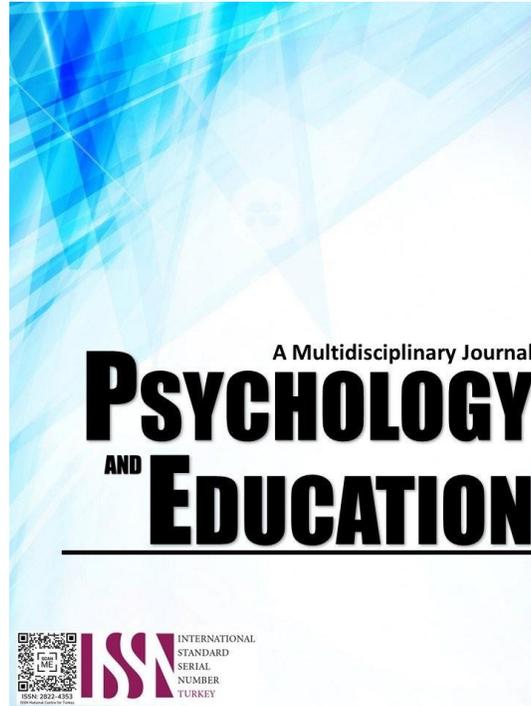


**EFFECTS OF SUPPLEMENTARY MATERIALS ON EXPONENTIAL
FUNCTIONS EMPLOYING DEMONSTRATION-FOCUSED
STRATEGY FOR SHS LEARNERS**



PSYCHOLOGY AND EDUCATION: A MULTIDISCIPLINARY JOURNAL

Volume: 18

Issue 10

Pages: 913-919

Document ID: 2024PEMJ1726

DOI: 10.5281/zenodo.10973466

Manuscript Accepted: 03-18-2024

Effects of Supplementary Materials on Exponential Functions Employing Demonstration-Focused Strategy for SHS Learners

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Abstract

Tanauan City, located in the province of Batangas, is consistently impacted by the volcanic eruptions of Taal Volcano. The tremors and volcanic smog, known as VOG, result in disruptions to the educational system, necessitating the implementation of Alternative Delivery Mode (ADM). In this kind of educational setup, the students' learning level is reflected in their mathematical skills. This research aimed to evaluate the impact of supplementary material, also called modules, on the topic of exponential functions in General Mathematics. The intervention involved a demonstration-focused strategy, a form of the flipped classroom approach. The study provided an overview of learner performance using supplementary material and the demonstration-focused strategy. By identifying differences between the two methods, it sought to determine how to improve the supplementary material provided by the Division offices. The study employed a survey and descriptive research approach to collect data from individuals within a specific population. A researcher-created questionnaire analyzed learner performance for supplementary material and the demonstration-focused strategy. Purposive sampling was employed based on the following criteria: students enrolled in the current academic year 2023-2024, students from the ABM strand, and students from the same number of classes to ensure equivalency. The study utilized frequency and percentage, weighted mean, and independent t-test for data analysis.

Keywords: *general mathematics performance, supplementary material, demonstration-focused strategy*

Introduction

Tanauan City, Batangas, is frequently affected by Taal Volcano eruptions. Seismic activities and volcanic emissions impede schooling, forcing Alternative Delivery Mode. The disturbances hampered teaching and learning, forcing the learners to use critical thinking and analysis (Aljaraideh, 2019). The importance of the subject underscores the need for a meticulous selection of relevant instructional resources for teaching learners (Sherman, 2021). The primary objective of Filipino educators is to offer students an opportunity to familiarize themselves with the assigned lesson for each day. In a typical Philippine classroom, students gather to listen to the teacher and make their own records using their notebooks (Aljaraideh, 2019). The sudden shift in learning methods has compelled educators and students to adopt digital resources like YouTube, Google Classroom, and other online platforms to ensure uninterrupted learning for students. Therefore, multimedia instruction plays a crucial role in enabling education to continue amidst the Coronavirus Disease (COVID) crisis (Asaad, 2019) and the Taal volcanic disturbances in Tanauan City, Province of Batangas (Bueza, 2020).

The traditional classroom configuration may not be optimal for facilitating effective learning, especially for children in the 21st century. The study examines the effects of blended learning, specifically the demonstration-focused flipped classroom approach, at Tanauan City Integrated High School, Senior High School Department, under the General Mathematics subject. According to Alvarez (2020), the primary aim of employing blended learning approaches is to cultivate a well-rounded individual with a global perspective. Tanauan City, Batangas, is a disaster-prone area in CALABARZON due to its location with the Taal Volcano. Due to the unrest state of the Taal volcano, even after its eruption (Bueza, 2020), there are days when students undergo alternative learning modalities, specifically using modules. This presents an opportune moment for educators to proactively explore alternative learning approaches that may enhance their students' prospects for success in a highly competitive, unpredictable, and rapidly evolving global landscape. On Thursday, Sec. Eduardo Año advised the people to stay safe and abide by the 14-kilometer danger zone of Taal Volcano, which continues to produce sulfur dioxide after its eruption (Galvez, 2020). Tanauan City Integrated High School is part of the 14-kilometer radius, and it frequently shifts from face-to-face to Alternative Distance Modality. To bridge the gap between the effectiveness of the existing modules and supplementary material, the researcher crafted this research that combines supplementary material (module) through a demonstration-focused strategy to further assist students during the time of Alternative Distance Modality.

As a Math teacher and researcher, upon observing the students' results from their activities during ADM, it was still at its lowest peak. Informal focus-group discussions with the teachers were conducted, and the researcher found out that students' performance was not so well in face-to-face discussions after coming back from ADM, with less than 80 percent earning a passing score in the formative assessment. The results of this research would assist the academic community, especially the Division of Tanauan, in enhancing the existing supplementary materials, including modules and video lessons, based on the feedback and performance of the learners across all academic subjects.

Research Objectives

The study dealt with the effects of supplementary materials on mathematics employing a demonstration-focused strategy for SHS learners. The researcher compared the learners' math performance under control and experimental situations. Specifically, this aimed

to:

1. Assess the performance of learners in Exponential Functions in General Mathematics using Supplementary Materials.
2. Evaluate the performance of learners in Exponential Functions in General Mathematics employing a Demonstration-focused strategy.
3. Determine if there is a significant difference in the use of supplementary materials and the demonstration-focused strategy in the mathematical performance of learners.
4. Identify potential enhanced supplementary materials based on the findings and feedback of learners.

Methodology

Research Design

The methodology employed in this study was deemed suitable for providing a comparison between two groups. However, it should be noted that the randomized assignment of individuals to conditions was not present in this design (Creswell, 2013). The study also utilized a demonstration-focused strategy, an instructional approach prioritizing student engagement. In this paradigm, the educator employed screen recording software to exhibit the activity, enabling students to engage with the material at their own preferred speed (Team, 2022).

Furthermore, the utilization of an evaluation test was warranted in this study due to the presence of two designated groups, namely an experimental condition and a control condition. Both groups underwent an evaluation exam to assess the impact of the treatment or manipulation, which included the use of supplemental materials such as modules and a blended learning strategy involving modules with recorded video lessons. To maintain comparability between participants in controlled and experimental settings, only responders enrolled in the selected class or section were administered the post-assessment test following the intervention of the flipped classroom. The study employed a multiple-choice test, rigorously tested, and officially endorsed assessment instrument to collect data, which was subsequently evaluated and interpreted to derive meaningful findings and draw conclusive statements. Furthermore, the study's dependent variable was the additional material, whereas the independent variables were the control and experimental conditions.

Participants

The participants of this study consisted of Grade 11 Senior High School learners from the fields of Accountancy, Business, and Management at Tanauan City Integrated High School, located in Tanauan City, Batangas. The population of the selected school had a total enrollment of 446 students. The study employed a non-probability sampling technique to choose the participants. The sample selection was conducted using a method where the likelihood of getting chosen is not known (Essays, UK, 2013). Non-probability sampling encompassed one distinct method, namely purposive sampling. This sample technique is alternatively referred to as judgmental sampling or purposive sampling (Dovetail Editorial Team, 2023).

To establish comparability among the participants in the study, the researcher deliberately selected two sections from the same academic strand, resulting in a total of 60 respondents. Each section consisted of students with diverse backgrounds. Participants were selected using these criteria: students should be enrolled in the academic year 2023-2024, students should belong to the ABM strand, students should belong to the same number of classes to ensure equivalency. Table 1 presented the distribution of participants across various grade level sections.

Table 1. *Distribution of Respondents*

<i>Strand & Sections</i>	<i>No. of Students</i>	<i>No. of Respondents</i>
ABM A	27	27
ABM B	27	27
Total	54	54

Instruments

The study utilized a teacher-created mathematics assessment as the primary tool for evaluating the mathematical performance of students in both groups and a learner feedback form to enhance the available supplementary material. In crafting the assessment tool, the researcher conducted a pre-survey that covered all the Most Essential Learning Competencies (MELCS) in the subject Mathematics. The results of the pre-assessment led to the selection of the topic exponential function, as this was the lesson that received the lowest score or mean percentage score. The researcher focused on crafting the assessment test on this topic, resulting in a 20-item assessment. The development, validation, and approval of the instrument were conducted by a panel consisting of three (3) master instructors specializing in the STEM strand.

Furthermore, the self-produced video-lesson and modules underwent a process of validation and approval by the designated validators. Participants were instructed to respond to the provided assessment by selecting the appropriate response for each question. The teacher-made evaluation was utilized to discern the disparity in learner performance with regard to the supplementary materials and blended learning technique employed in instruction. In addition to the supplementary materials and blended learning technique that were employed, the researcher gave the students a questionnaire focusing on the students' feedback about the supplementary material and

the demonstration-focused strategy. This served as a basis for enhancing the supplementary material and video lesson for future usage.

Procedure

The researcher decided to undertake a study investigating the impact of supplemental resources on mathematics education, specifically utilizing a demonstration-focused technique for senior high school learners. The primary research instrument employed in this study was a teacher-made assessment that had been designed, validated, and authorized. This was given in a face-to-face meeting with the respondents using a paper survey. To develop a robust study instrument, the researcher conducted multiple investigations to ensure its structure was appropriately rectified. Following the acquisition of pertinent information, the researcher proceeded to develop the research instrument, which was subsequently presented to a panel of three (3) validators. This was done to accurately assess the instrument's reliability and validity.

The researcher engaged in a discussion with the research professor to address the comments and ideas provided by the validators. The instruments to be utilized were altered with the assistance of the professor by the researcher. The researcher ensured that appropriate communication protocols were followed prior to completing the assessment. The researcher submitted a formal letter to the Principal and Assistant Principal of Tanauan City Integrated High School, requesting their authorization to carry out a study within the senior high school, focusing primarily on the Grade 11 ABM program. The letter was acknowledged by the assistant principal and afterward approved by the principal of the school.

Upon obtaining approval from the school administrator, the researcher proceeded to seek parental consent via written correspondence. The letter explicitly stated that parents provided assurance of the strict confidentiality of the information collected from the pupils. Upon obtaining parental approval, the study and assessment were administered to the chosen participants from Tanauan City Integrated High School. The academic performance of the pupils was evaluated based on the outcomes of the evaluation conducted during the School Year 2023 - 2024. To ensure the reliability of the self-made supplementary material and assessment tool, pilot testing was conducted for grade 11 HUMSS and STEM strands. The results of the pilot testing showed that the validated material was ready to use for the selected participants in the research.

Data Analysis

To address the problem posed in the study, the following statistical treatments were used.

Independent-Sample T-test. This test was employed to examine statistically significant differences in population means by comparing the means of two independent groups. The study specifically compared the math performance of students using additional materials versus a demonstration-focused technique.

Pilot-testing. This method was carried out to identify and address any issues before the full implementation of the self-made supplementary material and assessment tool. Pilot testing aimed to assess the validity of the material being used and every question given in the assessment.

Cronbach alpha. This statistical measure was employed to evaluate the reliability of an instrument by comparing the extent of shared variance or covariance among its constituent items to the total amount of variance.

Reliability test. This test was used to verify the soundness and replicability of the data, as well as the accuracy of the results.

Ethical Consideration

Engaging in research required careful consideration of ethical principles to protect the rights and well-being of participants, as well as to maintain the integrity of the research undertaking. The researcher in this work had a conscientious commitment to upholding ethical principles. In the context of informed consent, the researcher obtained informed consent from the principal, assistant principal, and parents, as the subjects involved were minors. The approach entailed furnishing a thorough elucidation of the study's aims, methodologies, potential risks, and benefits. Additionally, it was crucial that individuals participating in the study expressed their informed consent, indicating their voluntary agreement. It was of utmost importance that participants possessed a comprehensive awareness of their entitlement to discontinue their involvement in the study at any given moment without facing any negative consequences.

In addition, the researcher placed a high emphasis on protecting privacy and maintaining confidentiality through the implementation of appropriate methods to preserve the personal information and responses provided by participants, ensuring their confidentiality. Data were fully anonymized to safeguard participant privacy and confidentiality. Importantly, a comprehensive debriefing method was followed in the investigation. The participants engaged in a debriefing session with the researcher, during which the main goals of the study were clarified, any questions were answered, and further information related to the research was provided. The principal and pertinent stakeholders ensured the publication and reporting of the findings in an honest and transparent manner, irrespective of their alignment with the initial hypothesis.

In conclusion, it was of utmost importance to abide by ethical considerations, as they played a vital role in maintaining trust, protecting participants, and ensuring the integrity of scientific pursuits. The researcher adhered to ethical principles and sought approval from

relevant ethics committees before conducting research that involved human participants or sensitive topics.

Results and Discussion

Performance of the learners in Exponential Functions in General Mathematics using Supplementary Materials

Performance is derived from the assessment results of the learners using supplementary material. The assessment consists of 20-item questions targeting the cognitive level and problem-solving skills of the students regarding exponential functions. This is verbally interpreted using the score range and its corresponding descriptions. Getting a score below 75 is interpreted as not meeting the expectations, scores of 75 to 79, 80 to 84, 85 to 89, and 90 to 100 are interpreted as Fairly Satisfactory, Satisfactory, Very Satisfactory, and Outstanding, respectively.

Table 2. *Performance of the learners in Exponential Functions in General Mathematics using Supplementary Materials*

Score Range	Frequency	Percent	Verbal Description
Below 75	20	74.00%	Did Not Meet Expectations
75 – 79	6	22.00%	Fairly Satisfactory
80 – 84	0	0.00%	Satisfactory
85 – 89	0	0.00%	Very Satisfactory
90 – 100	1	4.00%	Outstanding
TOTAL	27	100%	

Table 2 indicates the performance of the learners using supplementary material in General Mathematics. The results of the assessment tests for grade 11 students show that twenty (20) out of twenty-seven (27) students scored below 75, not meeting the expectations of the subject, which accounts for 74 percent of the respondents. Meanwhile, 6 students out of 27 got a score ranging from 75 to 79, performing fairly satisfactorily, constituting 22.00 percent of the respondents. Furthermore, 4.00 percent of the respondents got a score ranging from 90 to 100, with 1 student out of 27 performing outstandingly in the assessment tests. As an overall result, it shows that most of the students received failing scores in the assessment test.

According to Aljaraideh (2019), education in a conventional classroom setting normally took place within the physical boundaries of the classroom, with a duration of approximately one hour. During this period, students were effectively acquainted with essential concepts through engaging in direct classroom activities. Following this, comparable assignments were allocated for completion in the home environment, leveraging the information obtained in the educational setting but with heightened levels of complexity (Aljaraideh, 2019).

Table 3. *Performance of the learners in Exponential Functions in General Mathematics employing Demonstration-focused strategy*

Score Range	Frequency	Percent	Verbal Description
Below 75	10	37.00%	Did Not Meet Expectations
75 – 79	3	11.00%	Fairly Satisfactory
80 – 84	1	4.00%	Satisfactory
85 – 89	1	4.00%	Very Satisfactory
90 – 100	12	44.00%	Outstanding
TOTAL	27	100%	

Table 3 indicates the performance of the learners employing the Demonstration-focused strategy in General Mathematics. The results of the assessment tests for grade 11 students show that ten (10) out of 27 students scored below 75 and did not meet the expectations of the subject, which is 37 percent of the respondents. Meanwhile, 3 students out of 27 students got a score ranging from 75 to 79, performing fairly satisfactorily, which is 11.00 percent of the respondents. Furthermore, 4.00 percent of the respondents got a score ranging from 80 to 84, which is 1 student out of 27 students who performed satisfactorily, and another 4.00 percent of the respondents obtained a score from 85 to 89, which is 1 student out of 27 students who performed very satisfactorily in the assessment tests. Lastly, 12 out of 27 students belong to the 90 to 100 score range, which is 44.00 percent, interpreted as outstanding. As an overall result, it shows that 17 out of 27 students, or 63.00 percent, got passing scores for the assessment test.

In the past, educators would provide additional education to students outside of the classroom by carefully selecting different materials, allowing students to independently gain basic knowledge instead of just depending on lectures in class (Sherman, 2021). Later, the homeroom environment changed into a professional setting where people worked together to solve problems, came up with new ideas, and actively took part in collaborative learning. According to Ferrer and Martínez (2021b), the implementation of flipped classrooms has effectively facilitated student inclusion and psychological engagement. Teachers successfully interrogated students, rectified misconceptions of topics, and elucidated mistakes, thereby tailoring instruction to individual pupils and augmenting academic achievement and involvement.

Difference between the Performances of the Learners Using Supplementary Materials and Demonstration-focused strategy in General Mathematics

The study aims to compare student performance in General Mathematics with and without extra materials. Using a marginal error of 5 percent, if the p-value is less than 0.05, the null hypothesis will be rejected, and the alternative hypothesis will be accepted, indicating statistical significance.

Table 4. *Difference between the usage of supplementary materials and demonstration-focused strategy in the mathematic performance of the learners*

Test Scores	Mean	t-value	df	p-value	Decision	Interpretation
Supplementary Materials	-4.92592	-4.97847	52	0.000	Reject H ₀	Significant Difference
Demonstration-focused Strategy						

Table 4 illustrates the disparity in the performance of Grade 11 ABM-SHS students in general mathematics concerning the usage of supplementary materials and the demonstration-focused strategy. The scores of the respondents underwent statistical testing using dependent samples test to assess whether a difference exists between the test scores of the learners. The responses from the students yielded a computed p-value of 0.000, which is less than the level of significance of 0.05. This observation leads to the rejection of the null hypothesis and the acceptance of the alternative hypothesis, with a verbal statement indicating a significant mean difference. The performance of students who use extra materials and the demonstration-focused technique differs significantly.

According to the findings of Chou et al. (2021), children demonstrate optimal performance in educational settings that provide competence, connection, and autonomy. Students were given the ability to independently manage their time, select their study environment, and determine their own learning speed through self-directed learning. According to Aljaraideh (2019), a blended course, which combines online and traditional teaching methods, offers benefits compared to one-way instruction. Blended online learning facilitates the evaluation of students' fundamental knowledge by employing a blend of online and in-person assessments (Chen et al., 2019). According to Chang et al. (2019), the implementation of a blended learning strategy has the potential to convert conventional homeroom hours into interactive sessions that facilitate the application of online learning in diverse contexts and foster the development of higher order thinking skills through engagement with teachers, peers, or both.

Blended learning expedites student learning, and in the aftermath of the pandemic, Filipino educators acknowledged their capacity to rival nations implementing blended learning.

Feedback of the learners on the use of supplementary material and demonstration-focused strategy

Table 5. *Feedback of the students on the use of supplementary material and demonstration-focused strategy*

Statements	Mean	Verbal Interpretation
1 The supplementary material helped me a lot in understanding the Exponential Functions in General Mathematics	3.52	Strongly Agree
2 The supplementary material is easy to understand minimal supervision of the teacher.	3.54	Strongly Agree
3 The content of the supplementary material gives me a lot of information about Exponential Functions in Gen Math by reading it at home during Alternative Distance Learning.	3.50	Strongly Agree
4 The content of the supplementary material is organized and easy to comprehend.	3.54	Strongly Agree
5 The assessment in supplementary material has clear instructions and easy to follow.	3.43	Strongly Agree
6 The objectives of the lesson are clearly shown in the lesson and assessment.	3.50	Strongly Agree
7 The level of my retention in the topic Exponential Functions is higher than using supplementary material only.	3.46	Strongly Agree
8 I clearly understand the lesson using the video and the supplementary material.	3.56	Strongly Agree
9 I can manage my own learning pace with the use of replay and pause options in the video.	3.52	Strongly Agree
10 I have more time in understanding the lesson with a little supervision from my teacher.	3.41	Strongly Agree
11 I can freely choose anytime and anywhere in watching and rewatching the video.	3.54	Strongly Agree
12 I can answer the activities in my supplementary material easily with the help of the video lesson.	3.48	Strongly Agree

Legend: 3.26-4.00: Strongly Agree; 2.51-3.25: Agree; 1.76-2.50: Disagree; 1.00-1.75: Strongly Disagree

Table 5 provides a detailed descriptive analysis of the students' feedback on the use of supplementary material and the demonstration-focused strategy. The results indicate that the respondents strongly agreed that they clearly understand the lesson using the video and supplementary material, with the highest obtained mean of 3.56. This suggests that having supplementary material and a video lesson can genuinely assist students in comprehending the lesson with minimal guidance from the teacher. Additionally, the students strongly agree that the supplementary material is easy to understand with minimal supervision from the teacher, the content of the supplementary material is organized and easy to comprehend, and they can freely choose anytime and anywhere to watch and rewatch the video, with an obtained mean of 3.54. This implies that learners can grasp the supplementary material when it is tailored to their needs, and the video lesson provides them the flexibility to review the lesson at their convenience. Furthermore, the students strongly agreed that they have more time to understand the lesson with little supervision from their teacher, with the lowest mean of 3.41. This suggests that while technology can assist teachers, teacher supervision remains crucial to student learning.

According to the findings of Chukwuemeka (2021), the introduction of flipped learning in a sixth-grade mathematics classroom, with

a specific emphasis on the idea of proportions, resulted in a notable improvement in students' attitudes towards mathematics when compared to traditional classroom teaching methods. Nevertheless, it is crucial to acknowledge that neither group exhibited a statistically significant improvement. Although flipped learning classes have demonstrated numerous favorable results, their efficacy is not assured. According to Alvarez (2020), the Center for Blended Learning in Cubao, Philippines, was founded in 2007 with the objective of providing educational and recreational opportunities for young children.

Conclusion

Based on the findings of the study, the following conclusions were drawn: (1) Most of the learners achieved passing scores on their assessment tests and performed fairly satisfactorily, indicating that supplementary materials employing a demonstration-focused strategy were an effective method for teaching and learning mathematics, contributing to the academic development of the students. (2) A significant performance gap was observed between grade 11 senior high school learners who utilized and employed demonstration-focused technique in general mathematics than those learners who solely used supplementary resources. (3) The utilization of supplementary material employing a demonstration-focused strategy in teaching general mathematics was deemed effective in motivating students, fostering their cognitive development, and improving their classroom performance.

Based on the findings and conclusions drawn, the following were recommended: (1) Students, guided by parents and teachers, can continue to enhance themselves by utilizing demonstration-focused strategy with localized supplementary materials, allowing them to develop confidence and improve performance anytime and anywhere. (2) Teachers can enhance student performance in mathematics and other subjects by localizing modules or additional materials with video lessons. (3) School administrators and curriculum developers should consider the recommendations with the objective of encouraging teachers to use localized supplementary materials that cater to the needs of the students. They should also develop a program or training that focuses on other flipped classroom strategies beyond the demonstration-focused strategy in mathematics instruction, thereby improving students' performance in secondary schools. (4) Teachers are encouraged to adopt classroom practices and activities that are learner-centered and enhance their problem-solving skills. This approach enables them to become better problem solvers in more challenging circumstances, employing the demonstration-focused strategy not only in mathematics but also in other subjects, particularly those with difficult topics requiring more assistance. (5) Future researchers may broaden the scope of the study to include a larger scale of respondents from different districts and divisions. Researchers may also explore new studies to identify relevant variables affecting students' feedback about supplementary materials and the demonstration-focused strategy.

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