

Improving Academic Performance of Grade 7 Learners in Mathematics Through 5E Inquiry-Based Supplementary Video Materials

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Abstract — The study aimed to improve the academic performance of Grade 7 learners in Mathematics through 5E inquiry-based supplementary video materials under the project Mathematics and Science Kit for E-Learning (MathSciKEL). The study used descriptive comparative research design since the academic performances of the learners were compared to draw a conclusion leading to the formulation of implications of the findings for the improvement of the learners' academic performance. The significant difference between the pretest and posttest mean scores was measured using t-test for dependent samples. A total of one hundred sixty-one (161) learners participated purposively chosen by the researchers. The findings of the study reveal that (1) as evidenced by the poor pretest mean score, the learners were not yet ready and struggled to answer the assigned activities in the mathematics modules, (2) the use of 5E Inquiry-Based supplemental material in teaching Mathematics was ascribed to the enhanced mean scores in the posttest following the quarter, (3) the utilization of supplemental teaching materials based on the 5E Inquiry-Based methodology effectively improved Grade 7 students' academic performance in mathematics, and (4) the institutionalization of the project Mathematics and Science Kit for E-Learning allows for continuous planning, monitoring, and assessment of learners' academic achievement in Mathematics. The study implies that in the New Normal, additional materials still needing with inquiry-based teaching and learning. Learning can be assessed in partnership with the community to guarantee that learners learn regardless of the current learning delivery modality.

Keywords — *5E Inquiry-Based, Academic Performance, Mathematics and Science Kit for E-Learning (MathSciKEL), Supplementary Video Materials*

I. Introduction

The COVID-19 pandemic offered significant hurdles in a number of areas. Its detrimental impact prompted schools to halt operations in March 2020 in order to prevent the spread of the virus, which could unwittingly harm students, teachers, and educational stakeholders. This jeopardized DepEd's intentions to start classes in June of each year. As a result, the department released D.O. No. 12, s. 2020 establishing the Basic Education Learning Continuity Plan (BE-LCP), which includes a set of educational interventions such as K-12 curriculum adjustments, alignment of learning materials, deployment of multiple learning delivery modalities, teacher and school leader training, and proper parent/guardian orientation. The BE-LCP was cascaded by community, faculty and school, leading to a thorough planning, implementation and evaluation of the current situation. One of the most important decisions that required a sudden decision was the choice of learning methods such as online, modular, and hybrid. In general, the majority of learners preferred modular distance learning (MDL) because they struggled to address the challenges of online distance learning, such as the lack of the Internet and devices.

As a result, empirical observations and interviews with parents / legal guardians show that most learners find it difficult to learn the concept of modules due to lack of teacher guidance and learning support. It was done during the onset of modular distance learning during the School Year 2020-2021 for Quarter 1. Mathematics and Science subjects have many problems as perceived by Grade 7 learners. One hundred forty (140) out of one hundred sixty-one (161) grade 7 students and their parents agreed that Mathematics and Science were the most difficult subjects in distance learning. This is due to the vague concept and the applicability of the concept to the real situation, which makes the topic difficult to understand (Kaptan & Timurlenk, 2012; Mulwa, 2015). In addition, the average first-quarter percentages (MPS) for Science 7 and Mathematics 7 yielded 55.33% and 60.28% results, respectively. These results were far from the expected national average of 75.00%. Ultimately, this means that the most essential learning competencies (MELCs) they expected were not completely met, which could impact the spiral progression approach of recent years.

Mathematics and Science Kit for E-Learning (MathSciKEL) is a project initiated by Mathematics and Science 7 teachers of Buenaventura Alandy National High School pioneering its Grade 7 of School Year 2020-2021. The development of the supplementary video material was based on the content of the PIVOT 4A ADM module published in Mathematics and Science and was localized to help learners easily understand the concepts taught in a given subject area with contextualized explanations and examples. Theoretically, the MathSciKEL videos followed Bybee's (1997) 5E instructional model where concepts were delivered in sequential Engage, Explore, Explain, Elaborate, and Evaluate phases. Studies have shown that learner's inquiry and problem-solving skills were developed using this five-step approach (CetinDindar & Geban, 2017; Singh & Yaduvanshi, 2015; Ergin, 2012). Specifically, these videos were uploaded weekly to the YouTube channel MathSciKEL, along with grade 7 modules of Mathematics and Science, according to the work budget per MELC. However, some learners have no gadgets at all to be used

in accomplishing activities. Researchers have worked with each student's barangay to allow people with limited access to the internet to watch supplementary instructional videos while answering modules. With this, the Grade 7 learners were expected to be engaged in a remote learning amidst pandemic to further realize DepEd's flagship program, the Sulong EduKalidad.

Literature Review

According to Agogo and Onda (2014), the complexity of themes, time constraints, and a shortage of learning materials for practical activities may be enough to justify the usage of supplemental materials. Apart from traditional modules and working materials, experts believe that current learners must innovate to satisfy their demands in order to maintain their concentration on key concepts. Researchers reported that adopting additional video resources based on the 5E inquiry-based methodology boosted grade 7 mathematics academic achievement significantly.

According to Brasili and Allen (2019), video is an important educational medium that has a track record of boosting learning. We can infer from quantitative and qualitative data that learners will require assistance in responding to the module. The majority of them struggled to understand some instructions, while others struggle to develop crucial learning skills at home due to a lack of precise examples and materials. Like a result, researchers have used this baseline data to find approaches to broaden their demands, as a mathematics teacher.

The 5E educational approach was identified by van Garderen et al. (2020) as a sound educational technique for engaging students in learning with lenses on demand. Soltura, (2018) study backed up this claim. The post-test score increased significantly compared to the pre-test score after using survey-based learning material as part of the class, according to the study. The learners' participation in the program might provide both quantitative and qualitative data. By watching the teacher demonstrate the topic in the video, the majority of them were able to understand the instructions and put it into practice.

According to the findings of Lin's study (2022), the experimental group can improve low-achieving students' learning effectiveness, overall cognitive level, and performance in answering open questions, as well as their level of understanding of the biogeochemical cycle concept, which will aid students in selecting appropriate materials and developing creative imagination of visual literacy when designing the model. The overall self-evaluation performance of the students in the high group is better at each level of the 5E inquiry-based instruction of the experimental group, while the self-evaluation performance of the students in the low group is poorer in the stages of exploration, explanation, and elaboration. In terms of attachment and attitude analysis, students in the high group favor task-based information searching and are more motivated to gather various forms of information in order to address inquiry difficulties. Students in the lower group dislike task-based information seeking, which could be attributed to a lack of information literacy, which lowers learning desire to participate in activities.

Meanwhile, the key finding of Suckoo and Ishizaka's study (2022) was that there appears to be a gap between the idea of Inquiry-Based Learning (IBL) and its execution, with online lessons for the restructured 5E being more favorable to developing mathematical thinking skills than knowledge and skills.

Further, Owusu, Adu, and Kwakye's study (2022) investigated how the 5Es combined with instructional aids affected students' academic performance in non-routine mathematics issues. The findings showed that students who were taught using the 5Es with teaching aids outperformed those who were taught using the lecture approach with teaching aids. Furthermore, the findings revealed that female students outperform male students on non-routine mathematical issues. It was consequently recommended that the 5Es be used in conjunction with teaching aids when teaching students nonroutine arithmetic problems.

Moreover, Yanakit and Kaewsaiha, (2021) studied the use inquiry-based learning to improve students' academic achievement and to study the impact of inquiry-based learning on students' Mathematics anxiety. The success of this research in terms of students' achievement after being instructed had an Effectiveness Index (E.I.) of 0.7689, indicating that students' learning achievement had been developed by 76.89 percent based on past knowledge. Furthermore, at the .05 level, post-test scores were statistically substantially higher than pre-test values.

II. Methodology

Research Design

The study used descriptive comparative research design because the academic performances of the learners were compared to draw a conclusion leading to the formulation of implications of the findings for the improvement of the learners' academic performance.

Research Locale, Population, and Sampling

The study was conducted at Buenaventura Alandy National High School in Barangay Poto, Tayabas City. The researchers chose this school because it was where they were currently rendering service. Besides, they were aiming to improve the learners' academic performance in Science 7 and Mathematic 7 through 5E inquiry-based supplementary video materials in Quarter 2 under the project Mathematics and Science Kit for E-Learning (MathSciKEL).

Buenaventura Alandy National High School had a student population of almost 900 learners coming from Grades 7, 11, and 12 for S.Y. 2020-2021. Out of this total number of students enrolled in Buenaventura Alandy National High School, the researchers only involved the one hundred sixty-one (161) Grade 7 students since these students were the most qualified respondents in the study for, they all found difficulty in Mathematics 7 and Science 7. With this, the researchers used purposive sampling technique in the selection of the respondents for obvious reason.

Research Instrument

The researchers make use of a 20-item multiple choice test to measure the students' academic performance in Mathematics 7. Words included in the set of items were chosen from the PIVOT 4A self-learning module and K to 12 Grade 7 Mathematics book.

The research instruments used in the study were discussed thoroughly below:

A. Development of the Pre- and Post-Level Test Questionnaire

Prior to the release of the supplementary videos in the YouTube channel and barangay roll-out, the researchers assessed the learners based on their pre-level of knowledge on what to learn in the subjects, and a posttest was given after watching the videos. The researchers followed several steps to develop the pre- and post-level test questionnaire as follows:

A.1 Construction of the Table of Specifications (TOS)

The table of specification contained the following elements namely: Content, Learning Competencies, Number of Hours, Weight, No. of Items, Knowledge (40%), Comprehension (40%), and Application (20%). The topics embedded in the most essential learning competencies (MELCs) primarily served as the basis for each test item questionnaire.

A.2 Construction and Validation of Pre- and Post-Level Test Questionnaire

The researchers adapted and modified questions in constructing a 20-item multiple choice assessment per quarter per subject area in which each item consisted of inquiry skills questions aligned to the target most essential learning competencies. The research questions were based on the contents of the PIVOT 4A modules and MathSciKEL supplementary videos. During the implementation proper, this research instrument would be administered among the learners as pre-level and post-level assessment. Likewise, the significant difference between the pre-test and the posttest means scores in the quarter would serve as basis as to the effectiveness of the 5E inquiry-based supplementary video materials under the project MathSciKEL.

B. Development of MathSciKEL supplementary videos in Grade 7 Mathematics and Science

In the development of supplementary videos, researchers followed these steps:

B.1 Identification of the Topics

The topics were identified based on the released PIVOT 4A Budget of Work in Grade 7 Science and Mathematics. These covered second, third, and fourth quarters of the said subjects considering the embedded most essential learning competencies (MELCs).

B.2 Development of 5E instructional model-based scripts for MathSciKEL

The researchers crafted the scripts following the 5E instructional model phases Engage, Explore, Explain, Elaborate, and Evaluate. Each script was sent to the education program supervisors in Science and Mathematics for consultation. After giving their constructive feedbacks and suggestions, the script was edited and modified accordingly.

B.3 Video recording of MathSciKEL supplementary videos in Grade 7 Mathematics and Science

After finalizing the scripts, the researchers convened in the school's science laboratory which turned into an improvised studio. They have agreed that Grade 7 Mathematics, and Science topics will be video-recorded every Monday and Wednesday, respectively. Each video lasted for about 10 to 15 minutes considering the short attention span of Grade 7, the availability of internet connection, and file size of each video.

B. 3.1 Editing, uploading of the videos in YouTube, and barangay roll-out

The video editor edited the supplementary videos using the applications Adobe PremierePro™, Photoshop™, and AfterEffects™. This was done every Thursday and Friday. Afterwards, it would be sent to the education program supervisors of Science, Mathematics, and LRMS for consultation. After giving their comments, and suggestions, it was edited again and sent to them for finalization. Once finalized, it was uploaded in the YouTube channel MathSciKEL to be premiered every Monday at 8:00 am for Science and every Wednesday at 8:00 am for Mathematics. This is in accordance with the given Weekly Home Learning Plan (WHLP) to the learners exactly at the specified time to answer the learning modules. For the barangay roll-out, each barangay was given a flash drive storing the supplementary videos to be inserted in their Smart TV and/or watched in the projector to be facilitated by the Math and Science teachers and/or Sangguniang Kabataan-designated officials. This was done every Wednesday between 8:00 am to 12:00 noon.

Meaningful learning experiences interview guide

Meaningful learning experiences of the learners were obtained using an in-depth interview among select Grade 7 learners who viewed the supplementary video via YouTube and/or barangay roll-out. Hence, its main purpose was to encapsulate the meaningful learning experiences in this form or remote learning. The interview responses were recorded and transcribed in verbatim. Beforehand, a letter of consent allowing the researchers to do so would be sought from the parents of the respondents. Transcripts would be analyzed using content analysis. Content analysis was conducted manually (usually in the initial coding stages). In connection to this, the researchers' asked fellow master teachers as the interrater during the thematic analysis of the gathered information from the interview.

In addition, to validate information collected from the interviews, participant observation was done during learning process via field note. The researchers took notes about learners' emotions, indicators of ease of use of the application, difficulties before, during, and after the viewing process, and other relevant information. All observers, during which conclusions were made, conduct a careful observation enlisted the subjective perspectives about the learners' learning experience during the process.

DATA GATHERING METHODS

The researchers administered the pretest to one hundred sixty-one (161) Grade 7 students on January 04, 2021. The 5E inquiry-based supplementary video materials under the project Mathematics and Science Kit for E-Learning (MathSciKEL) was introduced to their classes during their Online Meet and Greet after the administration of pretest. The same set of words was given before and after the implementation of the 5E inquiry-based supplementary video materials in Quarter 2. They only differed in the order of items provided in the posttest. The researchers administered the posttest on February 26, 2021.

Generally, the learners were given pre-test and post-test questionnaires to assess if the 5E inquiry-based supplementary videos were effective to be used in a remote learning. Each episode and script were sent to be checked and consulted to the education program supervisors of Science, Mathematics, and LRMS to ensure the appropriateness and correctness of the contents. The learners have an option in viewing the videos. First, it was available in the YouTube channel MathSciKEL premiered every Monday at 8:00 am for Science and every Wednesday at 8:00 am for Mathematics. This is in accordance with the given Weekly Home Learning Plan (WHLP) to the learners exactly at their time to answer the learning modules. Second, for the barangay roll-out, each barangay was given a flash drive storing the supplementary videos to be inserted in their Smart TV and/or watched in the projector to be facilitated by the Math and Science teachers and/or Sangguniang Kabataan-designated officials following strictly health protocols to ensure the safety of everyone. This was done every Wednesday between 8:00 am to 12:00 noon.

The project MathSciKEL supplementary videos were recorded and run from January – February 2021 covering the 2nd Quarter S.Y. 2020-2021. For two months, the researchers crafted the videos and shared them to the learners alongside the released PIVOT 4A modules in Mathematics 7. In addition, one day was allotted for the conduct of focus group discussion and semi-structured interview among select respondents as regards to their meaningful learning experiences in the utilization of MathSciKEL supplementary videos. An informed consent and personal protective equipment were given to the participants beforehand. This was to ensure that the respondents participated in the activity at their own will, hazard-free and, any data collected in the study would be treated with utmost confidentiality. Their anonymity was taken into consideration to keep information in private. After the study was completed, the researchers presented the results to the concerned individuals and authorities. Moreover, the manuscript undergone plagiarism checking to ensure that the study properly cited and acknowledged ideas

from different sources and authors. Finally, the results of the study were disseminated to all concerned to effect positive change and to help beneficiaries disseminate the results for further improvement.

Data Analysis Plan

To gauge the academic performance in Mathematics of the Grade 7 students of Buenaventura Alandy National High School before and after the implementation of project Mathematics and Science Kit for E-Learning (MathSciKEL), the researcher used simple percentage.

To measure if there is a significant difference in the performance, t-test for dependent sample was used. In doing so, the researchers determined the significant difference between the pre- and posttest mean scores in Mathematics 7 Quarter 2. All data gathered were calculated, tabulated, analyzed, and interpreted statistically using the paired t-test/t-test for dependent sample means formula.

III. Results and Discussion



Figure 1. Mean Percentage Scores in Mathematics 7 Pretest before the Implementation of the 5E inquiry-based Supplementary Video Materials in Quarter 2

Figure 1 shows the pretest results of Grade 7 learners in Mathematics 7 Quarter 2 before the implementation of the 5E inquiry-based supplementary video materials under the project Mathematics and Science Kit for E-Learning. It can be seen from the graph that the highest mean percentage score (MPS) was 7-AIO (70.69) followed by 7-MLL (67.65), 7-CPO (52.22), and 7-NBA (50.56) respectively. It was evidently shows that the Grade 7 learners lack knowledge in most essential learning competencies (MELCs) to be developed in Mathematics 7 Quarter 2.

Gay, et al., (2012) explained the importance of careful random selection at the beginning of the study. Hanita et al., (2017) also need similar disruptive factors, such as pre-evaluation points for studies that serve as initial characteristics, so that they are bias-free and allow all the changes observed in the education-learning process. It was emphasized that there is a dating back to the

intervention used. Meanwhile, Brasili and Allen, (2019) discovered that video is an important educational tool with a proven track record in improving learning. From quantitative and qualitative data, we can assume that learners need to be supported in responding to the module. Most of them couldn't understand some directions, but others struggle to learn important learning skills due to the lack of specific examples and materials at home. Therefore, as a mathematics teacher, researchers have used this baseline data to develop ways to expand their needs.

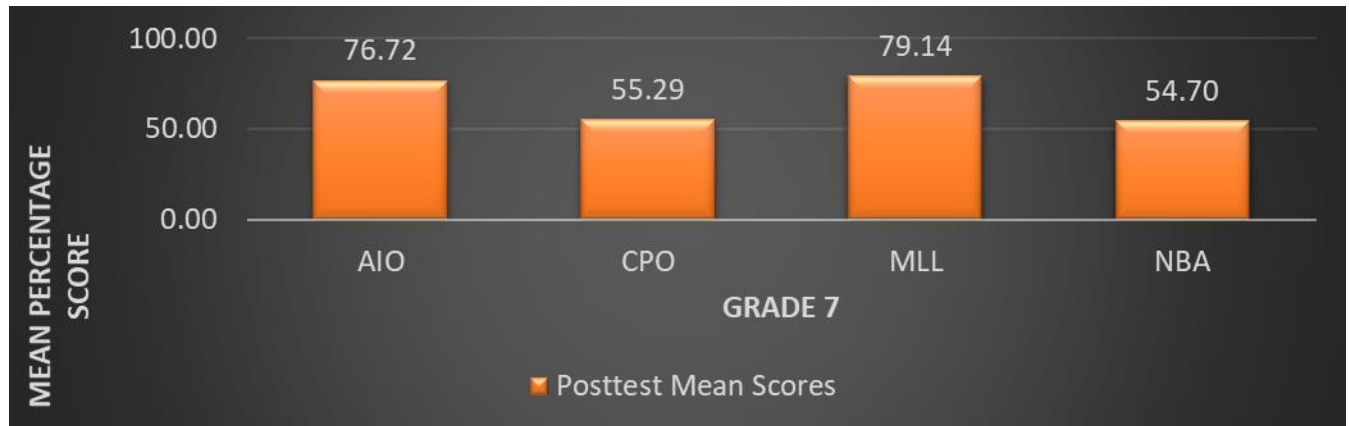


Figure 2. Mean Percentage Scores in Mathematics 7 Posttest after the Implementation of the 5E inquiry-based Supplementary Video Materials in Quarter 2

Figure 2 shows the posttest results of Grade 7 learners in Mathematics 7 Quarter 2 after the implementation of the 5E inquiry-based supplementary video materials under the project Mathematics and Science Kit for E-Learning. It can be seen from the graph that the highest mean percentage score (MPS) obtained was from 7-MLL (79.14) followed by 7-AIO (76.72), 7-CPO (55.29), and 7-NBA (54.70). It was evidently shows that the Grade 7 learners' academic performance in Mathematics 7 has reasonably improved as compared to their pretest results. This could be ascribed to the availability and existence of supplementary video materials to guide them in answering their learning modules.

van Garderen et al. (2020) described the 5E educational model as a solid educational practice for engaging students in learning with lenses on demand. This was supported by a study by Soltura, (2018). The study found that after using the survey-based learning material as part of the lesson, the post-test score increased significantly compared to the pre-test score. Quantitative and qualitative data can be inferred from the learners' support in responding to the module. Most of them were already able to understand the instructions and put the concept into practice by watching the teacher's demonstration in the video. This merely shows that such supplementary material can be used to enhance the understanding of math 7 learners, despite the New Normal education.

Table 1 Significant Difference in the Academic Performance in Mathematics 7 among Grade 7 Learners Before and After the Implementation of the 5E Inquiry-based Supplementary Video Materials in Quarter 2

Grade 7 sections	Type of Assessment	N	Highest Score	Lowest Score	Mean	SD	Mean Difference	t-value	*p-value	Interpretation
AIO	Pretest	40	13	4	14.14	2.80	2.20	1.68	0	Not Significant
	Posttest		20	14	16.34	1.84				
CPO	Pretest	40	12	3	10.44	2.95	2.88	1.68	0	Not Significant
	Posttest		20	13	13.32	4.24				
MLL	Pretest	41	14	5	13.53	1.99	2.30	1.68	0	Not Significant
	Posttest		20	15	15.83	2.38				
NBA	Pretest	40	10	2	10.11	3.27	3.32	1.68	0	Not Significant
	Posttest		20	12	13.43	4.66				

Table 1 shows a comparison of pre-test and post-test results between the four grade levels of grade 7 for the School Year 2020-2021. It also displays the significant difference between the pre-test and post-test average results obtained after using the supplementary video material with the 5E query-based model. The average of the post-tests was higher than the average of the pre-tests. This reveals that the use of 5E inquiry-based supplementary video materials was effective in improving the academic performance of Grade 7 learners in Mathematics for School Year 2020-2021 Quarter 2. The researchers thought this improvement could be attributed to learners' adjustment to the new learning delivery modality supplemented with 5E inquiry-based video materials under the project Mathematics and Science Kit for E-Learning (MathSciKEL).

Learners achieved higher academic performance by expanding their 5E learning-based learning materials (Soltura, 2018). In addition, Agogo and Onda, (2014) found that the complexity of topics combined with time constraints, and the lack of learning materials for practical activities, may be sufficient to use complementary materials. Apart from regular modules / working texts, researchers feel that current learners need to innovate to meet their needs in order to continue to focus on learning essential concepts. Researchers claimed that the academic performance of grade 7 mathematics improved reasonable by using supplementary video materials based on the principles of the 5E inquiry-based model.

Action Plans

The researchers generated action plans based on the study's findings and outcomes as a way forward to improve the project's procedures and implementation. These include the following objectives and activities: (a) improve colleagues' teaching practices and self-confidence in the execution of inquiry-based and problem-solving instruction under the project MathSciKEL by initiating virtual focus group discussions and limited face-to-face meetings before the video lesson execution, one-day rehearsal before the video lesson execution via virtual try-out, and executing the video lessons under limited face-to-face classes; (b) create 5E inquiry-based learning materials through video lessons using Bybee's (1997) 5E instructional model in planning, writing scripts, creating new ways to discuss concepts based on student needs, using laboratory materials available

in the school or localized objects in Tayabas City to facilitate problem solving in the video, editing, finalizing, checking, and re-editing of the final outputs; and (c) improve Grade 7 students' academic performance in the JHS Mathematics summative assessment by developing a program/plan to conduct appropriate and needs-based mathematics assessments and implementing methods to improve student academic performance.

IV. Conclusion

Based on the findings of this study, the researchers reached the following conclusions:

As evidenced by the poor pretest mean score, the learners were not yet ready and struggled to answer the assigned activities in the mathematics modules. The use of 5E inquiry-based supplemental material in teaching mathematics was ascribed to the enhanced mean scores in the posttest following the quarter. The utilization of supplemental teaching materials based on the 5E inquiry-based methodology effectively improved Grade 7 students' academic performance in mathematics. The institutionalization of the project Mathematics and Science Kit for E-Learning allows for continuous planning, monitoring, and assessment of learners' academic achievement in Mathematics.

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