaluators suggested that a short and brief discussion of the topics should be given before the students will be exposed to the phenomenon-based learning videos so that they will learn first the necessary skills in Calculus they have to apply in relation to the given task. This is why the phenomenon-based learning is primarily designed for asynchronous remote instruction. Thus, the teachers or instructors may consider to give a short synchronous online class in order to give brief explanation on the lessons.

4. Conclusion and Recommendation

The phenomenon-based learning videos were generally found by the evaluators to be highly acceptable. Thus, the videos are recommended for use especially in Calculus under asynchronous remote instruction. Similarly, the findings of this research have implications for both theory and practice in terms of the use of instructional videos in asynchronous online distance learning and the educators who design them. The researchers have hopes that by redirecting the focus of conducting video lectures into what the students are interested and capable of doing through the use of phenomenon-based learning videos, students will be encouraged to discover and explore the phenomenon presented in the video they have chosen, thus, making their learning more interesting and meaningful. Students are given the highlight and opportunity to apply their previous knowledge to investigate the phenomenon in their chosen video and thereby, making them feel their significant role in finding solutions to present real-life issues and problems. Furthermore, the use of phenomenon-based learning video allows educators to focus more on facilitating the task of the students in the video. Now, as suggested by some evaluators, educators may also consider to explore other real-life phenomena to be depicted in the video like the "virus of lies" which is now very rampant in the social media. Learners should be taught how to determine the difference between fact and opinion. Also, further research into this design is highly encouraged, particularly into how it influences the learners' performance.

Acknowledgments

The researchers are grateful to the following: To the six (6) mathematics professors, namely Dr. Elmer Castillano, Dr. Yamilita Pabilona, Dr. Dennis Roble, Dr. Rosie Tan, Dr. Janneth Rondina, and Dr. Jennifer Parcutilo, for their valuable time in validating the design of phenomenon-based learning video, to the validators of the researcher-made instrument, namely Dr. Esamel Paluga, Dr. Remelyn Asahid, Dr. Allan Jay Cajandig, Dr. Jessica Rose Fernandez, Dr. Jackelou Mapa, and Dr. Markdy Orong, to the thirty (30) mathematics experts for sharing their valuable time and expertise in evaluating the phenomenon-based learning videos, and finally, to the Department of Science and Technology – Science Education Institute (DOST-SEI) for the scholarship grant.

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