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Standard Inverted Classroom: Student's Mathematics Performance and Motivation

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Abstract**—** *This study explores the impact of the standard inverted classroom, an example of a flipped classroom approach, on students' Mathematics performance and motivation in a junior high school setting. Designed as a quasi-non-equivalent experimental study, it involved pre-class video lectures, assignments, and readings for initial concept exposure, followed by in-class interactive activities, discussions, and problem-solving exercises. The data collection tools were researcher-made Mathematics tests and Mathematics Motivation Scales. The study resulted in a significant difference in post-test scores in Mathematics between the control group exposed to the traditional method and the experimental group in the standard inverted classroom. Student-participants who were given pre-class information demonstrated improved subject understanding and thus obtained higher exam scores and overall Mathematics performance. In both settings, they displayed a solid eagerness to engage with the curriculum actively; therefore, intrinsic motivation levels were high regardless of the instructional method used. To summarize, the standard, inverted classroom approach positively impacts academic performance in mathematics. While motivation levels were consistent across teaching modalities used in the study, the flipped classroom can potentially improve educational outcomes through increased knowledge and engagement among junior high school students. The study recommends that Mathematics teachers, educators in general, recognize the potential of standard inverted classrooms to enhance learning of Mathematics concepts and further investigate using this approach to drive overall academic performance in Mathematics.*

Keywords**—** *Mathematics academic performance: motivation: standard inverted classroom.*

I. INTRODUCTION

The flipped classroom is one of the most popular innovative techniques for integrating technology into teaching. This methodology includes a procedure where the lecture in the study hall happens at home. Students watch recorded lectures and afterward come back to class to participate in the activities they would generally have for schoolwork and pose inquiries dependent on the lecture they viewed all alone at home. When students watch recordings at home, they can go back and forth at their own pace and take notes while relaxing. When they come back to class, they can work in a group to talk about what they viewed and have their inquiries replied to by the educator. In this procedure, students produce, work together, learn at their own pace, and apply what they have comprehended at home in the homeroom (Emdin, 2014).

The global education environment is constantly changing, with countries striving to compare their educational levels to international norms. In line with this goal, the Philippines joined the OECD's PISA (Program for International Student Assessment) in 2018 as a significant component of the Quality Basic Education reform plan and a step toward globalizing the nature of Philippine essential instruction. By taking an interest in PISA, the Philippines will be able to establish a pattern based on global benchmarks and benchmark the appropriateness of the improvements being implemented. The PISA data and the evaluations and studies of the Philippines will aid in strategy formulation, organization, and programming. Released on December 3, 2019, the 2018 PISA results uncovered that the Philippines has the most minimal reading comprehension, the second most minor in science and mathematics, and all beneath the normal of the 79 participating OECD nations. With the PISA results likewise mirroring the students' exhibition in the National Achievement Test, DepEd perceives the earnestness of tending to issues and holes in accomplishing the nature of essential training in the Philippines (Department of Education, 2019).

Recognizing the importance of providing Filipino students with the skills and competencies they need to succeed, the Department of Education has stressed society's collaborative responsibility in improving education quality. As educators work to revitalize the educational landscape, there is a rising recognition of the importance of adopting pedagogical approaches that encourage active learning and critical thinking. One such strategy is the standard, inverted classroom, in which teachers support learning by giving pre-class materials to establish the basis for comprehension, allowing more classroom time for collaborative activities and higher-order cognitive skill development.

While the typical inverted classroom has proven successful in university mathematical contexts, its potential impact on junior high school students has to be further investigated. This study examines how the standard, inverted classroom affects mathematics achievement and motivation in junior high school pupils. By analyzing the efficacy of this instructional technique, the researcher hopes to get significant insights into improving learning outcomes and increasing student engagement in the 21st-century educational environment.

II. METHODOLOGY

This study utilizes the quasi-non-equivalent experimental design to assess the impact of using the standard inverted classroom strategy on students' academic performance and motivation in Mathematics and a non-equivalent pretest and posttest control design. One was the control group, provided with the traditional teaching method. The other group was the experimental group, which was treated with the standard inverted classroom strategy.

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This study was conducted at a private Junior High School Department in Bohol, with 51 students in the experimental group and 47 students in the control group. According to Segumpan and Tan in their study on *Mathematics Performance and Anxiety of Junior High School Students in a Flipped Classroom*, the study of a flipped classroom approach should be on more mature students, preferably Grade 9 or Grade 10. The participants should be responsible enough to watch the video lectures, and the topics of the lessons can be provided with proper videos to apply the strategy appropriately. The following qualifications fit the selected respondents, Grade 10 students. The two groups were grouped heterogeneously; with the help of a t-test, the researcher could compare the students' academic performance based on their Mathematics grades in the first quarter. No significant difference was seen in the previous math grades of the students from the experimental and control groups. Hence, the two groups are comparable regarding the study's conduct.

The researcher carefully made and prepared the instrument. This was designed to determine the achievement of the respondents in Mathematics both in pretest and posttest. The preparation and validation of the test started with planning the test by using the table of specifications and following the competencies found in the curriculum guide of the Department of Education. It was followed by conducting the first trial run and the item analysis. The instrument was used to measure the students' motivation in mathematics before and after the study. The instrument was adapted from Yusuf F. Zakariya's study on the Development of Mathematics Motivation Scale Using Factor Analysis. The reliability coefficient of the instrument was 0.89, with sufficient evidence of content and face validity.

III. Results and Discussions

The results obtained from the data gathered for the experimental investigation are presented. It shows the profile of the Grade 10 students' motivation and achievement in Mathematics before and after the study and the needed outcomes that will respond to the specific problems reflected in this study. The data were tallied, tabulated, and treated statistically. The results were then analyzed and interpreted, forming the foundations of the findings and conclusions.

Table 1 shows the profile of students' motivation before and after the study. In the pretest motivation, no student from either group belongs to the category of moderately motivated or not motivated, which is why the category is omitted from the table. The table also reveals that most students are highly motivated towards Mathematics. It shows that the students were already motivated by the subject before the experiment. The pretest motivation result also implies that the two groups were suited to undergo the experiment. The post-test motivation result shows that most groups still fall in the highly motivated category. There is an increase in motivation in both groups, which showed an improvement in their drive and enthusiasm towards Mathematics.

Table 2 shows the students' academic achievement before and after the study. The pretest scores from the control group fall under the poor and below average interval, while the experimental group falls under the poor, below average, average, and above average. None of the two groups fall under the superior interval. Most students in both groups are in the below-average class interval in the pretest, which implies that their performance is low, indicating that the students had limited knowledge about the test given because it has not been discussed yet.

TABLE 1. Profile of Students' Motivation Before and After the Study

	BEFORE				AFTER			
	Experimental		Control		Experimental		Control	
Class Interval	f	%	f	%	f	%	f	%
49-72 Motivated	2	3.92	6	12.76	1	1.96	4	8.51
73-96 Highly Motivated	40	78.43	32	68.09	37	72.55	27	57.45
97-120 Very Highly Motivated	9	17.65	9	19.15	13	25.49	16	34.04
Mean	89.27		86.02		90.35		89.66	

Meanwhile, the posttest results, also presented in Table 2, revealed that nobody from the two groups got the lowest class interval, which is poor. Most students in both groups drastically changed their above-average performance during the post-test. Around 12 percent of the students in the experimental group got a score within the superior range, while 11 percent in the control group fell under this range. After the discussions, the results indicate an improvement in the student's achievement scores from both groups. Both methods created a positive result in students' scores in Mathematics. However, the experimental group scored better than the control group. The result shows that around 87 percent of the scores in the experimental group belong to the above-average to superior categories and around 69 percent in the control group.

TABLE 2. Profile of Students' Pretest and Posttest Scores

	PRETEST				POSTTEST			
	Experimental		Control		Experimental		Control	
Class Interval	f	%	f	%	f	%	f	%
0-8 Poor	1	1.96	9	19.15				
9-16 Below Average	30	58.83	38	80.85	1	1.96	1	2.13
17-24 Average	18	35.29			5	9.81	13	27.66
25-32 Above Average	2	3.92			39	76.47	28	59.57
33-40 Superior					6	11.76	5	10.64
Mean	11.84		11.04		29.10		27.26	

Table 3 presents the paired differences between the pretest and posttest scores in Mathematics within the control and experimental groups. The t-value of the experimental group is 24.04, while in the control group, it is 22.23, and the p-value of both groups is equal to 0.00, which is less than 0.05. It can be inferred that there is a significant relationship between the

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pretest and post-test scores in Mathematics of the control and experimental groups; thus, the null hypothesis is rejected. This supports that the students learned from the discussion of the teacher because there is progress in their scores.

Also, the results show an improvement in the scores of the students from pretest to posttest in both control and experimental groups. This is shown in the mean score of 11.84 to 29.10 of the experimental group and 11.04 to 27.26 of the control group. Comparing the groups, the experimental group has a higher increase in the mean score, as reflected by the mean gain of 17.26, than the control group.

The results imply that the standard inverted classroom strategy is more effective than the traditional approach when teaching Mathematics. It also agrees with the study of Segumpan and Tan (2018) on *Mathematics Performance and Anxiety of Junior High School Students in a Flipped Classroom* found that the mathematics performance of both groups recorded great improvements after the implementation. The mathematics performance of the students exposed to Flipped Classroom became significantly comparable with those exposed to non-flipped classrooms.

TABLE 3. Mean Gain Difference between the Pretest and Posttest Scores in Mathematics within the Groups

Groups	Achievement	Mean	SD	Mean Gain	t-value	p-value	Decision
Experimental	Pre-test	11.84	3.01	17.26	24.04	0.00	Reject Ho
	Post Test	29.10	4.15				
Control	Pre- test	11.04	2.92	16.21	22.23	0.00	Reject Ho
	Post-test	27.26	4.57				

Table 4 shows the paired differences of the mean scores in the student's motivation before and after the study. The p-value for both groups is greater than 0.05. Thus, the null hypothesis is accepted, and there is no significant difference in the student's motivation before and after the experiment. Both groups fall under the class interval of highly motivated. The control group reflected a higher mean gain of 3.64 after the lessons were delivered, and the experimental group reflected a 1.08 mean gain. There could be other factors in the change in the students' motivation.

According to Self-determination theory, there are three types of motivation: extrinsic, intrinsic, and amotivation. Intrinsic motivation refers to one's own performance and the pleasure and satisfaction derived from participation. Academic intrinsic motivation plays an important role in achievement, qualifications and academic learning.

TABLE 4. Mean Gain Difference of the Group Mean Scores on Students' Motivation in Mathematics before and after the study.

Groups	Motivation	Mean	SD	Mean Gain	t-value	p-value	Decision
Experimental	Pre-test	89.27	10.10	1.08	0.48	0.64	Accept Ho
	Post- test	90.35	11.14				
Control	Pre-test	86.02	12.14	3.64	1.65	0.11	Accept Ho
	Post-test	89.66	10.29				

Table 5 presents the difference between the pretest scores in Mathematics achievement and the pretest motivation in control and experimental groups. The results of the pretest achievement scores reflect that the experimental group has a higher mean score than the control group. The p-value is greater than 0.05, meaning the mean score is not statistically significant. This denotes that there is no significant difference in the pretest scores in Mathematics between the two groups before the study. The results are entirely not significant at all. Although the appearance of no significant difference in scores of the two groups is just only an indicator of comparability, the outcome also offers a strong foundation for the comparison of the probable effects of the intervention presented in the study.

The pretest motivation score shows no significant relationship with the mean scores from both groups since the p-value is 0.15, greater than 0.05. The mean scores are close enough to each other and fall under the highly motivated description. The two groups were comparable in their motivation towards mathematics before the start of the intervention.

TABLE 5. Difference of Pretest Scores in Mathematics Achievement and Motivation between the Groups

	Grouping	Mean	SD	t-value	p-value	Decision
Pretest Achievement	Experimental	11.84	3.01	1.05	0.40	Accept Ho
	Control	11.04	2.92			
Pretest Motivation	Experimental	89.27	10.10	1.45	0.15	Accept Ho
	Control	86.02	12.14			

Table 6 shows the difference between the post-test scores in Mathematics achievement as well as the post-test motivation in control and experimental groups. In terms of the p-value, it is less than 0.05 which means that the mean scores are statistically different. This denotes a significant difference in the post-test scores in Mathematics between the two groups after the study. It can be concluded that students who were taught using the standard inverted classroom strategy achieved better than those who were taught through the traditional teaching method. Although both groups have shown average post-test scores, the students from the experimental group obtained a higher mean score of 29.10 compared to the control group, which obtained a 27.26 mean score.

The positive impact of a standard inverted classroom strategy on students' achievement is supported by the study of Ozdemir and Sirakaya (2018) on *The Effect of a Flipped Classroom Model on Academic Achievement, Self-Directed Learning Readiness, Motivation, and Retention* that revealed that scores of the students who used the flipped classroom model were higher than scores of those who used the classical blended learning method.

The p-value is greater than 0.05 in the posttest motivation score, which means the null hypothesis is accepted. Even if there is no significant difference in the student's motivation, both groups still improved their motivation towards the subject. Although both groups have shown a highly motivated category in the posttest motivation scores, the students from the experimental group obtained a higher mean score of 90.35

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compared to the control group which obtained an 89.66 mean score. The results suggest that the standard inverted classroom strategy is more influential than the traditional approach in the student's motivation.

Although both methods increase the students' performance and motivation, it still indicates that a student-centered approach in the standard inverted classroom is better than the teacher-centered approach in the conventional teaching method. The standard inverted classroom environment improved learning achievement because the students were given the theoretical part before the class; they could ask questions in the classroom, receive immediate feedback, and interact with the course teacher during the lesson.

This supports the study of *Flipped Classroom Approach in Teaching Biology: Assessing Students' Academic Achievement and Attitude Towards Biology* that there is a significant improvement in both achievement and attitude towards Biology in favor of the FCG. The exposure to flipped classroom instruction developed a more positive attitude in students, resulting in an improved understanding of concepts as reflected in their performances.

TABLE 6. Difference of Posttest Scores in Mathematics Achievement and Motivation between the Groups

	Grouping	Mean	SD	t-value	p-value	Decision
Post-Test Achievement	Experimental	29.10	4.15	2.09	0.04	Reject Ho
	Control	27.26	4.57			
Post-test Motivation	Experimental	90.35	11.14	0.32	0.75	Accept Ho
	Control	89.66	10.29			

IV. Conclusion and Recommendations

The researcher concluded that utilizing the standard inverted classroom as a strategy for teaching mathematics showed better results. A standard inverted classroom strategy can also help students in their mathematics performance. Moreover, the strategy is influential in improving the students' motivation towards the subject. However, the traditional approach cannot be disregarded since it was also found to influence students' motivation. The traditional approaches could be incorporated in utilizing the standard inverted strategy to improve the drive and enthusiasm of students in Mathematics.

Based on the findings and conclusions of the study, the following recommendations are given:

1. Mathematics teachers are urged to utilize the standard, inverted classroom as an elective encouraging methodology since it can improve students' performance and advance better understanding. Additionally, educators dealing with different subjects are urged to utilize standard inverted classroom strategies.
2. A future researcher may conduct another study involving academic intrinsic motivation or different student motivation factors.
3. Another study will be conducted on other subjects and levels to see the consistency of its effect on the motivation and achievement of the students.

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