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Research Article

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YouTube Video Playlist as Mathematics Supplementary Learning Material for Blended Learning

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ABSTRACT

Blended learning in the new normal is a mix of distance learning modalities that aims to promote better instruction delivery since face-to-face modality is not yet permitted due to the continuous spread of mutated COVID-19. Online distance learning combines modular or TV and radio-based instruction in the Philippines. However, one-hour per subject for the synchronous session is not enough to cover the one-week lessons and develop the target competencies in mathematics. Students struggled to understand the mathematics lesson discussed by the teacher during synchronous. They need many explanations and illustrative examples to understand the underlying concepts, principles, and procedures for solving mathematical problems. Hence, video lessons are the best solution to help students cope with challenges. This study aims to determine the effectiveness of YouTube video playlists as mathematics supplementary learning materials for blended learning. The participants are grade 7 students in public school under the third grading period. The instruments are test materials, a survey questionnaire, and an interview guide validated by three experts in mathematics education. Findings showed that the YouTube video playlist helped the students to understand and develop students' mathematics competencies. Watching the said intervention boosted the students' confidence in answering the learning activities and performing tasks. However, they suggested uploading more videos with closed captions, illustrative examples, and explanations. Hence, similar studies must be conducted to verify the findings in different schools since the study was limited to one school.

Keywords: blended learning, learning material, mathematics, YouTube video playlist

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INTRODUCTION

Blended learning combines limited face-to-face with any distance learning modality or a mix of distance learning modalities to ensure proper social distancing and reduce the number of people outside their homes (DepEd Order No. 012, 2020). Hence, due to the continuous spread of COVID-19, face-to-face modality is still prohibited in places with active cases of the said disease. So, a mix of distance learning modalities is introduced to ensure the continuity of learning despite the challenges brought by natural and human disasters. In the Philippines, modular distance learning is mixed with online or TV and radio-based instruction.

In blended learning, students are given learning materials such as modules and other teacher-made materials via a learning management system ahead of the synchronous session to have ample time for self-paced learning. Hence, a synchronous session is done in a limited time to lessen the student's screen time. Also, the student's eyes must take away from the screen every 20 minutes based on the recommendation of the American Optometric Association (DM-CI-2020-00162, 2020). So, asynchronous sessions have more significant hours per week compared with synchronous.

Students are empowered to do self-paced learning using modules and other learning materials. However, many students are incapable of independent study (Pe Dangle & Sumaoang, 2020). They struggle to understand the concepts and procedures written in the modules, particularly in mathematics. They need much assistance from the teachers to explain and demonstrate the mathematical procedures because lessons are not simplified and appropriate to the student's understanding. Hence, one-hour synchronous session per week is not enough for the teacher to deliver a one-week lesson and cater to the student's queries. Students need more time to digest and absorb new competencies and opportunities to practice and apply new learning with the teacher's guidance.

Researchers believe that a one-hour synchronous session is not enough to deliver one-week mathematics competencies even with the provision of modules and asynchronous sessions. Hence, the students need many discussions and explanations from the mathematics teachers to be able to learn mathematics competencies. There must be interventions from the teacher using available resources accessible to

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the students aligned to their learning needs. The teacher may produce customized video lessons that can upload to YouTube, which may consume anytime. Ranga (2017) believed that customized video lessons via YouTube produce learning ownership of the students in a self-paced manner, empower the students to control viewing the video lessons frequently, and provide a platform to review the lesson.

Literature Review

YouTube provides video learning materials that are easy to access and use for all people with an internet connection; users can give feedback on the uploaded video and access different exciting videos (Faiqah et al., 2016). YouTube is applicable for students when learning difficulties are experienced in abstract science topics (Astriyani & Fajriani, 2020). Hence, mathematics is an abstract science (Arta et al., 2020) that is one of the compulsory subjects at school (Isnaini & Azhar, 2021). Moreover, mathematics teachers may use audio-visual media to develop learning independence and deal with mathematics problems. Also, Bonk (2008) claimed that video content helps students increase the retention of concepts and interest in learning academic lessons. These justify using videos via YouTube for high school students to improve learning and increase learning interest in school subjects. YouTube, an e-learning resource, allows cheap learning anytime, enhancing knowledge and skills development (Copper & Semich, 2019). Its use increases the student's interest in school subjects (Buzzetto-More, 2014), encourages self-directed learning (Lee et al., 2017), and enhances conceptual understanding of the school lessons (Clifton & Mann, 2011).

June et al. (2014) claimed that YouTube videos engage the students in learning and developing critical thinking skills. They revealed that YouTube videos are enjoyable and exciting and boost students' participation. The videos are appropriate to students' learning styles because of the sense of attraction like colors, sounds, and graphics (Vural, 2013). On the other hand, Muniyandy et al. (2015) found that substantial learning improvement occurs to the students when the YouTube video has an explanation included. It means that the YouTube video should be teacher-made with explanations from the students' teacher suited to the level of understanding. Hence, Moghavvemi et al. (2018) claimed that YouTube videos could be additional learning materials that enhance the student's learning if relevant videos are used to deliver school subjects. The videos must be aligned with the lessons taught in school, so the students feel the urgency to watch them.

Students are excited about watching YouTube videos if they learn something related to school learning (Zhou et al., 2020). Students are motivated and passionate to watch YouTube videos if they are relevant to school lessons. In addition, videos must be aligned with the school curriculum to sense the urgency of needs. Hence, various activities accompanied by the YouTube video produce better interactions between the students and the video, which develop critical thinking (June et al., 2014). It means that it is not enough to let the students watch the video but to get involved in different activities after watching.

YouTube videos may improve student learning and enhance critical engagement when part of a blended approach to learning (Jackman & Roberts, 2014; Mitra et al., 2010). Also, it improves good memory in examinations, increases interest, and helps non-science major students remain focused on the lesson (Eick & King Jr., 2012). It also increases students' critical awareness, engagement, and deep learning (Clifton & Mann, 2011). However, a lack of studies was conducted on YouTube videos in the school setting (June et al., 2014; Vural, 2013). The arguments above confirm the need to investigate the use of YouTube videos for educational purposes, especially when face-to-face learning modality is not permitted. Hence, no study has been conducted to measure the effectiveness of YouTube video playlists, particularly in secondary mathematics education in the new normal situation, which has a great potential to deliver instruction distantly.

On the other hand, grade 7 mathematics in the Philippine basic education curriculum consists of number sense, algebra, geometry, and statistics, transitioning from primary mathematics education to secondary. It aims to develop the student's problem-solving skills and critical thinking skills. Nevertheless, based on the result of the summative test and performance task from the first grading period at San Pedro Relocation Center National High School–Main Campus, the grade 7 students are still struggling in developing mathematics competencies under blended learning. An initial survey was administered to uncover the root causes. Based on the survey, too many lessons were taught in a one-hour synchronous session, and students had no time to practice the acquired learning competencies during asynchronous. A one-hour discussion is not enough to cover the target learning competencies. However, all students under blended learning are capable of solid internet connections and devices for online learning. So, a mathematics teacher creates a YouTube video playlist and shares it with their students as supplementary learning materials. The students may watch it anytime and anywhere.

Theoretical and Conceptual Framework

The study followed the cognitive theory of multimedia learning, which claims that in making video, combining words and pictures with good sounds yields deep learning compared with words only (Rudolph, 2017). In producing YouTube videos, essential words and images must be included and organized so students can link their prior knowledge to new concepts. The teacher must carefully plan the video production and content appropriate for students' understanding. This theory informs the teacher how the YouTube video becomes more meaningful once the student watches it. The said theoretical lens serves as a guide for deciding what was included in the video and how to make the video make sense.

Figure 1 presents the study flow under the plan-do-study-act (PDSA) model originating from the work of Walter Shewhart and Edward Deming (Taylor et al., 2014).

The plan stage started with analyzing the students' submitted activities and performance tasks from the first grading period. Based on the result, students struggled to accomplish the module activities and tasks, so the teacher conducted an initial survey to reveal the root causes. The students find it challenging to understand the mathematics lesson for one hour a week because the one-week lessons must be covered for a one-hour synchronous session. They needed much time interacting with the teacher and learning materials to gain mathematical competencies. They suggested having teacher-made video lessons to cover more lessons and acquire more skills. So, the teacher secured permission from the school head to conduct action research to implement organized video lessons via YouTube, which the students can watch anytime. Also, parental consent was secured for the students aged from 12 to 15 years old. Consequently, research instruments like test material, a survey questionnaire, and interview guide questions were constructed and validated by the two master teachers and one head teacher of the mathematics department.

Figure 1. Conceptual paradigm

During the do stage, a two-week pilot implementation was conducted to see the areas for improvement in the intervention based on the student's suggestions. Then, a pre-test was given to the target participants via Google Form during a synchronous session to ensure that the students were the ones who answered the pre-test. Then, a YouTube video playlist was shared with the students as supplementary learning materials during asynchronous sessions to avoid conflict with other subject schedules for two months.

Regular consumption monitoring via YouTube data analytics was done, and students were instructed to post comments or heart shapes. Also, the link for the student's activity was posted below the video, which was to be answered by the students after watching. After two months, the post-test was administered via Google Form during a synchronous session to monitor the proper administration of test material. Hence, the survey was conducted to identify the students' benefits from watching the YouTube video playlist and elicited suggestions for improvement. Hence, an online interview was done to gather more qualitative data to verify the quantitative findings.

Under the study stage, collected data were analyzed quantitatively using statistical software. Furthermore, qualitative data were treated using manual coding. The teacher reflected on the result of the study, thinking back on the implementation process to identify the good points and areas of improvement. Hence, key learning was highlighted as the basis for crafting the next action research cycle. Under the act stage, a research report was written together with an action plan. Finding dissemination was done through professional conferences, faculty meetings, and fora, and hopefully to be published in international journals for worldwide dissemination.

Research Questions

This study aimed to determine if the YouTube video playlist as supplementary learning materials for blended learning is effective or not in improving the student's academic performance in mathematics. Then, the following questions were addressed:

1. What is the student's academic performance in pre- and post-test examinations?
2. Does the YouTube video playlist improve the student's academic performance?
3. What benefits do students derive from watching the YouTube video playlist?
4. What are the suggestions for improvement for the YouTube video playlist shared by the students?

METHODOLOGY

Research Design

The PDSA model following a practical action research design was the most appropriate for this study since the main objective is to solve the perceived problem by implementing intervention utilizing the available resources. Despite having synchronous sessions and printed modules distributed to the students, they still need additional explanations from the teachers regarding mathematics lessons. One-hour synchronous session per week was not enough for the teacher to deliver the one-week lessons and develop the target competencies. Hence, this type of research addresses concerns, challenges, and issues

in the local context for the short term by utilizing interventions or innovations (Fraenkel & Wallen, 2010).

The study utilized a YouTube video playlist as organized 15 teacher-made video lessons uploaded to the YouTube account of the teacher and shared with the students under blended learning as supplementary learning materials considering the video watching students' interest. The weekly video lessons were teacher-made and aligned with the most essential learning competencies (MELC) issued by the Department of Education. The video has a span of a maximum of 15 minutes, and after watching the video, the student must answer the activity posted to verify that the students consumed the video. Hence, the teacher supervised the video consumption regularly to see the students who watched from the YouTube analytics. YouTube has analytics that can be used to trace who viewed and posted comments, giving data for the video creator to trace the consumers of the video (Terlumun et al., 2018). YouTube data analytics was used as proof of consumption in the monitoring process. The topics were lessons from Geometry such as undefined terms, subsets of a line, angle pairs, measuring angles, polygons, and measuring plane and solid figures. The video lessons started with a lesson title, review, lesson proper, and activities. The teacher presented a lesson using a whiteboard and marker while discussing the big mathematical idea.

Participants of the Study

The study was executed in San Pedro Relocation Center National High School–Main Campus for the school year 2021-2022, found in San Pedro, Laguna, Philippines. The said school offers secondary education committed to bringing accessible and quality education through a school learning continuity plan that prioritizes the health, welfare, and well-being of every student, teacher, and staff. It offers two learning modalities: blended learning for students with devices and an internet connection and printed modular distance learning for less-privileged students.

The 100 participants were from four grade 7 students struggling sections based on the summative test and performance task results from the first grading period. These students struggled in mathematics learning due to less interaction with teachers during synchronous sessions, and they looked for more teachers' explanations of lessons. These students were the students who had incomplete submitted activities in mathematics or students with low scores from the summative test and performance tasks. They were selected since they were the ones who needed much attention or interventions from the teacher. Hence, voluntary participation with parental consent was sought before the implementation period as part of a research protocol.

Research Instrument

The study utilized test material for pre-test and post-test examination, a survey questionnaire, and interview guide questions subjected to content validity. A group of three experts in mathematics education validated the test material, and their suggestions were considered in the revision, such as proper grammar, punctuation marks, increasing distractor efficiency, simplifying the questions, and aligning to the MELC. After revision, the instruments were returned to the validators to seek their approval for use. Then test material was pilot-tested on 30 non-participants via Google Form to establish the reliability using Kuder-Richardson Formula 20 since quantitative data were derived from the test result (Nugroho et al., 2019). The said test material has a reliability index of 0.86.

An item analysis was done to establish the quality of test materials (Sharma, 2021). In the pre-test result, five items with 0.20-0.39 difficulty index, ten items with 0.40-0.59 difficulty index, and fifteen with 0.60-0.79 difficulty index. For the discrimination index, six items were found between 0.30-0.39, while twenty-four items were more than 0.40. Hence, there were ten items with 66.66% and twenty with 100% for distractor efficiency. On the other hand, the post-test result has four items found between 0.20-0.39 difficulty index, eleven items with 0.40-0.59 difficulty index, and fifteen items with 0.60-0.79 difficulty index. However, eight items were found between 0.30-0.39 discrimination index, while twenty-two items were more than 0.40. Similarly, it has nine items with 66.66% and twenty-one with 100% for distractor efficiency.

Moreover, a survey questionnaire adopted from Jackman and Roberts (2014) was used to determine the students' benefits from watching the YouTube video playlist and suggestions to improve the interventions. Permission was secured via email for the use of the questionnaire. Some modifications were made, including adding Filipino versions of the items. Seven-item closed-ended questions and three-item open-ended questions were constructed to elicit rich data. Hence, interview guide questions were used to support the data collected from the survey questionnaire. Both questionnaire and interview guide questions were subjected to expert validation. The three experts in mathematics education carefully examined the items, and their suggestions, such as making the questions short, making options coherent, and using simple words, were strictly followed for the revision.

Data Gathering

An initial survey was done to identify the root causes of the problem of why students were struggling in learning mathematics under blended learning. Also, technological capabilities regarding the device used and an internet connection were considered to make the necessary adjustments in implementing the interventions. After securing permission from the school head, the pre-test was administered via Google Form during the synchronous session to measure the prior knowledge. The pre-test result was set aside for future comparison. Then, during the two months of implementation, regular monitoring and feedbacking of the teachers were done to ensure that the students watched the YouTube video playlist. In the post-implementation, the post-test was administered via Google Form during the synchronous session to avoid cheating or linkage of test items. Hence, a survey questionnaire was administered to determine the students' benefits from watching the YouTube video playlist and elicit suggestions for improvement. Also, 20 interviews were conducted online by the student-teacher to verify the responses obtained from the survey.

The first researcher was not related to student-participants, while the second was the teacher who implemented the interventions for two months. The first researcher was responsible for data collection using a survey questionnaire, analysis, and a research report. In contrast, the second researcher was responsible for administering the examinations. Student-teachers interviewed the participants to avoid biases in data collection. Hence, the researchers' insights were bracketed to avoid influence over the data to make the research report objective. **Figure 2** shows the flow chart of data gathering procedure.

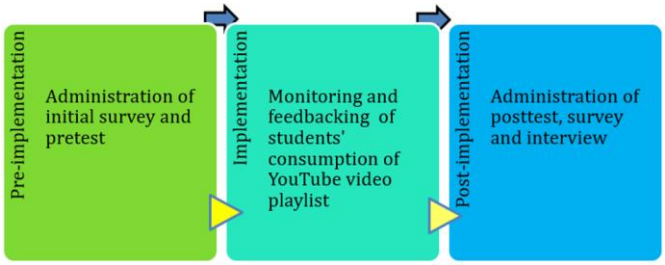

Figure 2. Flow chart of data gathering procedure

Table 1. Normality & homogeneity of variance test of scores in pre- & post-test scores

Test	Shapiro-Wilk test		Levene's test	
	Statistic	p-value	Statistic	p-value
Pre-test	.977	.094	1.217	.273
Post-test	.975	.071	2.604	.110

Ethical Considerations

As ethical consideration practices, permission from the school head was elicited before the start of the study. Before the pilot implementation, informed consent and assent forms were sent to the parent and student. Hence, the confidentiality of data was rest assured, and participants' identities were not disclosed to protect them from possible consequences. Pseudonyms were used to replace the participants' identities in reporting the findings. Also, data was stored in the researchers' computer only for two years. After that, all data will be erased. Moreover, the researchers will disseminate the study through faculty meetings, professional conferences, fora, and international journals.

Data Analysis

Numerical data from test scores were cleaned by removing the entries with missing data and the outliers. It was reduced from 100 data entries from examinations to 90 for quantitative data analysis. Descriptive statistics such as standard deviation, mean, Shapiro-Wilk test, and Levene's test described the quantitative data using statistical package for the social sciences version 23. For hypothesis testing, paired sample t-test for significant difference and Cohen's d for practical significance were employed. The researchers argued that quantitative data were insufficient to determine the effectiveness of the YouTube video playlist, so qualitative data were considered. However, qualitative data underwent manual coding after reading the transcripts from the interview and responses in open-ended survey items twice. Codes were assigned to represent the idea from the transcript. Categorizing codes was done immediately to look for the pattern and arrive at themes. Thematic analysis was used to reduce the qualitative data into meaningful experiences of the participants.

Table 1 depicts the Shapiro-Wilk test as the most reliable normality test (Hanusz & Tarasińska, 2015). Also, Levene's test for homogeneity of variances was employed. It can be gleaned from the table that the scores distribution of both pre-test and post-test are normally distributed and have homogeneous variances proven by the p-values, which are higher than the significance level of .05 alpha. It implies that a parametric test of difference is the most appropriate to test the statistical difference between the pre-test and post-test scores as evidence of academic improvement.

Table 2. Descriptive statistics of the pre- & post-test scores

Test	Minimum score	Maximum score	Mean	Standard deviation
Pre-test	4	20	13.46	3.57
Post-test	11	29	20.85	3.22

Table 3. Paired samples t-test for significant difference & effect size for practical significance

Group	Paired differences			t	df	S2T	Cd
	M	SD	SEM				
Pre- & post-test	-7.394	5.273	.544	-13.593	89	.000	2.589

Note. M: Mean; SD: Standard deviation; SEM: Standard error mean; S2T: Sig. (2-tailed); & Cd: Cohen's d

RESULTS

Table 2 depicts the descriptive statistics of the participants' pre- and post-test scores. The pre-test scores were from 4 to 20, while the post-test scores were from 11 to 29. It reveals that post-test mean score ($\bar{x} = 20.85$) is higher than pre-test mean score ($\bar{x} = 13.46$). It implies that the students performed better in the post-test examination than in the pre-test. The increment of mean score from pre-test to post-test reveals that the video lessons via YouTube video playlist enhance the student's academic performance, identical to the findings of Bardakcı (2019).

Table 3 shows the paired sample t-test for significant difference and effect size using Cohen's d for the practical significance of scores taken from the same group (Dankel et al., 2017). The t-value of -13.593 (p=.000) signifies a significant difference between the mean scores of the pre- and post-test examinations. It means there is an increment in the scores that shows the effect of the intervention made by the teacher. It connotes that the students performed well after consuming the YouTube videos, similar to the findings of Jackman and Roberts (2014) and Mitra et al. (2010). Hence, Cohen's d (2.589) signifies the practicality of the intervention. Watching a YouTube video playlist affects the student's academic performance, which should be utilized again. It is proven that the YouTube video playlist as supplementary learning material for blended learning during the pandemic helped students learn more even though the teacher-student interaction was limited to one hour per week. The video materials improve the learning experience, similar to Moghavvemi et al.'s (2018) findings. Students have control over their learning since the videos are available online anytime. Also, they can repeat watching, post anywhere and leave communication with the teacher, similar to the findings of Ranga (2017).

Figure 3 depicts the academic performance improvement from watching the teacher-made YouTube video playlist based on the survey result. One-third of the respondents agreed that much improvement in their academic performance was made. In contrast, many agreed on much or some improvement. It connotes that YouTube videos improve student learning as supplementary materials for blended learning, similar to Jackman and Roberts (2014) and Mitra et al.'s (2010) findings. The student's consumption of YouTube video playlists improved academic performance since the teacher explained the lesson content, similar to Muniyandy et al.'s (2015) findings.

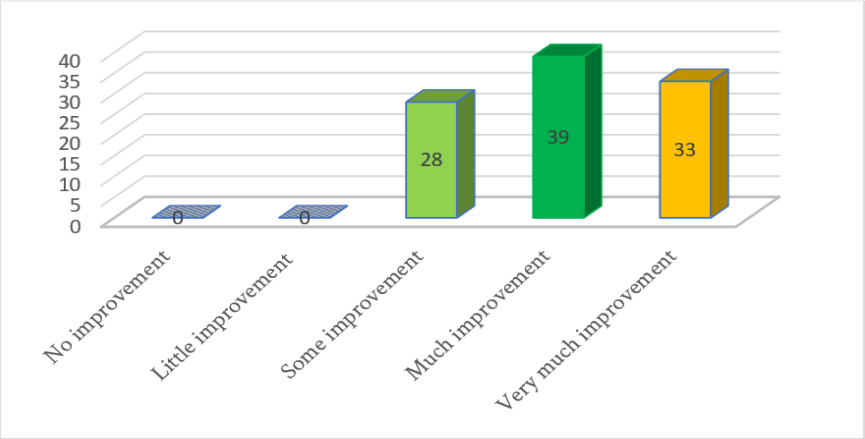

Figure 3. Perceived academic performance improvement made by YouTube video playlist

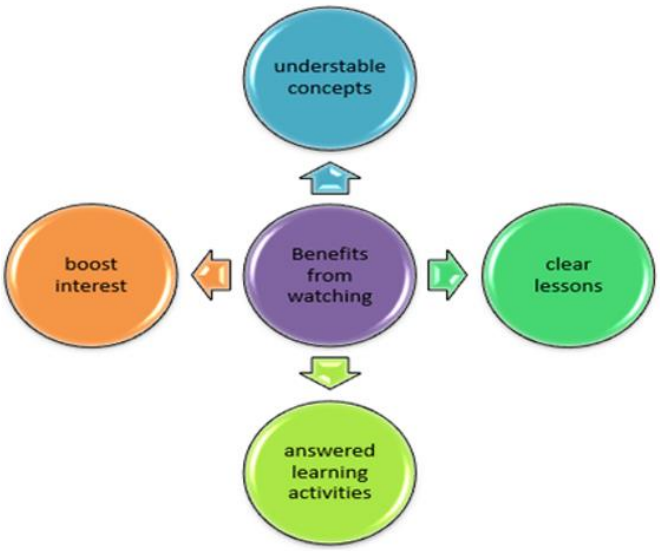

Figure 4. Benefits the students derive from watching the teacher-made YouTube video playlist

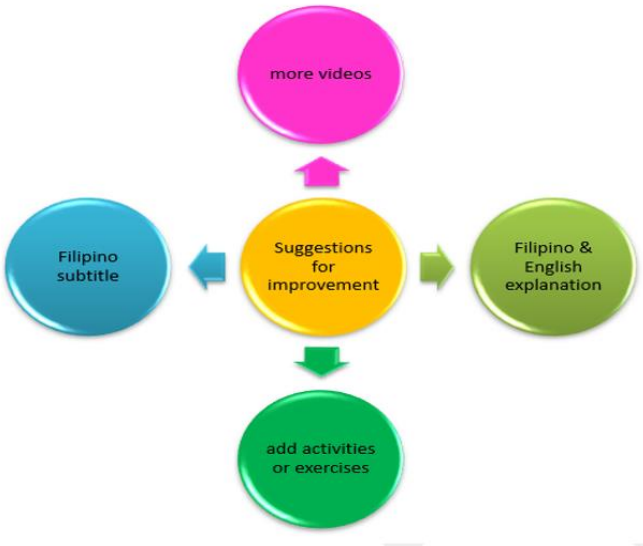

Figure 5. Students' suggestions for improvement of the teacher-made YouTube video playlist

Figure 4 reveals the benefits obtained by the students after watching the YouTube video playlist. By watching the mathematics videos, students understood the mathematics concept quickly since the videos were made by the teacher explaining the content lesson. Learning improvement happens after watching the videos since the teacher explains the content well, comparable to the finding of Muniyandy et al. (2015). It makes the mathematics lesson clear since the students have control over the video, and they can watch the video repeatedly at any time. Also, the students were capable of answering the assigned activities and performance tasks. They want to watch videos because these will improve their academic performance (Bardakci, 2019). Hence, they are interested in watching the YouTube videos since they are related to their mathematics lessons, similar to the finding of Zhou et al. (2020).

The findings above are supported by the words of the students below taken from the interview transcript.

> "Most of the time after the lesson, I barely remember what the teacher just tackled, that is why YouTube video playlist helps me to remember and make it easy for me to understand the lesson more" (Participant 6).

> "When I watch my teacher's video lessons, I will understand my lessons better. It will be easier to answer my homework" (Participant 12).

> "Watching YouTube videos boost my interest in learning the mathematics lessons more since I see my teacher explaining the lesson content, giving examples and solutions to a mathematical problem" (Participant 18).

Figure 5 shows the students' suggestions for improving the YouTube video playlist. Students asked for more uploaded teacher-made videos with more explanations of the content lessons to quickly understand the mathematics concepts, procedures, and computation. Hence, they suggested a long video explanation in Filipino and English to understand better. The teacher may add Filipino subtitles so that they can read the exact words from the mouth of the teacher. Also, they ask for exercises or activities as part of the video to increase their excitement while watching the videos.

The findings above are supported by the words of the students below taken from the interview transcript.

> "I think the YouTube playlist should have more videos to help us understand better. More examples to better understand the lesson" (Participant 8).

> "What I suggest is to have a Tagalog-English version and longer examples of video lessons because some of the students are not fluent with English and they may not understand it" (Participant 15).

> "The teacher may add Filipino subtitles so that the students can understand the explanation better. Not all students are good at listening and digesting English words" (Participant 20).

DISCUSSIONS

The teacher-made YouTube video playlist is useful as supplementary learning material for mathematics students under blended distance learning, which backs the study of Moghavvemi et al. (2018) that enhances the student's learning experience. The limited time for synchronous sessions, which causes the students difficulty in understanding the mathematics lesson, was surpassed by watching teacher-made videos, shown by the result of pre-test and post-test examinations and responses from the survey and interview. Hence, it connotes that the teacher's intervention was effective in the eyes of the students. However, they suggested having more uploaded videos with long explanations using the Filipino and English languages. Also, they want Filipino closed captions to read every word from the teacher's mouth and more exercises within the video to increase their excitement of watching.

Considering the lens of cognitive theory of multimedia learning, the content of the YouTube video complements the video in delivering the mathematics concepts, procedures, and solutions to mathematical problems. The words, images, and symbols helped the student-consumers to comprehend the mathematical concepts and principles behind problem-solving. Incorporating words, symbols, sounds, and pictures enables students to learn because it allows them to process information (Rudolph, 2017). However, it is admitted that some students find difficulty in understanding pure English explanations from the teacher since the Filipino students are not native English speakers. They tend to prefer Filipino and English explanations for better understanding. So, the teacher may use the Filipino language to explain the video content.

A YouTube video playlist is an excellent supplementary learning material if the teacher makes it for the student-consumers. The teacher must regularly monitor the students' consumption by instructing them to post comments, provide activities after watching and contact them to ask for feedback to improve the video. Hence, the teacher reflected on his practices. He found that he needed to upload more videos to the YouTube playlist with a lengthy explanation so that the students could grasp the mathematics concepts quickly. He needs to improve the video by adding drill exercises within and after so that the student's high interest in watching them will be maintained throughout the video. Hence, he realized that a simple weekly survey must be done so that immediate suggestions from the students must be inculcated in the improvement, communicate with parents about the video lessons, and contextualize the examples found in the video.

CONCLUSIONS AND RECOMMENDATIONS

The mean score of the post-test examination is statistically significant than the mean score of the pre-test, having a closed standard deviation. However, a statistical difference was established, which means that the students performed better in the post-test examination after consuming the YouTube video playlist. Also, the effect size signifies that watching the said playlist contributes to the student's academic improvement. Watching a teacher-made YouTube video playlist helped the students comprehend the mathematics lesson better. Lessons became apparent, and the mathematics concepts, procedures, and solutions became understandable. If the student wants to clarify the mathematics lesson, he/she can watch the video repeatedly. Hence, students could quickly answer the activities and performance tasks given by the teacher, which boosted their interest in learning the mathematics lesson. Students' suggestions for improvement were that the teacher must upload more videos with longer explanations using Filipino and English languages.

This study was limited to one school with two months of implementation since the nature was practical action research. Hence, the experiences and hindrances of the students in watching the video playlist were not included in the study. So, it is suggested that future researchers do a phenomenological study focusing on the student's experiences watching YouTube video playlists to reveal the qualitative aspect. Moreover, more teachers from different learning areas must utilize teacher-made video playlists to supplement their teaching and enhance learning by utilizing online resources like YouTube.

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Data availability: Data generated or analysed during this study are available from the authors on request.

REFERENCES

Arta, M., Japa, G. N., & Sudarma, K. (2020). Problem based learning berbantuan icebreaker berpengaruh terhadap kemampuan pemecahan masalah matematika [Problem based learning assisted by icebreaker has an effect on mathematical problem-solving ability]. *Mimbar PGSD Undiksha, 8*(2), 264-273.

Astriyani, A., & Fajriani, F. (2020). Pengaruh penggunaan media audio visual youtube materi pythagoras terhadap keaktifan belajar matematika siswa [The effect of using YouTube audio-visual media on pythagorean material on students' learning activities in mathematics]. *FIBONACCI, 6*(1), 87-90.

Bardakci, S. (2019). Exploring high school students' educational use of YouTube. *International Review of Research in Open and Distributed Learning, 20*(2), 260-278. https://doi.org/10.19173/irrodl.v20i2.4074

Bonk, C. J. (2008). *YouTube anchors and enders: The use of shared online video content as a macrocontext for learning* [Paper presentation]. The American Educational Research Association 2008 Annual Meeting. AERA.

Buzzetto-More, N. A. (2014). An examination of undergraduate student's perceptions and predilections of the use of YouTube in the teaching and learning process. *Interdisciplinary Journal of E-Learning and Learning Objects, 10*, 17-32. https://doi.org/10.28945/1965

Clifton, A., & Mann, C. (2011). YouTube enhance student nurse learning? *Nurse Education Today, 31*(4), 311-313. https://doi.org/10.1016/j.nedt.2010.10.004

Copper, J. M., & Semich, G. W. (2019). Professional development in the twenty-first century: YouTube teacher training and professional development. In M. habib (Ed.), *Advanced online education and training technologies* (pp. 185-199). IGI Global. https://doi.org/10.4018/978-1-5225-7010-3.ch011

Dankel, S. J., Mouser, J. G., Mattocks, K. T., Counts, B. R., Jessee, M. B., Buckner, S. L., & Loenneke, J. P. (2017). The widespread misuse of effect sizes. *Journal of Science and Medicine in Sport, 20*(5), 446-450. https://doi.org/10.1016/j.jsams.2016.10.003

DepEd Order No. 012. (2020). *Adoption of the basic education learning continuity plan for school year 2020-2021 in the light of the COVID-19 public health emergency.* https://www.deped.gov.ph/wp-content/uploads/2020/06/DO_s2020_012.pdf

DM-CI-2020-00162. (2020). *Suggested strategies in implementing distance learning delivery modalities (DLDM) for school year 2020-2022.* https://region8.deped.gov.ph/wp-content/uploads/2020/07/DM-CI-2020-00162-2.pdf

Eick, J., & King Jr., D. T. (2012). Nonscience majors' perceptions on the use of YouTube video to support learning in an integrated science lecture. *Journal of College Science and Teaching, 26*(1), 26-30.

Faiqah, F., Nadjib, M., & Amir, A. S. (2016). YouTube sebagai sarana komunikasi bagi komunitas makassarvidgram [YouTube as a means of communication for the makassarvidgram community]. *Jurnal Komunikasi KAREBA* [*KAREBA Communication Journal*], *5*(2), 259-272.

Fraenkel, J. & Wallen, N. (2010). *How to design and evaluate research in education.* McGraw-Hill Companies, Inc.

Hanusz, Z., & Tarasińska, J. (2015). Normalization of the Kolmogorov–Smirnov and Shapiro-Wilk tests of normality. *Biometrical Letters, 52*(2), 85-93. https://doi.org/10.1515/bile-2015-0008

Isnaini, J., & Azhar, E. (2021). Mathematics learning independence: The relationship of YouTube as a media for mathematics learning. *Desimal: Jurnal Matematika* [*Decimal: Journal of Mathematics*], *4*(2), 177-184.

Jackman, W. M., & Roberts, P. (2014). Students' perspectives on YouTube video usage as an e-resource in the university classroom. *Journal of Educational Technology Systems, 42*(3), 273-296. https://doi.org/10.2190/ET.42.3.f

June, S., Yaacob, A., & Kheng, Y. (2014). Assessing the use of YouTube videos and interactive activities as a critical thinking stimulator for tertiary students: An action research. *International Educational Studies, 7*(8), 56-67. https://doi.org/10.5539/ies.v7n8p56

Lee, C. S., Osop, H., Goh, D. H., & Kelni, G. (2017). Making sense of comments on YouTube educational videos: A self-directed learning perspective. *Online Information Review, 41*(5), 611-625. https://doi.org/10.1108/OIR-09-2016-0274

Mitra, B., Lewin-Jones, J., Barrett, H., & Williamson, S. (2010). The use of video to enable deep learning. *Research in Post-Compulsory Education, 15*(4), 405-414. https://doi.org/10.1080/13596748.2010.526802

Moghavvemi, S., Sulaiman, A., Jaafar, N. I., & Kasem, N. (2018). Social media as a complementary learning tool for teaching and learning: the case of YouTube. *The International Journal of Management Education, 16*(1), 37-42. https://doi.org/10.1016/j.ijme.2017.12.001

Muniyandy, S., Khuenyen, N., Yap, C. G., Shogo, M., My, N. A., Chowdhury, M. E. H., & Musa, A. F. (2015). Influence of YouTube videos on the learning of tablet- and capsule-formulation by Malaysian pharmacy students: A pilot study. *Pharmacy Education, 15*(1), 248-251.

Nugroho, A., Warnars, H. L. H. S., Heriyadi, Y., & Tanutama, L. (2019). Measure the level of success in using Google Drive with the Kuder Richardson (KR) reliability method. In *Proceedings of the 2019 International Congress on Applied Information Technology, 2019* (pp. 1-7). https://doi.org/10.1109/AIT49014.2019.9144915

Pe Dangle, Y. R., & Sumaoang, J. D. (2020). The implementation of modular distance learning in the Philippine secondary public schools. In *Proceedings of the 3rd International Conference on Advanced Research in Teaching and Education* (100-108). Diamond Scientific Publishing. https://doi.org/10.33422/3rd.icate.2020.11.132

Ranga, J. (2017). Customized videos on a YouTube channel: A beyond the classroom teaching and learning platform for general chemistry courses. *Journal of Chemical Education, 94*(7), 867-872. https://doi.org/10.1021/acs.jchemed.6b00774

Rudolph, M. (2017). Cognitive theory of multimedia learning. *Journal of Online Higher Education, 1*(2), 1-15.

Sharma, L. R. (2021). Analysis of difficulty index, discrimination index and distractor efficiency of multiple-choice questions of speech sounds of English. *International Research Journal of MMC, 2*(1), 15-28. https://doi.org/10.3126/irjmmc.v2i1.35126

Taylor, M. J., McNicholas, C., Nicolay, C., Darzi, A., Bell, D., & Reed, J. E. (2014). Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Quality & Safety, 23*(4), 290-298.https://doi.org/10.1136/bmjqs-2013-001862

Terlumun, I. T., Appollm, Y. I., Ibrahim, F. J., Mamman, F. S., Yusuf, A. K., & Ibrahim, A. H. (2018). Determining the effectiveness of Youtube videos in teaching and learning with Mozdeh algorithm. *International Journal of Education and Evaluation, 4*(4), 100-110.

Vural, O. F. (2013). The impact of a question-embedded video-based learning tool on e-learning. *Educational Sciences: Theory & Practice, 13*(2), 1315-1323.

Zhou, Q., Lee, C., Sin, S. Lin, S., Hu, H., & Ismail, M. F. (2020). Understanding the use of YouTube as a learning resource: A social cognitive perspective. *Aslib Journal of Information Management, 72*(3), 339-359. https://doi.org/10.1108/AJIM-10-2019-0290