

Effectiveness of Blended Learning Techniques in Teaching Laws of Exponents

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ABSTRACT

This study sought to ascertain whether blended learning techniques helped teach the laws of exponents to students in Grade 7 at Pulo National High School-Diezmo Ext., City of Cabuyao, Laguna for the SY 2021-2022. For this investigation, a quasi-experimental research approach was used. Sixty (60) seventh-grade students took part in this study. The pretest and posttest used in this study covered the fundamental idea of laws of exponents. The experimental group outperformed the comparison group on average, scoring a mean of 26.13 as opposed to 18.27 for the comparison group, according to the formative test results. The formative assessments for the two groups differed noticeably on $p.01$. Results from the posttest frequently improved over those from the pretest. The difference between the pretest and posttest mean scores was significant at $p.01$ for the experimental and comparison groups, indicating that it is very effective for both groups of students. The difference between the pretest and posttest scores for the experimental group produced a t -value of 9.525, which is significant at $p.01$. Based on the study's findings, the researchers concluded that blended learning is a successful intervention that may be used in the classroom to help kids get better at math.

Keywords: *blended learning, experimental/comparison group, laws of exponents*

INTRODUCTION

The COVID-19 pandemic abruptly hit the world in 2019. The Philippines in particular, its Department of Education (DepEd) spent a lot of time and thought considering how to admit and conduct classes, and as a result, the DepEd Order No. 007 s. 2020 was released the following school year. Students, parents, and teachers were exceedingly challenged since everyone had a tough time adjusting to the new standard. The Regional Office immediately started working on getting kids back in school. Teachers received a lot of training to refine their abilities and skills in the context of the new teaching norm. The Department has taught and prepared all teachers to be successful educators despite the current circumstances. The Division Memorandum No. 306, Section, was one of the memos that SDO Cabuyao executed. The document is in accordance with RA No. 10533, also known as the 2013 Enhanced Basic Education Act.

At the beginning of the school year, parents and teachers put in a lot of work to get things ready and continue the learners' education. However, in this educational system, parents struggled to facilitate learning since explaining the lessons to their children proved to be a difficult task. On the other hand, the youngsters cannot complete the modules because they are too challenging to comprehend. It is acknowledged that children must have

adult supervision while they learn to retain the information and complete the module's assigned activities.

New normal caused difficulties. Many people have thought that it is difficult to adjust to change. The COVID-19 pandemic has caused a recent resurgence of blended learning, a notion that has become increasingly popular in education over the past ten years. It is a method of delivering education that combines in-person instruction with technologically supported online learning. The best tool for children today is this one. Children may benefit much from blended learning if they are aware of it. Since it enables students to review missed lessons and repeat them, if necessary, this approach is advantageous to children. The secret for today's pupils to better understand the task and learn from their teachers' videos is blended learning. However, in this situation, significant participants in education should learn to adapt.

One of the more challenging disciplines is mathematics, which tends to dull pupils' enthusiasm and interest in the subjects being covered. It is a significant problem for educators, particularly at the elementary and intermediate levels, when pupils are expected to acquire a solid understanding of fundamental ideas and effective study techniques. Traditional educational methods are insufficient to meet each student's needs. Despite its expanding popularity, little study has been done on the efficacy of blended learning, which combines traditional classroom instruction with online learning. The blended learning combines the advantages of in-person teaching with online learning, ignites students' motivation, reduces class time, and encourages self-regulated learning. Dolores et al. (2019) looked for ways to transform the conventional teaching method into contemporary blended learning. They performed observation for student learning in in-person and online classrooms that have also been successful among teachers. In a different study, Ige and Hlalele (2017) tested how junior high school pupils in Nigeria's Ondo Region learned and discovered that blended learning is beneficial for a lesson focused on student learning. According to Ma and Lee (2021), blended learning is meant to keep students' attention and make them more satisfied with their learning material. Blended learning produces better accomplishments and equitable learning growth with the help of technologies.

Because of this, we might continue to encourage individuals to watch videos as a current habit. The pupils may be able to understand the lesson—precisely, the grade 7-level topic of laws of exponents—through a video clip presentation. As mentioned above, the instructors at the institution strive to help the student's mathematics skills.

The needs of the pupils at Pulo National High School-Diezmo Ext. in terms of their mathematical abilities should be addressed by the students, parents, teachers, and administration. They might be able to handle the current learning abilities in mathematics if the students study the lesson by watching video presentations. Goals will not be accomplished if this issue is not addressed, even though essential mathematics instructions are followed. Math proficiency among students may be a good indicator of their future success.

Mathematics remains as the most difficult and challenging subject in basic education despite being a powerful tool for learners to develop logical reasoning and problem-solving skills (Domondon, et al., 2022). Given the current state of the world's health, it makes sense

that the students are struggling with their lessons. Today's options include using blended learning strategies to make it simpler for students to complete their mathematics modules. Children, particularly those at PNHS-Diezmo Ext., need this method or style of learning. The kids at PNHS-Diezmo Ext. would therefore be pleased to learn their lesson using the blended learning strategies that their teacher has shared. As a result, no pupil would be left on the periphery, and they would be promoted and make academic progress.

Teachers must keep an eye on, encourage, and assist pupils' learning while also providing them with the wisdom they deserve. And in this instance, that goal is to facilitate learning based on the video lesson supplied by teachers and to function as an effective blended learning strategy.

METHODOLOGY

Research Design. This investigation used the pretest-posttest-non-equivalent control group research design, which is a specific kind of quasi-experimental research design. In educational research, a quasi-experimental study design is frequently employed, particularly when assessing the efficacy of intervention programs or instructional strategies (Shadish et al., 2002).

The two student groups in this study received a pretest and a posttest, but only the experimental group was provided the research treatment or intervention method. The two student groups attended a series of sessions, with the first group using the traditional method. In contrast, the other group was exposed to blended learning techniques as an Intervention tool. The results of the two groups of grade 7 students using the two intervention tools were compared using a quantitative approach to the pretest, formative testing, and posttesting phases. The formative assessments given after each lesson or level serve to gauge students' mathematical proficiency and track their growth as math performers using the Laws of Exponents as a case study. A series of comparative analyses were performed on the results of these formative tests to evaluate the hypotheses. After each session, students took a posttest, and the findings were statistically analyzed to determine whether the differences between the experimental and control groups were substantial.

Participants of the Study. To choose the final group of study participants, a pretest was given to two diverse sections of grade 7 at Pulo National High School-Diezmo Ext. The study considered 44 pupils from the second section of grade 7 and 46 students from the first section. Based on the pretest scores, pupils from section 2 who scored poor were given the beginning (B) grade and this were tallied and matched with the results of the other group. The total number of responders was determined using the results of the match-pairing of scores. A total of 30 respondents for each portion of the survey were recognized as being in grade 7. The group also included the remaining pupils or blind responders, but the study did not consider their performance.

A total of 60 individuals served as respondents of the study; 30 in the experimental group, and 30 were in the control group. Table 1 displays the participation distribution.

Table 1
Distribution of Participants

Group	No. of Students	No. of Blind Participants	No. of Selected Students Participants
Experimental	46	16	30
Comparison	44	14	30
Total	90	30	60

Research Instrument

The researchers used pretest, formative tests, and posttest to collect the data and information required for this study. The written assessment is the primary method used to collect information on how blended learning strategies work when teaching grade 7 students about the Laws of Exponents. The researchers pilot-tested the questionnaire to ascertain its validity. The department head and the officer-in-charge validated the surveys to confirm that the outcomes were accurate, well-written, and aligned with the competency of the lesson.

The researchers used contextualized videos as instructional materials for their blended learning lessons, which were approved by the school's head of faculty and the officer-in-charge. The researchers' videos, created based on the feedback from those who verified the technology used for pilot testing, concentrated on the most crucial learning characteristics. After analyzing the findings, the adviser endorsed the validity and thoroughness of the questionnaires submitted to respondents from Pulo National High School-Diezmo Ext. Additionally, the teacher forwarded the movies to the pupils, who watched them at their own pace. The conversations took place at the appointed hour.

The learning competency covered for the second quarter is the basis of the pretest the researchers created. It was distributed to the students as a means of picking the participants. The formative exam replaced quizzes and other evaluations that covered the entire lesson for the quarter. The results of the posttest, which came last, demonstrated the success of the intervention.

Research Procedure

The researchers provided the necessary fundamental protocol. The Division Superintendent of Cabuyao City and Pulo National High School-Diezmo Extension's principal approved the conduct of the study. The researchers administered the pretest to two distinct Grade 7 groups after approval of the conduct of study. The pupils first group's scores were tallied and contrasted with the results of the second group to determine the final respondents. Following the approval, the researchers personally administered the test to the respondents. Twenty questions on the Laws of Exponents were used to collect the information required for the quasi-experimental study.

The math instructor and OIC/Head Teacher I in Mathematics of Pulo National High School-Diezmo Extension verified the researchers' prepared YouTube video lesson presentation. After the videos were validated, the grade 7 students were shown them

outside of class. The time was set for 9:00 to 9:30 in the morning. A formative test was given after watching the video course for 30 minutes. The researchers continuously recorded the formative test scores during the intervention. The grade 7 students were given a post test that was very comparable to the pretest.

The experiment began in December 2021 and was completed in February 2022. The comparison group used the grade 7 mathematics current learner's module, whereas the experimental group received exposure to blended learning strategies using video lessons as a medium. The intervention tool provided to the two groups was used in a series of conversations and exercises. After the session, a formative exam was provided, and the last stage was administering the posttest to gauge how well-blended learning strategies worked.

Statistical Treatment of Data

The researchers applied appropriate statistical techniques to quantify the data gathered and address the study's problem. In the posttest and formative test, the study's results were tallied and evaluated using descriptive statistics, including mean, standard deviation, and Cohen's d. The statistical metrics applied in the study are listed below.

Mean and standard deviation were employed to determine the average results of two groups on the formative test, pretest, and posttest.

Utilizing the mean results from each group's pretest, formative test, and posttest, blended learning techniques for teaching Laws of Exponents were assessed. It was evaluated whether there was a significant difference in the scores between the two groups formative and posttest assessments using an independent t-test. The mean test scores of the various groups were compared using a paired t-test.

McLeod claims that when comparing two means, Cohen's d is the proper effect size (2019). In this study, the size of the mean difference in student performance between the comparison and experimental groups on the formative and posttest was estimated using Cohen's effect size estimation.

RESULTS AND DISCUSSIONS

This section presents and analyzes the tabulated and obtained data.

The formative test mean scores for the two participant groups are displayed in Table 2.

Table 2

Mathematical mean results on formative tests for the two groups of students

Group (n=30)	Mean	Std. Dev.	Descriptive Interpretation
Experimental	26.13	1.74	Very High
Comparison	18.27	3.54	Average

Legend: 26-30 = Very High; 21 – 25 = High 16 – 20 = Average; 11 – 15 = Low; 1 – 10 = Very Low

According to Table 2, the experimental group's mean score of 26.13 (SD=1.74) is greater than the comparison group's 18.27 (SD=3.54). It is noteworthy that whereas the comparison group performed about average on the formative test, the experimental group performed exceptionally well.

To support Rivera's (2017) claim that blended learning gives teachers the latitude and options to include extra online activities to enhance special needs children's reading and math skills. Since students with different skills and learning needs may be present while focusing on distinct curricular areas and target activities, a blended learning classroom can be more inclusive, offering chances to further special education inclusion initiatives. Extensive research is required to evaluate blended learning strategies with specific student groups.

Table 3*Mean scores on the math posttest for the two student groups*

Group	Mean	Std. Dev.	Descriptive Interpretation
Experimental	16.80	1.24	Average
Comparison	11.43	2.82	Low

Legend: 26-30 = Very High; 21 – 25 = High; 16 – 20 = Average; 11 – 15 = Low; 1 – 10 = Very Low

Table 3 displays the posttest mean scores for the two groups. With a mean score of 16.80 (SD: 1.24) versus 11.43 (SD: 2.77) for the comparison group, the experimental group scored significantly better than the control group overall. The descriptive interpretation of the comparison group is inadequate compared to the experimental group's mean.

These findings corroborate the claim Owston et al. (2019) made that a successful blended learning delivery involves 80% high-quality online learning and 20% classroom instruction connected to online content. On the other hand, according to personal communication, broadcasting, and publishing, blended learning combines several pedagogical approaches such as group work, discovery learning, expository learning, presentations, and others to deliver education.

Table 4*Comparison test of the mathematics students in the two groups formative test mean scores*

Group	Mean	SD	t-value	df	Mean Difference	Cohen's d	Effect size
Experimental	26.13	1.74	10.992**	58	7.867	2.818	Large

** Test is Significant @ p-value < 0.01; Cohen's d: 0.01-0.49: Small; 0.50-0.79: Medium; 0.80-2.99: Large; 3.0 or higher: Very Large.

It can be gleaned in Table 4 that the comparative analysis generated the t-value of 10.992 is significant at p-value<0.01. It also shows a large interpretation of the standardized difference (Cohen's d).

This finding supports the conclusion of Kintu et al. (2017) that a successful blended learning environment is essential to deploying innovative pedagogical strategies leveraging technology in teaching and learning. Examining learner characteristics/background, design aspects, and learning outcomes as effectiveness criteria can help in the creation of effective learning environments with both face-to-face and online components. Most of the student traits and components of the blended learning design highlighted in this study are critical predictors of blended learning efficacy. Among the independent factors, there were no significant predictors of student performance. These discrepancies should be investigated further to determine whether they may be utilized to predict blended learning success in a similar or different learning environment.

Table 5 presents the test of difference in the posttest mean scores in mathematics of the learners in each group.

Table 5

Comparison of the learners in each group's posttest mathematics mean scores

Group	Mean	SD	t-value	df	Mean Difference	Cohen's d	Effect size
Experimental	16.80	1.24	9.525**	58	5.367	2.465	Large
Comparison	11.43	2.82					

** Test is Significant @ p-value < 0.01; Cohen's d: 0.01-0.49: Small; 0.50-0.79: Medium; 0.80-2.99: Large; 3.0 or higher: Very Large.

Table 5 shows that comparing the experimental and comparison groups' posttest mean scores resulted in a t-value of 9.525, which is significant at a p-value of 0.01. Additionally, it demonstrates the broad interpretation of Cohen's d statistic, which is 2.465. It supports the research by Keskin and Yurdugül (2020) that learners' preparedness for this process can largely be determined by looking at readiness structures for blended learning. The researchers began with the premise that the learners, recognized as digital natives, could use blended learning technology.

The statistically significant difference in the students' mean mathematics scores on the pretest and posttest for each group is shown in Table 6.

Table 6

Comparison of the learners in each group's mean Mathematics scores between the pretest and posttest

Group	Test	Mean	SD	t-value	df	Mean Diff	Cohen's d	Effect Size
Experimental	Pretest	6.73	1.93	-27.120**	29	-10.067	6.208	Very Large
	Posttest	16.80	1.24					Large
Comparison	Pretest	6.73	1.93	-8.728**	29	-4.700	1.945	Large
	Posttest	11.43	2.82					

** Test is Significant @ p-value < 0.01; Cohen's d: 0.01-0.49: Small; 0.50-0.79: Medium; 0.80-2.99: Large; 3.0 or higher: Very Large.

The results in Table 6 show a significant difference between the mean scores of the experimental group's pretest and posttest at a p-value of less than 0.01. Using a p-value of 0.01 also established that the difference between the pretest and posttest mean scores was significant.

The effect size of the difference was calculated using Cohen's d because the test showed significance. The experimental group's pretest and posttest mean scores varied on average by 6.526 points, which is a "very large" effect size. Given that the computed Cohen's d value for the comparison group was 1.945, it was evident that there was a "large" effect size on the mean difference between the pretest and posttest mean scores for the comparison group.

The results support Wang's (2018) claim that blended learning boosts students' academic performance more than face-to-face learning. In a blended learning setting, pupils actively collaborate. According to findings from a prior study on collaborative learning in an online learning environment, students share their knowledge with peers to receive current knowledge and actively create new knowledge for task performance.

CONCLUSION

Based on the findings of the study, the following conclusions were made: The experimental and control groups' formative testing revealed a significant difference at p-value 0.01, contradicting the null hypothesis that claimed no change had occurred. Also shown to be statistically significant at $p=0.01$ was the difference in posttest mean scores between the experimental and comparison groups. Because of this, the null hypothesis that there has been no substantial change is rejected. The null hypothesis, which held that there was no discernible difference between the pretest and posttest outcomes for each group, is likewise refuted by detecting a significant difference with a p-value less than 0.01. The findings show that the students benefit from the teaching method because they employ the blended learning tools their teacher offers to help them learn the subject.

RECOMMENDATIONS

The following suggestions are provided in light of the results and conclusion: 1) Teachers can design intervention resources to scaffold their students' learning in their capacity as curriculum designers and implementers. Using strategies should be both unique and based on prior research, as long as it will allow students to study effectively at their speed; 2) The school administration might give kids additional money to duplicate intervention learning resources. The support of the administration is crucial in improving teaching and learning techniques; 3) A stimulating environment can help students learn. The learner requires a relaxing environment in which to learn. These include the methods, instructors, and other relevant elements.

ETHICAL STATEMENT

We have considered some of the ethical issues while conducting this research. We have kept all the personal information of the learners, teachers, and the school confidential. This is to protect their privacy and make them feel secure. Consent, confidentiality, and data protection were the significant ethical issues in the research process. Proper communication of all the vital details were observed, and the aim of the study was to secure consent from the respondents. The respondents were able to understand their role in the data gathering through a thorough explanation of the important details. Respondents were assured that the gathered data were treated with confidentiality and that all participants were treated fairly. Hence, only relevant information needed to answer the specific research questions was disclosed.

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