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Cogency Of Flipped Classroom on Students' Performance in Mathematics in The Modern World

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ABSTRACT
The purpose of this study was to investigate the influence of a flipped classroom on the performance of students in the subject Mathematics in the Modern World. The study made used an experimental design, namely a pre-posttest design, for this investigation. Before and after the research was conducted, both groups of respondents were given a 50-item test created by the researchers and administered by them. Students' pre- and post-test results were submitted for data analysis, which included mean and t-test for independent samples for each group of students. The subjects in both groups performed satisfactorily and were comparable before the experiment, according to the findings of the study. But after conducting a posttest, it was discovered that the results of the control and experimental groups were good and skilled in their respective areas of performance. Moreover, it was discovered that the flipped classroom is an exciting educational strategy that has the ability to significantly assist teachers in their classroom instruction while also ensuring that students receive the best possible learning experience.

Keywords: flipped classroom, mathematics performance, Mathematics in the Modern World

INTRODUCTION

Mathematics instruction can only be effective if it has a positive impact on student learning. Mathematics teachers that are successful employ a range of teaching approaches and methods to meet the various learning needs of their students. Nonetheless, teachers have difficulties while teaching students with diverse intellectual abilities, interests, and learning styles.

In higher-level Mathematics, the classic lecture style is the most often employed method of instructing students. Students are often placed in a passive position. As a result of this teaching technique, students recall isolated information that may be forgotten later. Tertiary education, on the other hand, has been under increasing pressure to adopt more flexible and effective teaching techniques that are more active and student-centered in order to overcome the limits inherent in conventional transmittal models of education. Teachers are obligated to provide technology-enhanced classrooms that are accessible to all students, regardless of their preparedness, financial resources, interests, or past knowledge or experience.

Today, the emphasis of the educational system is on preparing students for higher education and careers after they graduate from high school. Teachers are shifting away from the traditional lecture-style as a result of increasing their use of technology in order to widen and deepen students' grasp of the subject matter. Because of this, the flipped classroom helps to ease the transition from high school to college.

The flipped classroom is referred to as a method of instruction when students learn new information outside of class rather than through traditional review chores. The lecture and other instructional materials can be accessed outside of the classroom in this manner, allowing students to devote more time in the classroom to active learning activities, such as problem-based learning and practice (The Flipped Learning Network, 2014).

Cheng et.al, (2019) pointed out that when students are exposed to a learning subject before class, flipped learning is a pedagogical strategy that allows them to develop their knowledge via interaction with peers and problem-solving activities under the supervision of an instructor during class time.

Bull, Ferster, & Kjellstrom (2012) emphasized that students in a flipped classroom learn before class and use class time to explore and apply concepts and ideas they have learned via interaction with their classmates and lecturers during class. Following the class, students reflect on the feedback they received and consider how it may be applied to their learning.

In flipped classroom, collaborative distance learning allows students to study at different locations and times while using a variety of technological devices. Learning in the digital age requires students to work independently and collaboratively before entering the classroom, and this is accomplished via the use of various technology tools. New learning instructions are now having a positive influence on education and boosting students' autonomy in their learning processes. Because technology is always evolving, it is essential for students and teachers to keep up to date on the most recent developments in educational technology and technology in the classroom.

The research studies of Zengin (2017), Janotha (2016), Graziano (2017), and Yılmaz (2017) have focused on the impacts of flipped classroom learning environments on students' academic achievements. The results of their study unanimously revealed that the flipped classroom learning environment facilitated student learning and contributed to students' success in their academic endeavor.

Likewise, the investigations of Bhagat, et.al. (2016), (Wilson, 2013) and Khan & Watson (2018) showed a critical distinction within the learning accomplishment between the two groups of students, with understudies utilizing the flipped classroom performing way better. The result of their undertakings appeared that students' understanding of concepts was accomplished through the flipped classroom approach.

Furthermore, the quantitative results of the studies of Wei, et.al, (2019), Clark, et.al. (2015), Spotts (2020), and Amstelveen (2019) uncovered that the student participants reacted favorably to the flipped model of instruction and experienced an increment in their engagement when compared to the traditional classroom encounter.

On the other hand, although the bulk of research indicates that the flipped classroom has a good impact on students' learning, certain studies have failed to produce the predicted positive effects. Smallhorn (2017) and Cambi (2018) discovered that there was no noticeable improvement in the academic development of students. The results of another study, conducted by Kim et al. (2014), revealed no evidence that the flipped classroom was associated with greater student grades. In a similar vein, Sun and Wu (2016) found that employing the FC Model had no influence on teacher-student interaction or student satisfaction with learning.

As an instructional method in higher education, however, it has not yet been adequately examined, despite the fact that it satisfies the demands of students in the twenty-first century and provides contemporary solutions to current pedagogical issues. It was possible for researchers to explore student-centered active learning approaches because the goal was to transform standard higher education teaching practices. It is therefore considered vital to the authors, to conduct a thorough investigation on the impact of the flipped classroom on students' performance in Modern World Mathematics as well as to gauge their attitudes to the instructional approach.

The purpose of this study was to answer the following questions: (1) Based on the results of their pretest and posttest, what is the performance of the control and experimental groups in Mathematics in the Modern World? (2) Is there a significant difference in both groups' pretest and posttest results? and (3) How do students feel about the flipped classroom?

METHODOLOGY

Research Design

The experimental design, specifically the pre-posttest design, was used for this study because the goal was to determine whether using the flipped classroom approach in the teaching of Mathematics in the Modern World will improve students' mathematics performance.

The following shows the design of the experiment.

Group	Pretest	Teaching Method	Posttest
Experimental	O_1	X_1	O_2 - Feedback Questionnaire
Control	O_3	X_2	O_4

where:

O_1 = pretest scores of the experimental group
O_2 = posttest scores of the experimental group
O_3 = pretest scores of the control group
O_4 = posttest scores of the control group
X_1 = Flipped classroom
X_2 = Traditional Method of Teaching

The design of the study included two groups of participants: the experimental group and the control group. Both groups were selected based on a number of variables that were shared by both groups. It was decided which participants would participate in the study based on their class schedule and the number of students in each class.

Also included was a pretest and a posttest, which were administered to both groups. It was decided to apply the flipped classroom technique in the experimental group as opposed to the conventional technique in the control group to see which group would perform better.

Participants

This study was carried out at Cagayan State University, which is a public school of higher learning in the Cagayan Valley region, Philippines. Cagayan State University is made up of eight campuses that are spread across the three congressional districts of the province of Cagayan. The first district includes the Aparri, Lal-Lo, and Gonzaga campuses; the second district includes Piat, Lasam, and Sanchez-Mira campuses; and the third district includes the Andrews and Carig campuses. More precisely, the information for the study was gathered from students of the College of Teacher Education in Andrews Campus, Tuguegarao City, where the researchers are stationed.

The two classes of second-year college students specializing in English were enrolled in the course Mathematics in the Modern World (GEC 102) offered by the College of Teacher Education at Cagayan State University's Andrews Campus during the second semester of the academic year 2018-2019. Each class, consisting of 35 students, served as the study's participants. Prior to the experiment, a pretest was conducted to guarantee that the students in the control group and the experimental group were correctly matched with one another. Furthermore, the t-test for independent samples was also used to determine whether or not the participants from the two groups were initially comparable in terms of their mathematics performance.

Data Collection Tools

The teacher-made test served as the primary research instrument of the study. The test is a 50-item multiple choice exam that included topics such as mathematical language and symbols, problem solving and reasoning, data management, geometric designs, and simple interest. According to the subject's competencies, the test was developed and the questions were validated and amended in accordance with the results of a series of item analyses that were performed during the period of time when the subject was taught by the researchers over the course of the study.

Data Analysis

The information obtained was categorized, evaluated, and interpreted in accordance with the study's objectives. In order to analyze the data, descriptive statistics such as frequency count, mean, and the t-test for independent samples were utilized.

The results of the pretest and posttest of the participants in both groups were verified and collated in order to compare their overall performance with one another. On the pre-post tests, an arbitrary scale was utilized to evaluate the raw scores of both groups of respondents. This scale was constructed as follows:

Scores	Descriptive value
41-50	Excellent (E)
31-40	Proficient (P)
21-30	Satisfactory (S)
11-20	Developing (D)
0-10	Needs Improvement (NI)

RESULTS AND DISCUSSION OF FINDINGS

1. Performance in Mathematics in the Modern World of the two groups of students based on the pretest and posttest results

Table 1: Frequency and mean distribution of subjects' pretest and posttest results

Scores	Experimental Group (n = 35)				Control Group (n = 35)			
	Pretest		Posttest		Pretest		Posttest	
	f	%	f	%	f	%	f	%
41-50(E)			22	62.86			4	
31-40(P)			13	37.14			31	
21-30(S)	27	77.14			26	74.29		
11-20(D)	8	22.86			9			
0-10(NI)								
Mean (interpretation)	22.69 (satisfactory)		41.06 (excellent)		22.06 (satisfactory)		38.60 (proficient)	

According to the data in the table, the mean pretest scores for the experimental and control groups were 22.69 and 22.06 for the experimental group, and 22.69 and 22.06, respectively, for the control group. As evidenced by the mean ratings, both groups possessed strong mathematical abilities prior to the conduct of the research; however, the mean rating for the experimental group is significantly higher than the mean rating for the control group, indicating that the experimental group possessed significantly stronger mathematical abilities.
When posttest results were analyzed separately, the experimental and control groups got mean scores of 41.06 and 38.60, respectively. Experimental groups received descriptive values of exceptional, while the control groups received only proficient. Following the completion of the activity, the results of the experiment revealed that the Mathematics performance of both groups had substantially increased. In contrast, the mean performance of the experimental group is much higher than that of the control group at the end of the experiment. This result evidently manifest and agrees with the findings of Spotts (2020) and Amsteelveen (2019) that employing flipped classroom could enhance Mathematics performance.

2. Test of significant differences on the performance in Mathematics in the Modern World of the two groups of students based on the pretest and posttest results

Table 2: T-test on the significant differences of the pretest and posttest mean Mathematics performance of the experimental and control groups

Test	Group	Mean	SD	df	t-value	p-value	Interpretation
Pretest	Experimental (n = 35)	22.69	2.98	68	0.922	0.360	Not Significant
	Control (n = 35)	22.06	2.72				
Posttest	Experimental (n = 35)	41.06	1.68	68	5.818	0.000	Significant
	Control (n = 35)	38.60	1.85				

At the.01 level of significance, the pretest scores of both groups were calculated, resulting in a t-value of -0.922 and a probability value of 0.360 at the.01 level of significance. As determined by the results, the findings indicate that there is no statistically significant difference in mathematics performance between the two groups prior to the exposure of the two groups to the two distinct instructional approaches. That is, prior to the experimentation, the individuals were initially similar in terms of their mathematical abilities, which was a significant discovery.
Following the results in the table, the t-values for the posttest scores of the experimental and control groups were computed to be 5.818 and 0.00 at the 0.01 level, respectively, suggesting that the experimental group did significantly better than the control group.
As a result of this, there is a statistically significant difference between the Mathematics results of the two groups after they have been exposed to their different teaching approaches. Similar with the findings of the study of Bhagat (2016) and Khan & Watson (2018), it appears that flipping the classroom have the ability to improve students' mathematical skills. It also indicates that students benefit and learn more effectively through flipped learning or the inverted classroom, in which students study instructional material before class and apply what they've learned in class. Scholastically, this entails that students are more enthusiastic in engaging flipped classroom and this redound to the uplift of their academic performace.

3. Test of significant differences on the performance of the experimental group based on pretest and posttest mean scores

Table 3: Test of significant differences on the Mathematics performance of the experimental group before and after their exposure to flipped classroom

Variables	Mean	Mean Difference	df	t-value	p-value	Interpretation
Pretest	22.69	18.37	34	-49.766	0.000	Significant
Posttest	41.06					

It is clear from the table that the mean difference of 18.37 indicates a statistically significant improvement in the mean Mathematics performance of the participants who took part in the experimental study compared to their baseline performance. The estimated probability value of 0.000 is used to draw a second inference, which

suggests that there is a statistically significant difference between the pretest and posttest scores of participants in the experimental group. This finding support those of Zengin (2017), Janotha (2016), Graziano (2017), and Yılmaz (2017), who found that the flipped classroom is effective in enhancing students' mathematics performance.

4. Feedback of students on flipped classroom

The study participants who were exposed to the flipped classroom activity noted that the pertinent reading materials and electronic lectures were available on an e-learning portal. It was also made clear by the participants that they were given enough time to participate in the flipped classroom activities. Furthermore, they stated that during the activities, the instructor was able to provide clarification on challenging ideas. As a result, they showed support for the concept of flipped classroom and highly suggested that more courses be delivered in a flipped classroom format.

CONCLUSIONS

Based on the findings of the study, the following conclusions were drawn:

Students' performance in Mathematics in the Modern World improved dramatically as a result of the flipped classroom. The flipped classroom can accomplish a high level of collaborative learning among students through group activities, discussions, and problem-solving in Mathematics. Thus, the flipped classroom can be seen as an alternative method of delivering courses to match the demands of today's students.

Moreover, flipped learning has the ability to turn higher education classrooms into dynamic and interactive learning spaces. The instructor's function is also transformed in the flipped classroom. The teacher guides and monitors the works of the students by offering timely comments and assessing their work as needed in order to assist them through their personalized learning experiences.

Correspondingly, it was shown that the flipped classroom enhanced student engagement and gave students more opportunity to see how the knowledge and skills they learned are used in the real world. However, varied learning resources that maximize students' learning experiences are still needed to support educators in transitioning their teaching to the flipped learning approach.

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