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The Academic Performance and Engagement in Physics among Grade 9 Learners Using Flipped Classroom

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ABSTRACT

This study determined the effects of the flipped classroom on the academic performance and engagement in Physics among Grade 9 learners. Two (2) intact classes of learners in Physics were randomly assigned either as the experimental group or the control group. It was conducted at Central Mindanao University Laboratory High School, University Town, Musuan, Maramag, Bukidnon. A quasi-experimental non-equivalence static group comparison pretest-posttest was utilized in this study.

A validated 30 item researcher-made Physics Academic Performance Test (PAPT) and the Student Engagement in Physics adopted from Wang et al. (2016) were the main research instruments used in the study. The PAPT was validated and tried-out before the final data gathering. The reliability coefficient for the test was 0.97. The data were treated with descriptive statistics and the Analysis of Covariance (ANCOVA) at a 0.05 level of significance.

Results revealed that both the experimental and control groups' academic performance did Not Meet Expectation (DNME). However, there is a statistically significant difference in the learners' academic performance in Physics in favor of the experimental group. Moreover, the learners in the flipped classroom were often engaged in Physics.

KEYWORDS: *flipped classroom, academic performance, student engagement in physics*

INTRODUCTION

Flipped classroom is a teaching approach that turns a paradigm-shift of a learning process where learning becomes anytime and anywhere. It interchanges classroom routines and targets the concerns of generating better student preparation before the classroom schedule, creating opportunities for the students to exchange ideas and queries, maximizing the use of home-based activities, and providing learning opportunities even with the cancellation of classes. Segumpan and Tan (2018) mentioned that flipped classroom tries to do away with the conventional mode of lecture to a more dynamic classroom experience for the learners. The presentation of the contents is done outside the classroom leveraging technology.

Today's learners often tagged as the millennials and Generation Z, are challenged with teaching and learning perspectives. Leading these learners to an engaged learning environment is a paramount concern. Bergmann &Sams(2012) mentioned that learners became more curious and learned in their different individual needs. This approach may hope to aid the teaching-learning process in the spectrum of Science, particularly, Physics.

Several researches claimed that the common problem in Physics, as a subject, is learners' misconceptions and engagement towards physics. Gonzales&Paoloni (2015) corroborated that the students' interest is the driving force behind engagement and the dedication needed to ensure optimum academic performance. Hence, the role of engagement towards physics plays a significant role in improving its academic performance.

In the Central Mindanao University Laboratory High School (CMULHS), a common problem was observed and experienced in physics. The spiraling effect of K to 12 in Science makes the learning transition of the subject much more difficult. The learners' retention is quite a challenge since it was not taught for the entire school year, which was only taught for grading instead. Their perception and engagement towards the subject may serve as a key factor for the learners to gain interest in the lessons. Henceforth, the study was undertaken to determine the flipped classroom's effects on the academic performance in Physics and engagement among Grade 9 learners in CMULHS.

OBJECTIVES OF THE STUDY

This study determined the effects of the flipped classroom on the academic performance in Physics and engagement among Grade 9 learners.

Specifically, it aimed to:

1. determine the academic performance in physics of the Grade 9 learners using the flipped classroom and those using K to 12 Learning Modules;
2. find out if there a significant difference in the academic performance in physics between the learners using flipped classroom and those using K to 12 Learning Modules; and
3. assess the engagement in physics of the Grade 9 learners using flipped classroom.

MATERIALS AND METHODS

Research Design

The quasi-experimental non-equivalence pretest-posttest static group comparison research design was utilized to investigate the learners' academic performance and engagement in physics using flipped classroom.

Research Locale

The study was conducted at Central Mindanao University Laboratory High School (CMULHS), situated at University Town, Musuan, Bukidnon.

Participants of the study

Two (2) intact classes of Grade 9 learners were used in the study. On average, there were 45 learners in each section of Grade 9. One (1) section was randomly assigned for the control group, and another one (1) section was randomly assigned for the experimental group.

Development of the Lessons

The lessons were developed using the Flipped Classroom model following three phases. The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) was adopted to develop the lessons.

The scoring guide for rating the developed lessons is shown as follows

Scale	Range of Mean	Rating	Qualifying Statement
5	4.20-5.00	Strongly Agree	The *features are very adequately provided.
4	3.40-4.19	Agree	The *features are adequately provided.
3	2.60-3.39	Uncertain	Not sure if the *features are adequately provided.
2	1.80-2.59	Disagree	The *features are slightly provided.
1	1.00-1.79	Strongly Disagree	The *features are not provided.

*Content and content accuracy, appropriateness, and clarity

Research Instruments

The Physics Academic Performance Test (PAPT) and the Student Engagement in Physics (SEP) were used as research instrument tools. The researcher constructed the PAPT. For equal distribution of the items, a Table of Specifications (TOS) was created. The PAPT underwent pilot testing with Grade 10 learners from Central Mindanao University Laboratory High School.

Physics Academic Performance Test

In the development of the test items for the Physics Academic Performance Test (PAPT), a Table of Specification (TOS) was made with lesson objectives and competencies and assigning the level of difficulty. Test items that were multiple-choice questions were constructed. It underwent pilot testing, which validated and retained the reliable questions. The researcher administered the pilot test to Grade 10 learners. The reliability coefficient of the PAPT, which was 0.97, was determined after the pilot test.

Scoring for the Academic Performance Test

The researcher-made academic performance test was developed. A range set based on DepEd Memo no. 8, Series of 2015, was used.

Score Range	Performance Level	Qualifying Statement
28-30	Outstanding	The student at this level exceeds the core requirements in terms of knowledge, skills, and understandings and can transfer them automatically and flexibly through authentic performance tasks.
25-27	Very Satisfactory	The student at this level has developed the fundamental knowledge and skills and core understanding and can transfer them independently through authentic performance tasks.
22-24	Satisfactory	The student at this level has developed the fundamental knowledge and skills and core understandings and, with little guidance from the teacher and /or with some assistance from peers, can transfer these understandings through authentic performance tasks.
19-21	Fairly Satisfactory	The student at this level possesses the minimum knowledge and skills, and core understandings but needs help throughout the performance of authentic tasks.
0-18	Did Not Meet Expectation	The student at this level struggles with his/her understandings; prerequisites and fundamental knowledge and /or skills have not been acquired or developed adequately to aid understanding.

*Qualifying Statements is adopted from DepEd Order No. 73, S. 2012

Student Engagement in Physics

The Student Engagement in Physics (SEP) was utilized in the study. SEP was a 33-item scale adopted from Wang*et al*. (2016). It measured the engagement of the grade nine learners in the experimental group in Physics. It is also a multifaceted construct that operates in four levels: cognitive, behavioral, emotional, and social. Cognitive engagement is engaging in metacognition and self-regulated learning. Another engagement construct was behavioral engagement, an observation inferring learners' persistence, effort, attention, participation, and involvement in the class. The emotional engagement construct involved interest, boredom, happiness, anxiety, and other affective states, any of which factors could affect learners' involvement with learning. It also involved a sense of belongingness and values. Finally, social engagement was the ability to work constructively within and between social groups to create a more resilient and sustainable learning process.

Scoring for the Engagement in Physics

The scale was made up of positive and negative scales, mean values, and equivalent qualifying statements. The tool used the 5-point Likert scale that ranged from 1- Never, 2- Sometimes, 3- Occasionally, 4- Often, and 5- Always.

Scale		Limits		Response	Qualifying Statements
		Positive Items	Negative Items		
5	1	4.20– 5.00	1.00-1.79	Always Engaged	Student has a very high level of confidence/ enjoyment of the subject.
4	2	3.40-4.19	1.80-2.59	Often Engaged	Student has a high level of confidence/enjoyment of the subject.
3	3	2.60-3.39	2.60-3.39	Occasionally Engaged	Student has a moderate level of confidence/enjoyment of the subject.
2	4	1.80-2.59	3.40-4.19	Seldom Engaged	Student has a low level of confidence/enjoyment of the subject.
1	5	1.00-1.79	4.20– 5.00	Never Engaged	Student has a very low level of confidence/enjoyment of the subject.

RESULTS AND DISCUSSIONS

The Academic Performance in Physics of the Grade 9 Learners Using the Flipped Classroom and those using the K to12 Learning Module.

The first research problem was to assess the academic performance of the Grade 9 Learners using the flipped classroom and those learners using the K to 12 Learning Module in Physics.

The descriptive statistics of the pretest and post-test was used to assess the academic performance of the learners in the experimental group and those in the control group.

The data in Table 1 show the pretest's academic performance and in the post-test of the control group and the experimental group. The pretest scores indicate that the control group Did Not Meet Expectation, with one (1) learner who reached Fairly Satisfactory Level of Proficiency. There was a variation in the standard deviation between the experimental group and the control group. There was variation in the distribution of the scores in the pretest. On the other hand, the pretest of the experimental group Did Not Meet Expectation, with one (1) or 3.33% of the learners with Fairly Satisfactory Proficiency. Looking at the profile, the cluster of the experimental group was Did Not Meet Expectation proficiency level.

After the intervention, the post-test scores of the experimental group had attained a greater mean. Nevertheless, they still Did Not Meet Expectation, with five (5) or 16.7% and one (1) or 3.33% of the learners who had attained the fairly satisfactory and satisfactory proficiency level, respectively. The standard deviation showed variation in the distribution of their scores. On the other hand, control group still Did Not Meet Expectation. There was variation in the distribution of their post-test scores.

The result manifests that both the experimental and control groups were in Did Not Meet Expectation proficiency level. However, there was an increase in academic performance. Based on the mean scores, both the experimental group and the control group improved their academic performances. It was also apparent that the experimental group's academic

performance is more improved than that of the control group. Hence, flipped classroom could improve the learners' academic performance.

Table 1
Academic Performance in Physics of the Grade 9 Learners

Level of Proficiency	Range of Scores	Control Group				Experimental Group			
		Pretest		Posttest		Pretest		Posttest	
		f	%	f	%	f	%	f	%
Outstanding	28-30	0	0%	0	0%	0	0%	0	0%
Very Satisfactory	25-27	0	0%	0	0%	0	0%	0	0%
Satisfactory	22-24	0	0%	0	0%	0	0%	1	3.33%
Fairly Satisfactory	19-21	1	3.33%	3	10%	1	3.33%	5	16.67 %
Did Not Meet Expectations	0-18	29	96.67%	27	90%	29	96.67 %	24	80%
$\bar{x}$		13.10		15.40		11.73		16.87	
sd		2.68		2.18		3.15		2.08	
QD		DNME		DNME		DNME		DNME	

Legend:

O	Outstanding	FS	Fairly Satisfactory
VS	Very Satisfactory	DNME	Did Not Meet
S	Satisfactory		Expectations

During the study's conduct, the mean scores of both the experimental and control groups could even attest that their academic performances had improved. In the experimental group, learners had improved significantly. However, it was shown that the academic performance still at the Did Not Meet Expectation proficiency level. It could be due to the extraneous factors and variables that could affect the learners' academic performance.

Although the study's findings affirm Guanzon (2017), who mentioned that in the advent of the K to 12 curriculum in the country, the physics still marks as developing, beginning, and did not meet expectations in the level of proficiency. However, it was quite an improvement on both the experimental and control groups' academic performance.

The study's result corroborates with the flipped classroom study of Atwa et al. (2016), who alleged that the flipped classroom is effective and positively affects physics academic achievements. The study also stressed that teachers' relation with learners becomes better than before that cause the learners to become more active inside the classroom.

Comparison of the Academic Performance in Physics between the Experimental Group and the Control Group

Analysis of Covariance (ANCOVA) at a 0.05 level of confidencewas used to compare the experimental and control groups' academic performance.The pretest was used as a covariate of the study to equate both groups' behavior and statistically control the effect of the initial differences of the experimental group and the control group before the study's conduct.

The data in Table 2 show a significant difference in the Academic Performance between the learners using flipped classroom and those not using flipped classroom, in favor of the experimental group. It is based on the computed p-value of 0.042, which was less than 0.05 level of confidence.

Based on findings, there isa significant difference in the learners' academic performance taught using flipped classroom and those taught using K to 12 Learning Module, in favor of the experimental group. Based on the mean values in Table 1, even if they "did not meet expectation," there could be other factors that must have contributed. Nonetheless, it is to conclude that flipped classroom could increase the performance of the students.The result magnifies an improvement in the learners' academic performance in physics taught using flipped classroom. Bersano (2016) supported that learners encounter meaningful learning experiences if they are engaged in the learning activity.The flipped classroom was favorable because the two groups were incomparable at the beginning of the intervention, as indicated in the significant pretest. However, the researcher noticed a positive engagement of the learners in the experimental group who happened to be the low-performing group during the study.

Table 2
ANCOVA Summary Table comparing the academic performance of Grade 9 Learners

Source	Type III Sum of Squares	df	Mean Square	F	p-value
Intercept	504.161	1	504.161	126.156	0.000
Pre_Test	34.877	1	34.877	8.727	0.005
Group	17.321	1	17.321	4.334	0.042
Error	227.790	57	3.996		
Total	15912.000	60			

One learner said that physics became interesting. That was, for that learner, due to the influence of the instructional videos that made them more prepared than the usual instruction. Classroom activities were also becoming more interesting because they feel that they are doing and learning it. Few learners even conversed that they became more excited about the next physics concepts and how they are explained in the instructional videos.Moreover, the study's finding affirms Holik (2016), who compared the flipped classroom and traditional classroom student engagement and teaching method's effectiveness, supplemented the study. The learners and instructor's perceptions indicated engagement in the flipped classroom was higher in the flipped classroom than in the traditional classroom.

Learners' Engagement in Physics Using Flipped Classroom

The data in Table 3 show descriptive statistics of the student engagement in Physics in the cognitive, emotional, social, and behavioral engagement constructs. The data show that emotional engagement had the highest score, followed by social engagement, behavioral engagement, and cognitive engagement. This study shows that emotional engagement is significant to enhance the academic performance of the learners.

The result affirmed Taylor and Statler (2013), who alleged that there is a relationship between emotions and learning. Further, it is mentioned that less emotion means less learning, and more emotion means more learning. Emotional engagement will also help learners assume responsibility towards one another, motivating them to complete the task (Jones, 2012). In the study, learners were motivated to finish the group activities on time, with excitement and enthusiasm.

Table 3

Engagement Summary of the Grade 9 Learners using Flipped Classroom

	Engagement Construct	Mean	Sd	Response	Qualifying Statement
1	Cognitive Engagement	3.37	0.71	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
2	Behavioral Engagement	3.77	0.90	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
3	Emotional Engagement	3.93	1.07	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
4	Social Engagement	3.80	0.76	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
	Over All Engagement	3.83	0.95	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.

In social engagement, which encompasses the interactions between the learners and their peers, the learning environment's support is essential to promote active learning. The study's result affirmed Kahu (2013) where the use of collaborative activities did enhance behavioral engagement, which resulted in satisfaction and achievement, social and academic integration, and teaching practice are related to student behavior.

Fredricks, Blumenfeld, & Paris (2004) mentioned that the teachers' direction to learners in the activities that require them to apply initiative is in the behavioral engagement construct. In the study, behavioral engagement was manifested, especially in the experimental group.Among the four (4) engagement constructs in the study, cognitive engagement had the lowest score. The study of Barr (2014) alleged that cognitive engagement is the pathway to achieve active learning in a class. However, it maybe true that in the present generation, technologies, particularly gadgets, have become a way of life for learners.

The data in Table 4 show the learners' engagement in Physics using Flipped Classroom. The result reveals that learners were often engaged in physics using flipped classroom. It was shown that learners considered physics lessons interesting using flipped classroom, with their responses, on how they were engaged throughout the study.

Table 4
Grade 9 Learners' Engagement in Physics using Flipped Classroom

	Items	Mean	Sd	Response	Qualifying Statement
	Cognitive Engagement	3.37	0.71	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
1.	I go through the work of physics class and make sure that it's right.	3.70	0.70	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
2.	I think about different ways to solve a problem.	4.03	0.89	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
3.	I try to connect what I am learning to things I have learned before.	3.83	0.95	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
4.	I try to understand my mistakes when something gets wrong.	4.33	0.66	Always Engaged	Student has a very high level of confidence/ enjoyment of the subject.
5.	*I would rather be told the answer than have to do the work.	2.40	0.81	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
6.	*I don't think that hard when I am doing work for class.	2.73	1.05	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
7.	*When work is hard, I only study the easy parts.	2.67	0.99	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
8.	I do more than what is required in class.	3.27	0.78	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
	Behavioral Engagement	3.77	0.90	Often Engaged	Student has a high level of confidence/

					enjoyment of the subject.
9.	I stay focused.	3.66	1.01	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
10.	I put effort to learning physics.	3.93	0.98	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
11.	I keep trying even if something is hard.	3.27	0.98	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
12.	I complete my homework on time.	2.80	1.06	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
13.	I talk about physics outside of class.	3.97	0.93	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
14.	I participate in-class activities.	2.60	0.97	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
15.	*I do other things when I am supposed to be paying attention.	2.20	1.00	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
16.	*If I don't remember, I give up right away.	3.80	0.85	Seldom Engaged	Student has a low level of confidence/ enjoyment of the subject.
	Emotional Engagement	3.93	1.07	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
17.	I look forward to physics class.	4.33	0.99	Always Engaged	Student has a very high level of confidence/ enjoyment of the subject.
18.	I enjoy learning new things about physics.	3.30	0.99	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.

19.	I want to understand what is learned in physics class.	2.97	1.07	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
20.	I feel good when I am in physics class.	2.20	0.89	Seldom Engaged	Student has a low level of confidence/ enjoyment of the subject.
21.	*I often feel frustrated in physics class.	1.50	0.78	Always Engaged	Student has a very high level of confidence/ enjoyment of the subject.
22.	*I think that the physics class is boring.	1.50	0.82	Always Engaged	Student has a very high level of confidence/ enjoyment of the subject.
23.	*I don't care about learning physics.	2.10	0.92	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
24.	*I don't want to be in physics class.	2.00	1.08	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
25.	*I often feel down when I am in physics class.	3.50	0.78	Seldom Engaged	Student has a low level of confidence/ enjoyment of the subject.
26.	*I get worried when I learn new things about physics.	3.60	0.86	Seldom Engaged	Student has a low level of confidence/ enjoyment of the subject.
	Social Engagement	3.80	0.76	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.
27.	I build on others' ideas.	2.93	1.01	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
28.	I try to understand other people's ideas in physics class.	1.90	1.03	Seldom Engaged	Student has a low level of confidence/ enjoyment of the subject.

29.	I try to work with others who can help me in physics.	1.57	0.82	Never Engaged	Student has a very low level of confidence/ enjoyment of the subject.
30.	I try to help others who are struggling in physics.	1.63	0.85	Never Engaged	Student has a very low level of confidence/ enjoyment of the subject.
31.	*I don't care about other people's ideas.	3.02	0.92	Occasionally Engaged	Student has a moderate level of confidence/ enjoyment of the subject.
32.	*When working with others, I don't share ideas.	3.70	0.70	Seldom Engaged	Student has a low level of confidence/ enjoyment of the subject.
33.	*I don't like working with classmates.	4.03	0.89	Never Engaged	Student has a very low level of confidence/ enjoyment of the subject.
	Over All Mean	3.83	0.95	Often Engaged	Student has a high level of confidence/ enjoyment of the subject.

*Negatively stated statements

Legend:

1.00 – 1.79	Never	2.60 – 3.39	Occasionally	
1.80 – 2.59	Seldom	3.40 – 4.19	Often	4.20 – 5.00 Always

The data show that the highest mean comes from the item which they asserted to have tried to understand their mistakes when something went wrong. It implies that the learners were always engaged. It indicates that the learners had a very high level of confidence or enjoyment of the subject. This item had the lowest standard deviation, which means that most of the learners' responses were homogeneous. Further, an item which the highest mean is also when they looked forward to physics class. It also indicates that learners were enthusiastic and excited about the activities which majority of them agreed that activities were highly engaging.

The data also show that the items in which they thought about different ways to solve a problem ranked the second among the highest mean items. It means that the learners developed optimism and positivity in solving various problems that were given. It also reveals that the learners enjoyed the lessons, and their responses on the items clustered closely, based on the standard deviation.

It was also shown that the items they often felt frustrated in physics class and thought physics class is boring had the lowest mean. It implies that learners are enjoying the lessons. It also reveals that the learners have a high level of engagement in the lessons. The overall mean and

standard deviation show that the learners were often engaged in their Physics lessons. It further indicates that the flipped classroom use as aThe finding corroborates with Blumenfeld (2006),who mentioned that student engagement is a significant circumstance to motivate students in learning experiences and willingness to endeavor continuous effort. Walker et al. (2006) suggested that student engagement is a predictor of students' performance in several environments. The teacher needed to engage students to work as scientists worked as they analyzed data and created a theory and hypotheses. Further, Fortney (2016) mentioned that an increase in student engagement in Science positively correlates to improved student academic performance. That is, influencing student engagement would be a valuable tool for educators in designing student intervention and improving student academic performance.

The investigation in the flipped classroom effects on academic performance revealed that although the learners' level of proficiency did Not Meet Expectation, there is still a significant difference in the academic performance between the experimental group and the control favor of the experimental group. It is safe to affirm that flipped classroom enhanced the academic performance of the learners. Moreover, the learners were often engaged, that they had a high level of confidence/ enjoyment of the subject.

CONCLUSIONS

From the analysis of data, the following conclusions were formulated:

1. The academic performance in Physics of Grade 9 learners using Flipped Classroom and those using the K to 12 Learning Module is Did Not Meet Expectation.
2. Though the experimental and the control group's academic performance did Not Meet Expectation, there is a statistically significant difference in Physics' academic performance in favor of the experimental group.
3. The Grade 9 Learners using the Flipped Classroom were often engaged in Physics, which means that learners have a high level of confidence or enjoyment in learning Physics.

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