

Students' Academic Performance and Engagement in Mathematics via Blended Learning

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Abstract Blended Learning deals with student acquisition of knowledge via electronic and online media and the use of printed modules. This study examined the mathematics performance and engagement of students via blended learning at Kalilangan National High School. It aimed to (a) ascertain the level of students' academic performance when exposed to Blended Learning in terms of pretest and posttest; (b) find out the level of students' engagement when exposed to Blended Learning in terms of pretest scores and posttest scores; (c) determine if a significant difference exist between pretest and posttest scores of students' academic performance before and after exposure to Blended Learning; and (d) determine if a significant difference exists between the pretest and posttest scores of students' engagement in Mathematics when exposed to Blended Learning. The study used the one-shot pretest-posttest research design. It was conducted at Kalilangan National High School with the Grade 10 students as participants during the pandemic. The academic performance and engagement of students in Mathematics were gathered from the participants using validated instruments to answer the research problems. Results showed that students have very low performance in the pretest while moderate in the posttest. Findings revealed that there is a highly significant difference in the academic performance in Mathematics between pretest scores and posttest scores. Paired t-test showed that there is a highly significant difference between the pretest and posttest scores of the students' engagement level in Mathematics when exposed to the Blended Learning approach.

Keywords: *academic performance, engagement, mathematics, blended learning*

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1. Introduction

Corona virus have a big impact in the world of education [1]. That is why the learning delivery system is an issue that should be addressed as we move towards fighting the new normal [2]. Through e-technology and printed modules are slowly being part of the medium of instruction due to pandemic. It was announced in Manila Bulletin Latest News last July 22, 2020 that senator Christopher Lawrence "Bong" Go chairman of the senate health stands that not to allow face-to-face classes until there is no vaccine to the virus, that is why most of the students and teachers struggle in this situation. With the help of technology and printed modules, every teacher can still continue their responsibility to their students even if there are no face-to-face classes.

Blended Learning deals with students learning via electronic and online media and the use of printed modules. It deals with the transmission of knowledge through technology and modules provided by the teacher. The teacher allows the students to use the technology and

read educational support that the students can gain insight from it.

Promoting student engagement and participation in Mathematics is considered important for students' learning and subsequent study in mathematics [3]. Engagement is the core in blended learning. It pushes students to participate or engage in the instruction using the e-education and printed modules.

There were already studies being done in the past that examined different factors to enhance students' academic performance, namely, contemporary teaching strategies [4-10], assessment tools and techniques [11,12,13,14], and other teacher-and-or-student-related factors [15-22]. However, these investigations were conducted before the pandemic.

With the abrupt change of the mode of delivery of instruction brought about by the pandemic, the Department of Education shift to other way to supplement the needs of the students which is the use of blended learning. Hence, the researchers investigated the effectiveness of blended learning in the development or improvement of the academic performance and engagement of the grade 10 students of Kalilangan National High School.

2. Materials and Methods

The study assessed the mathematics performance and engagement in mathematics via Blended Learning at Kalilangan National High School Grade 10 Students. The study made use of a one-shot research design.

The instrument used was a matrix formed close-ended questionnaire that helps us gather the students' engagement in mathematics. The questionnaire used was pilot tested [23]. The questionnaire consists 8 Cognitive engagement questions, 8 behavioral engagement questions, 10 emotional engagement questions and 7 social engagement questions and ranges from 5 to 1. Reverse scoring procedure is done for negative statement.

The researcher prepared a 56-item teacher-made test which covered the Arithmetic Sequence, Geometric Sequence, Division of Polynomials, Remainder Theorem, Factor Theorem, and Rational Root Theorem topic in the first grading period composed of multiple-choice test type. Items were scored 1 for every correct response, and 0 if otherwise.

The participants of the study were the Grade 10 STEM and SPS students of Kalilangan National High School.

Before the start of the experiment, pretest on academic performance and engagement in Mathematics was administered to the students. The experiment was operated two months during the first grading period. After the intervention the students was took again the same test as serve as the posttest. The result of these tests was determined the difference in the students' academic performance and engagement in Mathematics of Kalilangan National High School Grade 10 students during the first grading period of school year 2020-2021.

The data collected were tabulated and analyzed using appropriate statistical tool using a statistical software. Descriptive statistics like mean, standard deviation, frequency and percentage were used to answer the questions on the descriptive levels. Paired t test was used to investigate if there is a significant difference between the pretest and posttest in engagement and academic performance in mathematics of the students when exposed to blended learning

The following rating scale was used to better understand the data:

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.51 – 5.0	Strongly agree	Highly Positive
4	3.51 – 4.50	Agree	Positive
3	2.51 – 3.50	Undecided	Fair
2	1.51 – 2.50	Disagree	Negative
1	1.00 – 1.51	Strongly disagree	Highly Negative

Score	Percentage score	Descriptive rating	Interpretation
0 – 28	74% and below	Beginning	Very Low
29 – 35	75% - 79%	Developing	Low
36 – 43	80 – 85%	Approaching Proficiency	Moderate/Average
44 – 51	86 – 89%	Proficient	High
52 – 56	90% and above	High Proficient	Very High

3. Results and Discussions

This chapter presents the analysis and interpretation of data gathered from the student's scores relevant for testing the hypothesis of the study. The order of presentation follows the arrangement of the problems identified in the study.

3.1. Mathematics Performance of the Blended Learning Group

The mathematics performance of the students exposed to Blended Learning in terms of pretest is presented in Table 1. As shown in Table 1, 12 students or 12% of the students of blended learning had a high performance, 16 students or 16% had a moderate performance, 17 students or 18% had a low performance and 52 students or 54% had a very low performance in the pretest. The overall mean score of the blended learning group in the pretest is 28.13 which indicates a very low performance.

Table 1. Student Academic Performance in Mathematics when exposed to Blended Learning in terms of Pretest

Range	BLENDED LEARNING		
	F	%	Interpretation
90% - 100%			Very High
86% - 89%	12	12%	High
80% - 85%	16	16%	Moderate
75% - 79%	17	18%	Low
65% - 74%	52	54%	Very Low
Total	97	100%	

The result of this study shows that the level of students' academic performance of Grade 10 students not exposed to Blended Learning had a very low performance. Several studies [6,7,8,24] found out that the students' performance in Mathematics before the conduct of the study is very low. It indicates that students have a less interest in Mathematics.

Table 2 shows the mathematics performance of the students exposed to blended learning in terms of posttest. It can be seen in Table 2 that 8 students or 8% of the students in blended learning group had a very High performance, 22 students or 23% had high performance, 25 students or 26% had a moderate performance, 26 students or 27% had low performance and 16 students or 16% had a very low performance in posttest. The overall mean of blended learning group in the posttest is 37.75 which indicates a moderate performance.

Table 2. Student's academic Performance in Mathematics when exposed Blended Learning in terms of Post-test

Range	BLENDED LEARNING		
	F	%	Interpretation
90% - 100%	8	8%	Very High
86% - 89%	22	23%	High
80% - 85%	25	26%	Moderate
75% - 79%	26	27%	Low
65% - 74%	16	16%	Very Low
Total	97	100%	
Mean = 17.26 (Moderate)			

The Table 2 shows that the academic performance of the students in posttest had a moderate performance level. These results are similar to other study [8] but some study [5,24] found out that the academic performance of the students in posttest had a very low performance level.

3.2. Students' Engagement in Mathematics before Intervention

Table 3 shows the students' engagement in Mathematics in blended learning before the intervention. Among the 33 items, students in Blended Learning group rated "positive" on the 20 items and "fair" on 13 items.

Table 3 also show that prior to intervention, 5 items with higher means in the Blended Learning group are "I try to understand my mistakes when I get something

wrong" (4.1), "I keep trying even if something is hard (4.1), "I want to understand what is learned in math class" (4.06), "I don't like working with classmates (rev)" (4.02) and "I try to connect what I am learning to things I have learned before" (4.00).

Also reflected in Table 3 are 5 items with lower means in the Blended Learning group and they are "When work is hard, I only study the easy parts (rev)" (2.7), "I do just enough to get by (rev)" (2.79), "I would rather be told the answer than have to do the work (rev)" (3.00), "I don't think that hard when I am doing work for class (rev)" (3.00) and "I talk about math outside of class" (3.00).

The overall mean score of students' Engagement in Mathematics before intervention is 3.57 in the Blended Learning group. This shows that students have a positive engagement in mathematics.

Table 3. Student's Engagement in Mathematics of blended learning before and after intervention

Engagement in Mathematics	Blended Learning			
	Before		After	
	Mean	Interpretation	Mean	Interpretation
I go through the work for math class and make sure that it's right.	3.8	P	3.79	P
I think about different ways to solve a problem.	3.9	P	3.68	P
I try to connect what I am learning to things I have learned before.	4	P	4.11	P
I try to understand my mistakes when I get something wrong.	4.1	P	4.30	P
*I would rather be told the answer than have to do the work.	3	F	3.00	F
*I don't think that hard when I am doing work for class	3	F	2.87	F
*When work is hard, I only study the easy parts.	2.7	F	2.83	F
*I do just enough to get by.	2.79	F	2.79	F
I stay focused.	3.8	P	4.02	P
I put effort into learning math.	3.9	P	4.15	P
I keep trying even if something is hard.	4.1	P	4.40	P
I complete my homework on time.	3.2	F	3.96	P
I talk about math outside of class.	3	F	3.49	F
*I don't participate in class.	3.4	F	3.87	P
*I do other things when I am supposed to be paying attention.	3.13	P	3.32	F
*If I don't understand, I give up right away.	3.51	F	3.83	P
I look forward to math class.	3.49	F	3.81	P
I enjoy learning new things about math.	3.6	F	4.02	P
I want to understand what is learned in math class.	4.06	P	4.47	P
I feel good when I am in math class.	3.3	F	3.51	P
*I often feel frustrated in math class.	3.1	N	2.72	F
*I think that math class is boring.	3.4		3.81	P
*I don't want to be in math class.	3.69	F	4.09	P
*I don't care about learning math.	3.85	P	4.06	P
*I often feel down when I am in math class.	3.43	F	3.70	P
*I get worried when I learn new things about math.	3.51	P	3.53	P
I build on others' ideas	3.59	F	3.83	P
I try to understand other people's ideas in math class.	3.9	P	4.09	P
I try to work with others who can help me in math.	3.98	P	4.23	P
I try to help others who are struggling in math.	3.72	P	4.09	P
*I don't care about other people's ideas.	3.8	P	3.60	P
*When working with others, I don't share ideas.	3.95	P	3.72	P
*I don't like working with classmates.	4.02	P	4.02	P
Overall Mean Interpretation	3.57	P	3.75	P

(rev) means scoring is reversed.

Legend:

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.51-5.00	Strongly Agree	Highly Positive (HP)
4	3.51-4.50	Agree	Positive (P)
3	2.51-3.50	Undecided	Fair (F)
2	1.51-2.50	Disagree	Negative (N)
1	1.00-1.50	Strongly Disagree	Highly Negative (HP)

Students are positively engaged in Mathematics when they try their best to learn specially when they found out that they need to correct their misconception in the subject and they are trying to involve their selves when things get hard. They are more engaged in the subject when they have a classmates or peers to work with them, they are trying to understand what they want to learned in the subject. Also, they love to connect on what they had learned before to the current situation.

Students are highly engaged when they are safe in school, enjoy talking to their classmate, having some friends in the class, willing to help for them when they needed them and wanted them to keep trying when things get tough at school [6]. In contrast [25], students revealed disengagement in Mathematics.

3.3. Students' Engagement in Mathematics after intervention

As reflected in Table 3, among the 33 items, students in the Blended Learning rated "positive" on the 28 items, "fair" on the 5 items.

After the intervention, 5 items with higher means in the Blended Learning are "I try to understand my mistakes when I get something wrong" (4.4), "I think about different ways to solve a problem" (4.2), "I try to connect what I am learning to things I have learned before" (4.2), "I want to understand what is learned in math class" (4.2) and "I keep trying even if something is hard" (4.14).

Also reflected in Table 3 are 5 items with lower means in the Blended Learning and they are "I talk about math outside of class" (3.4), "I often feel frustrated in math class (rev)" (3.4), "I do other things when I am supposed to be paying attention (rev)" (3.43) "When work is hard, I only study the easy parts (rev)" (3.5) and "I don't think that hard when I am doing work for class (rev)" (3.6).

The overall mean score of students' engagement in Mathematics after intervention is 3.85 in the Blended Learning, this shows that students have a positive engagement in Mathematics.

This means that after exposure, students positively engaged in Mathematics with the help of technology and printed materials, they can gain knowledge from the e-technology and learning materials that sends by the teacher via messenger and google classroom. Also, students are more engaged in Mathematics when they feel that it is challenging for them, by this they put more effort to study well. More specially students don't get easily give-up when they got the wrong answer but rather, they make an action to correct their selves.

The students are engaged in the subject when the students are supported by their families and also have some friends to enjoy talking to their classmate during Mathematics class interaction [6,7,26]. The students are engaged when they show interest, enthusiasm, positive attitude and when you show more communication and connection between the teacher and the students.

3.4. Paired t-test between the Pretest and Posttest Scores of Students' Academic Performance in Mathematics when Exposed to Blended Learning

Table 4 shows the paired t-test of the pretest and posttest scores of the treatment. As shown in the table. The t-value is -11.454 with the probability value of 0.000 ($p < 0.01$) indicating a highly significant difference, thus the null hypothesis that There is no significant difference between the pretest and posttest in academic performance of the students in Mathematics exposed to Blended Learning is rejected. This means that the students' performer better in the post test with the mean 37.7526 compare to the pretest with the mean 28.1340.

Table 4. Comparison of students' performance between pretest and posttest

GROUP		N	MEAN	SD
Performance	before	97	28.1340	11.05915
	After	97	37.7526	9.79055
		Mean	Std. Deviation	t-value
Pair 1				Sig.
Pretest-Posttest		-9.61856	8.27074	-11.454
				0.000**

**P< Highly Significant at 0.01 level.

Similar studies using blended learning to possibly enhance students' performance in mathematics were also successful [7,8]. This study utilizing the use of blended learning to increase the performance of the students. However, the result of this study contradicts to the study of Pagtulon-an and Tan [11] wherein they found out that there was no significant difference in the posttest of students.

3.5. Paired t-test between the Pretest and Posttest Scores of Students' Engagement in Mathematics when Exposed to Blended Learning

Table 5 presents the comparison of engagement of students who were exposed Blended Learning. The mean score of the Blended Learning before intervention is 3.57 with the standard deviation of 0.422 while the mean score of the Blended Learning group after intervention is 3.85 with a standard deviation of 0.536.

Table 5. Comparison of students' Engagement between pretest and posttest

GROUP		N	MEAN	SD
Engagement	before	97	3.57	0.422
	After	97	3.85	0.536
		Mean	Std. Deviation	t-value
Pair 2				Sig.
Pretest-Posttest		-0.28397	0.55481	-5.041
				0.000**

** P< Highly Significant at 0.01 level

As seen in Table 5, the t-value is -5.041 and the p-value is 0.00 implying that there is a highly significant difference between the pretest and posttest in engagement of the students in Mathematics exposed to Blended Learning. Thus, the null hypothesis, stating there is no significant difference between the pretest and posttest in engagement of the students in Mathematics exposed to Blended Learning is rejected.

The result showed a similar outcome on engagement of the students in Mathematics as it concluded that there is a significant difference on cognitive engagement of students [7].

On the other hand, the study on Students' Mathematics Performance and Engagement in Inquiry-Based Approach wherein they found out that there was no significant difference in the affective engagement of two groups [6]. And also, it conforms with the study entitled "Assessment of Learners' Engagement in Mathematics: Towards Building Mathematics Culture in South Africa Schools" in which the respondents have normal to strong disengagement leading to a conclusion that the learners are not engage in Mathematics [25].

4. Conclusions and Recommendations

Based on the above findings, the conclusion was drawn as follows:

Students exposed to Blended Learning have a significantly higher posttest score compared to pretest score. Thus, there is a highly significant difference in the academic performance in Mathematics of grade 10 students of Kalilangan National High School exposed to Blended Learning between pretest scores and posttest scores. There is a highly significant difference between the pretest and posttest in the engagement level of the students in Mathematics when exposed to Blended Learning.

Based on the aforementioned conclusion, mathematics teachers need to learn to utilize technology and printed modules to maximize instruction such as the use of Blended Learning to improve the mathematics performance of the learners since it is noted in the study that there is an increase in the performance of the students before and after the intervention.

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