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# MATHEMATICS PERFORMANCE AND ANXIETY OF JUNIOR HIGH SCHOOL STUDENTS IN A FLIPPED CLASSROOM

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**Abstract:**
The conventional schoolroom scenario portrays the teaching-learning processes orchestrating in the four walls of the classroom. Flipped Classroom tries to do away with the traditional mode of lecture to a more dynamic classroom experience of the students where presentation of the contents are done outside the classroom utilizing instructional videos. This study determined the effectiveness of the Flipped Classroom in the mathematics performance and anxiety of the Grade 7 students of Central Mindanao University Laboratory High School. Specifically, it aimed to answer the questions on the mathematics performance of the students when exposed to Flipped Classroom and to Non-Flipped Classroom before and after the experimentation and few days after the experimentation; on the mathematics anxiety of the students when exposed to Flipped Classroom and to Non-Flipped Classroom before and after the experimentation; on the difference in mathematics performance of the students when exposed to Flipped Classroom and to Non-Flipped Classroom after and few days after the experimentation as either significant or not; and lastly, on the difference in the mathematics anxiety of the students when exposed to Flipped Learning and to Non-Flipped Classroom as either significant or not. Results revealed 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 the mathematics performance of the students exposed to Non-Flipped Classroom in the retention test. On mathematics anxiety, the students are on moderate level in both groups before and after the implementation. Moreover, the mathematics anxiety of the students exposed to Flipped Classroom is lower after the implementation and it is even significantly lesser than the anxiety of the students exposed to Non-Flipped Classroom.

**Keywords:** anxiety, flipped classroom, mathematics performance

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## 1. Introduction

Mathematics is one of the subjects that is oftentimes more effective to be taught using the traditional lecture method and all other teacher-centered approaches rather than student-centered ones. This is due to the nature of mathematics being difficult and the instruction being complicated when dealt lightly. As a matter of fact, Sivar (2012) insists that the responsibility of guiding the thinking of the students is put into the shoulders of the teachers. This task is so great that the teacher must make sure that he/she also understands what he/she is talking about. Furthermore, she made mention that the interest of the students is based largely on how the teacher delivers his/her class. This is a clear indication that teachers, firsthand, needs to be the sole, if not most, responsible for the uplifting of students interest, which includes anxiety levels of the students, and the process and output of instruction which is the performance, and that teacher-centered approaches are more convenient to apply in a classroom setting.

However, nowadays, with the present generation of the 21st century learners, teaching of Mathematics through a traditional classroom setting breeds few, if not none, changes in the improvement of mathematics learning. This is also observable in Central Mindanao University Laboratory High School (CMULHS). Students, in a conventional classroom, don't have enough preparation before the class, learn while the teacher is presenting and discussing the concepts and complete the day's concern with a take home activity that will be submitted before the next session. This cycle goes on and on, but then, retention became more of a problem, not to mention, the perceptions of the students on what mathematics nature is.

Another concern is the use of classroom time. The use of open-ended activities involving practical works and group-based works in a classroom setting consumes much time – not to mention the need for a discussion before the conduct of said activities. The common amount of time of a mathematics class here in the Philippines ranges from 3-5 hours per week. This amount of time is now enough only for the teacher to discuss thoroughly and properly any Mathematics concept, but fewer opportunities for the students. This is just for one classroom instruction schedule. Imagine on how much more for a whole grade level competency for a school year. The lesser the instructional time, the more cloudy the closure the teacher can give during a typical mathematics class period (Grouws, D.; Tarr, J.; Sears, R.; Ross, D. 2010). This also results to higher anxiety levels of students when dealing with Mathematics and its instruction. This is where outside classroom works are needed to supplement instruction.

In CMULHS, students are almost fully equipped with competence in using technology. This fact helps teachers to use technology during classroom instruction with ease. The use of technology also creates lighter atmosphere while discussing Mathematics and caters growth of interests of the students. In his research, Myllykoski (2016) found out that the use of instructional videos during remedial instruction produced positive feedback from the students. Students reported that the instructional videos helped them to remember the specific topics in Mathematics. Even the results in

their exams showed great improvement. Also, almost all of the students who were reported to be peer learners, that is, they learned better with the help of their peers, solved mathematical problems by themselves. This supports that if used appropriately, technology-aided classroom instruction will produce better confidence, retention and performance of the students. The only concern is even with the use of technology during classroom instruction; the amount of instruction time can't suffice the heavy topics of Mathematics.

The shift now from a traditional classroom instruction to a classroom instruction full of activities is the target. Teachers need to facilitate learning while students must do some tasks. This may be possible if the classroom instruction is done before instruction schedule or beforehand. The instruction now may come from a different time under a different situation – a situation where students are interested in. To match the interests of the 21st century learners, the teachers now are challenged to create a learning environment outside the classroom instruction schedule which involves the use of technology. It caters the two concerns of mathematics teachers, the time restriction and the students' interests.

This is actually a big challenge for mathematics educators. The challenge on whether the teacher is capable of using the technology, on whether the technology is within the reach of both the teacher and the students, on whether there is enough opportunity of the students to respond, and many more. However, it is a necessity to improvise the teaching scenario to cater not just two of the concerns mentioned above but the diversity of the learners. There are students who can learn better on their own, with technology, with visual materials, and with challenging tasks.

Aside from the concerns on anxiety, and mathematics performance, the CMULHS also envisions to maximize instructional time and advance learning to all of its students. However, these targets are not always realized due to lack and not enough instruction time in classes. Especially for mathematics classes, teachers observe oftentimes that fewer mathematical concepts are delivered in classes than what was prepared and expected. These observations forced the teacher to solely take charged in class and minimally allow student participation. There are few instances that classes are cancelled due to school activities and other things that affect the range of the learning competencies the mathematics educators targeted before the start of every school year. These concerns call for extra and more instructional time for the students to learn and even outside class and school hours. There is a need for a classroom style that is designed for these endeavors. This has been the reason why this study came into the light.

This study is concerned on the possibility of improving students take on what Mathematics is and their performance. These may be accomplished in a situation where the usual instruction is done outside the classroom instruction schedule aided by technology. This use of technology outside the classroom aims to improve readiness of students where the usual home-based activities are done using the whole classroom instruction time allotment to maximize teacher-to-student and student-to-student

interactions inside the class. The classroom now becomes anywhere and anytime – hence called, the Flipped Classroom.

This study determined the effectiveness of Flipped Classroom on the mathematics performance and anxiety of the Grade 7 students. Specifically, it aimed to answer the following questions:

1. What is the level of mathematics' anxiety of the CMULHS Grade 7 students exposed to a non-flipped and to a flipped classroom in terms of
    a. pre-survey results; and
    b. post-survey results?
2. What is the level of Mathematics' performance of the CMULHS Grade 7 students exposed to a non-flipped and to a flipped classroom in terms of their
    a. pretest scores;
    b. posttest scores; and
    c. retention scores?
3. Is there a significant difference between the mathematics anxiety levels of students exposed to a non-flipped and to a flipped classroom?
4. Is there a significant difference between the mathematics performance of students exposed to a non-flipped and to a flipped classroom in terms of their
    a. posttest scores; and
    b. retention scores?

## 2. Review of Related Literature and Studies

### 2.1 On Anxiety

If self-efficacy stands on the belief of the students that they can do great things in Mathematics, let's say it is the positive attitude area; anxiety, on the other hand, that talks about the fear and any negative attitude towards Mathematics.

In his research, Mutodi (2014) claimed that it is actually the traditional mathematics classroom practices that cause the great anxiety among many students. These said traditional practices include imposed authority, public exposure and time deadlines. He added that the best way(s) to reduce anxiety and probably, a sense of competition and tension among students, is to apply teaching methods which include less lecture, more student directed classes and more discussions.

> "*Cooperative groups provide students a chance to exchange ideas, to ask questions freely, to explain to one another, to clarify ideas in meaningful ways and to express feelings about their learning. Much of the anxiety happens in the classroom due to the lack of diversity in learning styles of students. Mathematics must be looked upon with a positive attitude to reduce math anxiety. Therefore, teachers must re-examine traditional teaching methods which often do not match students' learning styles and skills needed in a technologically advanced society. Lessons must be presented in a variety of ways which accommodates students' different learning styles. It may also be due to the complexity of the mathematics curriculum where more advanced concepts are introduced at the higher*

*level. These results may also have an impact on the way mathematics is taught in the lower grade levels. Teachers need to use instructional strategies that are suitable for the cognitive abilities of the students and progression of the content should be gradual. The current data suggest that both challenging and caring environments positively influence math self-efficacy. It is interesting to note that perceptions of teacher caring effected math self-efficacy as strongly as perceptions of challenge and mastery. It is not hard to imagine that when students believe that their math teachers have a personal interest in their well-being and concerns, they have less anxiety and are more confident in their ability to do their math work."* (Mutodi, 2014)

This what-we-so-called anxiety in Mathematics actually springs out from negative experiences in a mathematics class. It was Hamza, (2013) who further describes it as a situation wherein students feel frustration because of the lack of explanation of the sub-steps of mathematical procedures. An additional burden came to be the sequential nature of mathematics instruction as it becomes more difficult. Thus, the student does not immediately grasp the procedures or concepts being taught at a specific point in time (Brady & Bowd, 2005).

Additionally, too many activities and drill exercises contribute to frustration and anxiety, which in turn leads to frustration at not being able to keep up with the class. And where does this boil down? Aside from the subject itself, it is pointed at the teacher's way of handling the class.

Shannon (2008) claimed that the development of over dependence between the math teacher and the math student is the root of the problem – the problem of anxiety. She believed that because of this dependence, students are getting afraid on doing initiative tasks since what the students often believed is that the sole source of learning is the teacher. And this also caters another problem that students who can't understand what the teacher is saying don't have that capacity to learn Mathematics.

In the same research, Shannon (2008) stated that it is when the utilization of more hands-on exercises in the classroom are allowed when the students get to feel a low-anxiety atmosphere. Though it is necessary for teachers to ask questions to assess understanding of the current topic, it would be wise to allow group activities with manipulatives so the students could be assessed in a relaxed format and that students won't be afraid to be called on to answer questions in front of their peers. Reinforcement of what the students have learned in their own before coming to class created more meaningful learning and lesser stress to the students (Brown 2015).

**2.2 On Mathematics Performance**

Mathematics performance is the result of the interlinking processes done in a mathematics classroom instruction. Aside from the processes, this is always affected by how Mathematics is perceived by the students and presented by the teacher. Most of the times, this is being paralleled to how the teacher teach rather than how the students learn. This conflict is one of the things that need to be addressed since Mathematics performance is actually a product of both.

As stated by Generalao, as cited by Andamon and Tan in 2018, teachers role in the teaching and learning process is very vital in the sense that students mathematics performance will depend on how the teacher makes the instruction meaningful and interesting. No matter how abstract and difficult Math is, making the instruction dynamic and open for communication will make it simpler. This focuses on the teaching concerns such as method or strategies, educational tools used and even the environment created by the teacher. Mathematics performance, as claimed, is affected by how the students perceived the classroom instruction.

Minao (2013) relates Mathematics to everything in this universe, and that it is the "bedrock" of all science and technologically based subjects. With this, the emphasis on Mathematics as a "need-subject" to be learned came from the fact the Mathematics is all around us and it actually explains the universe. However, this oftentimes creates problems because teachers have troubles on relating Mathematics to real-life situations. This is where the performance of students is being shaken.

Pal (2009) even added that the multiple difficulties that students faced in learning are rooted in the lack of understanding of lower level concepts. This is due to many misconceptions brought by the lack of clarity by the instruction the teacher teaches.

According to Honor as cited by Pagtulon-an and Tan (2018), there are many factors that contribute to low performance in Mathematics among basic education students. These include classroom environment, teacher's personality and teaching approaches (Turner et al, 2002). Most of these reasons are due to the fact that teachers do not innovate their classroom style and are more focused on what they should do rather than what the students should do. This is a realization that the traditional classroom instruction is not anymore conducive to meet the new way of student's learning.

Ulep (2006) explained the teaching of Mathematics in the Philippine setting. One thing that a Filipino Mathematics teacher must always take into consideration is to develop and familiarize open-ended activities involving practical work in every classroom instruction. She added that Filipino teachers must prepare to involve and manage cooperative learning groups to maximize the benefits of each instruction. Sadly, in general, still, to a great extent, it was the teacher who explains and asks questions in a whole classroom setting. Students cannot sustain the discussion and make it more productive, leaving the teacher as the one who begins and ends the topic. "*The most common strategies in teaching mathematics are exposition, practice and consolidation, and discussion*" (High School Mathematics Education Group 1996; Bernardo, Salazar-Clemena, and Prudente 2000) as cited by Ulep (2006).

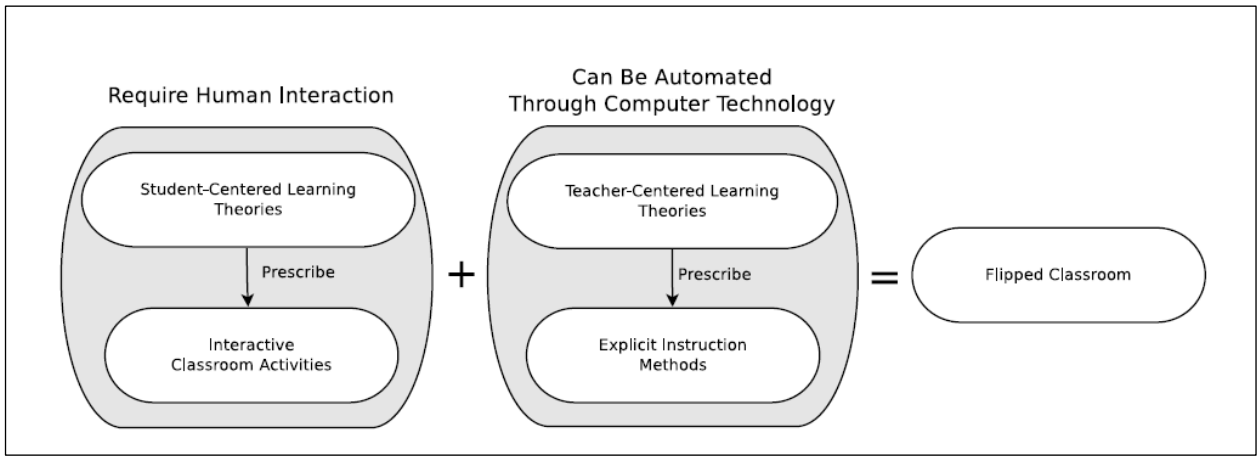
Furthermore, in connection to students' mathematics performance, Dalan (2004) emphasized that achievement of the students plays an important role as a basis for developing educational system specifically in the teaching and learning process. Academic performance now is a criteria in identifying whether the instruction the teacher offers is considered of quality or just mediocre.

Ciubal-Fulgencio and Tan (2018), stated the study of retention by Akinsola and Popoola in 2004. There, understanding, comprehension and application of mathematical concepts are very important factors of mathematics performance. It can be summarized into one word – retention. Retention is not just recalling but retaining important information that is essential for the understanding of the concepts to be discussed in the near future. However, it is only achieved if there is a formal support provided outside the class.

As cited by Marcia (2007), teachers must take extra preparation and planning in complementing their usual instruction by take-home activities. As an action towards this, educators must use learning enhancement strategies in complementing their instruction management (Kauchak & Eggen, 1999). These activities must contain activities exemplifying the competencies needed to be achieved.

### 2.3 On Flipped Classroom

Overmyer (2014) described the flipped classroom model as a model of instruction where technology is used to leverage the learning in a classroom, so that a teacher can spend more time interacting with students instead of lecturing. This is most commonly done by using teacher created videos that students view outside of class time. It is called the flipped class model because the whole classroom/homework paradigm is "flipped". In its simplest terms, what used to be classwork (the lecture) is done at home via teacher-created videos and what used to be homework (assigned problems) is now done in class as illustrated by Figure 1.




**Source:** Bishop, J. & Verleger, M. (2013). The Flipped Classroom: A Survey of the Research. Utah State University. Retrieved from https://www.asee.org/public/conference/20/papers/6219

**Figure 1:** The Flipped Classroom Model

He added that Flipped Learning is a dynamic and interactive learning environment where students move from a group learning to individual learning in which the role of the teacher is only to guide the learner and ensure that they are creatively engaged in the subject matter.

Some of the benefits like being more visual for students, students being able to work at their own pace, and learning for homework not just practicing demonstrate that a flipped classroom can help create more differentiated homework that will help students get more out of the time they are spending working on mathematics outside of class (Szparagowski, 2014).

Bergmann (2012) added some observable change in the behavior of his students. His students began asking questions with more confidence. The quiet, introspective students often have the same questions, but rarely voice those in the traditional model. In the flipped-mastery model all students asked questions. More and better questions were received in the flipped classroom rather than they ever did in a traditional model, and the discussions have been richer. Students became more curious, and in that nonthreatening format, all students can demonstrate their curiosity and learn in an individualized way. Another thing, during the question-and-answer times, it is noticeable how the quiet students come out of their shells.

Similarly, Marlowe (2012) noticed some improvements. The students showed the greatest increase in semester grades with low performing students. This is because these students were given more opportunities for small group work and one-to-one contact with the teacher than would be possible in a traditional classroom. Lower performing students were required to take part in small group discussion after formative tests and had ample opportunity to ask questions during group and individual work. Instead of these students asking their peers or parents for help on assignments, they were able to immediately ask me for clarification and assistance.

He continued that Flipped classroom is a positive model which can influence more students to succeed. The top achievers will be motivated and learn regardless of the teaching style, but if the flipped classroom model will help motivate middle and low achieving students to work harder and learn in a more efficient manner, than it is worth exploring. The flipped classroom model became an appropriate method for differentiation and for creating an independent learner.

The feedback from the class was also overwhelmingly positive. Throughout the process, students were open and honest about their feedback and provided great suggestions about how to improve the way the flipped classroom model was working. The class was less stressful for both students and teachers. In fact, Sharpe (2016) mentioned that Flipped Classroom gave teachers the opportunity to reach more students. Diversity of methods, as allowed by the Flipped Classroom, caters the diversity of learning styles the students prefer. The interactions between the teacher and students almost tripled in Flipped Classrooms as compared to the traditional classrooms as discussed by Smith (2015). This means that the Flipped Classroom can increase student engagement.

Bishop (2013) added that the importance of these student-centered learning activities to the flipped classroom cannot be undermined. Without these, the flipped classroom simply does not exist. As shown in Figure 1, the flipped classroom is made up of two components: one component that requires human interaction, the in-class

activities; and a second component that uses computer technologies such as video lectures, the outside activities.

The most important aspect of teaching in a flipped learning model requires teachers to not just present lectures on videos and open class time for working on homework, but must use face-to-face class time for dynamic and active, inquiry-based, and cooperative learning opportunities for their students. Still, obviously, the classroom component is critical. Unfortunately, some may overlook this fact and instead conceptualize the flipped classroom based only on the presence (or absence) of computer technology such as video lectures. It is not just addition of technology; it is simply the change of role of technology and instruction, lecture and group-works, teacher-centered and student-centered activities.

The essential first step is to teach your students how to watch the videos. Watching an instructional video is not like watching an entertainment movie or TV show. These educational videos need to be watched critically like reading a nonfiction book rather than reading a fiction book. During this training period, students will also be taught how to improve effective note taking skills (Bergmann, 2012).

Positive results were recorded in the study of Shyr and Chen (2018). The results showed that Flipped Classroom does not only better prepared students but also better promoted learning performance compared to the conventional classrooms. Several factors were presented by Dafoe (2016) as contributing factors to these positive outcomes. These factors were improved student-to-teacher relationship and vice versa, flexibility of the teachers, positive classroom environment and less stressful expectations set in the classroom. Although there was hesitation at the beginning in the study of Sierra (2015), students observably grew to accept and adopt the Flipped Classroom model over time. The flipped model allowed for individualized attention leading to a better student experience in high school mathematics classrooms.

Unfortunately, there are researches that showed no significant difference between the non-flipped classroom and flipped classroom. Sparks (2013), in his findings, said that although flipping the classroom does work for some students, it does not appear to increase learning in all students as reported. He further declared that it is on the fact that students use technology that learning was improved and not the "reversing" of activities. In his own words, "*It appears that the flipped classroom works by increasing the total time a student spends on the material. Therefore, the flipping the classroom method does not significantly increase learning but using technology to increase learning time does."* Similar thing happened to the study of Ramaglia (2015). Little notable differences were observed and classrooms seemed to function relatively similarly to each other with only notable difference being what took place outside of class instruction schedule (Ramaglia, 2015).

Another downside was recorded by Levy et al. (2011). The students' lack of preparation may negatively influence the quality of the collaboration activities – not to mention the availability of resources and length of time done outside the classroom. They found this experience to be quite normal within the structure of the flipped instructional model. When students in the flipped classrooms did not complete the

homework, they were not able to use foundational knowledge from the content videos to critique each other's work or extend the conceptual skills acquired from the videos to real world applications during class collaborations.

Furthermore, the flipped classroom does have the benefit of increasing time on task for the student by using technology to increase learning time outside the classroom. However, this technique is only effective because students spend more time learning the material. Any method that gives more time to learn the material will result in increased learning. The true value of the flipped classroom appears to be not in the method but in the use of technology to increase the time students spend learning.

Vang (2017) found out that students in the flipped classroom performed at least as well as or, in some instances, even better than students in the traditional instruction. One of the reasons that may have influenced the similarities in the results was the fact that the flipped instructional model limited some students' access to the course content prior to class collaboration. Because several students did not complete the flipped lesson, collaboration time was consumed in order to review the flipped content prior to the start of the lesson. This had to be done in order to ensure all students had access to the instruction needed for the collaboration activities. The allocation of time could have influenced the results as the differences in instruction among the two groups could have been too minimal for the flipped classroom to show significant gains. The byproduct leads to a slowdown of the pacing and discontinuity in the instruction that caused setbacks and a lack of cohesiveness within the flipped learning environment.

Caicco (2016) unfortunately, added more negativity on the output of the research. Caicco's research talked about the experiences of the teachers under the Flipped classroom instruction model. Teachers became hesitant to use the said strategy because of the limitation on the internet. Some other circumstances, students who have better access than others, either in terms of internet connection reliability or mobile device quality, clearly manifested greater improvement.

## 3. Conceptual Framework

Mathematics, on the course of history, is taught as a tool for survival and societal development. Nowadays, Mathematics has been regard as an opportunity to understand real-life. Mathematics is oftentimes taught using the traditional lecture method. This is due to the fact that Mathematics is considered as a difficult subject that may bring multiple problems if not handled properly in a class. This makes the teacher carry out all opportunities to discuss and become responsible for student learning. The present generation of 21st century learners also opens the discussion of using an alternative method in delivering the classroom instruction through the use of technology. This is in connection to the recent researches that show that new generation learners learn better if they are engaged in the class and given chances to use available technology to improve, remedy and check learning. The advent of these concerns brought out the concept of "flipping" the classroom to the sense that students are now

in-charge to discovering their learning. The Flipped classroom is based on the following theories of learning.

Jean Piaget's theory of Constructivism suggested that for young learners, learning comes out from actively exploring and engaging on tasks. By letting the learners participate in the discovery of the concepts and with the teacher as a facilitator, learning can come in. This further emphasizes that committing errors and mistakes as the learners experience tasks are very important in the process of learning. Learning a concept comes from the learners' self-initiated and explorative activities.

Lev Vygotsky's Zone of Proximal Development supports the claim of Flipped learning that students learn as they are guided into it. The term used is scaffolding. The implications are letting the learners observed how to do something, then do something in collaboration with another more experienced person, and finally they will be able to do it themselves. This is where the take-home videos in the Flipped classroom come in. As lectures and exercise problems are discussed through video, the students will know how to do it later on by themselves. Success in these activities will definitely help with encouraging and advancing their individual learning.

Having a Flipped type of a classroom encourages students of different intelligences to learn in their own pace, style and manner. The Theory of Multiple Intelligences by Howard Gardner explains that not all students learn through listening to a lecture, to which a similar concern brought out by a Flipped classroom. Those students who like to see how a thing is done, those students who like to learn in their own, those students who like to use technology in learning, those students who like to learn without time restrictions, those students who like to be responsible in discovering their own learning and other type of students as mentioned by Gardner is being catered by the Flipped classroom. Learning styles of the students as proposed by many educational theorists such as Kolb, Dunn, Honey and many more is also covered in this new method of classroom instruction.

Edward Thorndike's theories are also basis of Flipped learning. His Laws of Effect, Exercise and Readiness are just few of them that promote learning in a different way. The Law of Effect is concerned on the concept that learning is better if the effect of instruction is pleasant for the students. The use of technology outside the class can enhance the interest of the students and can create better feeling of satisfaction after learning. Both Law of Exercise and Readiness talked about the improvement of learning if the students are prepared and have practiced the learning before things are tackled in a classroom instruction. Flipped classroom makes the practice and preparation pleasant for the students since they would be prepared for the class ahead of time, and inside the regular classroom instruction schedule, the students additionally practices more ways of learning as they will be given more group-based and exploratory activities in the class.

Both of Bandura's Social Cognitive and Social Learning Theories is also one of the best backbone of Flipped type of classroom. Through the conduct of outside-the-class lecture and inside-the-class activities, the concept of observation, imitation and modeling, as emphasized by Bandura, are all captured and given importance. The

teacher lets the students use all the time in a regular classroom instruction schedule to learn how to do things with even minimal teacher participation.

Flipped learning is also anchored to John Dewey's Learning by Doing. The learning now of the topic is made possible through opportunities to use the technology by their own and furthermore, the students try to check their learning by their own. Students feel the sense of ownership with their learning as they creatively and meaningfully do the intended prepared tasks into a realistic context.

## 4. Methodology

This study used a quasi-experimental research design. Two intact classes were selected among the Grade 7 classes of CMULHS. One of the two intact classes was randomly selected as the experimental group (Flipped Classroom) while the other one as the control group (non-Flipped Classroom).

Students in the experimental group were exposed to a flipped style of classroom instruction while the students in the control group were exposed to a non-flipped classroom instruction. With the use of these groupings, the results of this study helped determine the difference in the mathematics' anxiety and performance of the CMULHS Grade 7 students during the fourth grading period of school year 2017-2018.

CMULHS caters more than 700 students from the different parts of Bukidnon under a K to 12 Science Curriculum for Junior High School and Science, Technology, Engineering and Mathematics (STEM) Curriculum for the Senior High. There are three (3) sections in each grade level in the junior high school while there are only two (2) sections in each grade level of the senior high school. These details made the study of flipping the Mathematics classroom instruction with the aid of technology even more meaningful.

A written permission was submitted to the Principal of CMULHS for the researcher to be allowed to conduct the research study participated by the Grade 7 students who are officially enrolled in school year 2017-2018. A designed lesson plan matrix for the Flipped classroom setting and the non-flipped classroom setting was followed to see the difference and significance of improvement on the mathematics anxiety and performance of the students. The said lesson plan matrix included the instructional videos and group-based activities prepared for the Flipped classroom and the set of home-based activities prepared for the Non-Flipped classroom. There were eight (8) sessions in the whole experimentation period that covered the basic concepts of Grade 7 Geometry.

The survey questionnaire of the mathematics anxiety and the pre-test for the mathematics performance for both groups of students were given before the start of the experimental period. The posttests for both the measurement of mathematics anxiety and performance were also given after the experimental period. In completion of the experimentation process, a retention test were given sixteen (16) days after the administration of the posttest.

### 4.1 The Flipped Classroom

The randomly selected group that was subjected to a Flipped Classroom was designed to experience plenty of group-based activities during the regular classroom instruction schedule. Series of problem sets and collaborative activities were given during the experimental period. The instruction was given through a researcher-made instructional videos validated by senior mathematics educators. In those instructional videos, the researcher explained the mathematical concepts through embedded voice recording while colorful and moving mathematical terms and explanations were viewed. The said instructional videos contained problem sets with time allotment. These instructional videos were attached in the Schoology group (www.schoology.com), an online learning system where students were given with access codes. All students under the Flipped Classroom were able to enroll in the said group.

The instruction time, through the instructional videos, was done within a day before the regular classroom instruction schedule. The researcher also asked permission from the principal of CMULHS that allowed the students under the Flipped Classroom to utilize the e-Library during their free time. This ensured that all students under the Flipped Classroom were given equal opportunities to experience the lecture discussions through the posted instructional videos.

During the regular classroom instruction schedule, the teacher handed out designed activities of any form; they may be individual, peer-related or group activities, and these activities were submitted before the class ended. The teacher acted as a facilitator rather than a dispenser of knowledge while students were given time to interact with one another through a free flow of exchange of ideas and queries. The teacher also supplemented the class with open-ended questions that created a safe teacher-to-student communication.

### 4.2 The Non-Flipped Classroom

The Non-Flipped Classroom was designed as a classroom full of lecture-discussions instruction and teacher-centered activities during the regular classroom instruction schedule. Outside the regular classroom instruction schedule, home-based activities were given to the students in the form of assignments. These activities were submitted before the start of the next class schedule.

Students during the regular classroom schedule experienced the traditional form of instruction where the teacher was in-charge of the class. Still, students were allowed to ask questions and interact within the class. Formative assessment, then, were given every time after the topic was discussed.

### 4.3 Instrumentation

The instruments used in this study were the adopted mathematics anxiety scale for the measurement of anxiety levels in both pre-test and posttest, the teacher-made test for the mathematics performance in pre-test, posttest and retention test. The anxiety level of the students was distributed in different classes where the sizes of all classes are

equal. For the mathematics performance, the results were grouped with the use of the standards set by CMULHS. The results of the mathematics performance were transmuted using the approved Revised Transmutation Table of CMULHS to get the percentage scores.

In determining the levels of mathematics' anxiety of the students, the researcher adopted the Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ) by Diana K. May (2009) in her dissertation of the same title. The researcher only used the Anxiety Scale portion of the said questionnaire.

The MSEAQ scale was developed according the Social Learning Theory of Bandura for anxiety levels. The said scale is a 5-point scale questionnaire from Never (1) to Usually (5). Each mean score were translated into this scoring procedure.

| Scale | Range | Qualitative Description | Interpretation |
|---|---|---|---|
| 5 | 4.21 – 5.00 | Usually | Severe Anxiety |
| 4 | 3.41 – 4.20 | Often | High Anxiety |
| 3 | 2.61 – 3.40 | Sometimes | Moderate Anxiety |
| 2 | 1.81 – 2.60 | Seldom | Mild Anxiety |
| 1 | 1.00 – 1.80 | Never | No Anxiety |

A sixty (60)-item teacher-made test that covered the Geometry topics for the Grade 7 Curriculum was administered before and twice after the experimental period, one for the posttest and one for the retention test. The items included were from the test bank of Grade 7 Geometry with reliability of 0.82. The test is a multiple choice type test where a score of 1 for every correct response while 0 for incorrect responses were recorded. The scores of each student in pre-test, posttest and retention tests were given percentage with the use of the approved Revised Transmutation Table of CMULHS. These percentage scores became the basis of the mathematics performance for each of the student. The mathematics performance was then classified with the use of this range scale.

| Equivalent Grade | Level of Proficiency | Qualitative Interpretation |
|---|---|---|
| 94-100 | Exemplary | Very High Performance |
| 88-93 | Above Average | High Performance |
| 82-87 | Average | Moderate Performance |
| 75-81 | Below Average | Low Performance |
| 65-74 | Deficient | Very Low Performance |

Descriptive statistics such as mean and standard deviation were used to compute the mathematics anxiety levels, and as well as their performance. Frequency table which included frequency count and relative frequencies were also recorded to verify decrease of anxiety levels and improvement of performance of the students in both groups. To describe the levels of anxiety and mathematics performance of both groups, a scoring scale was then used.

Analysis of Covariance (ANCOVA) was then employed to investigate the presence of significant difference on the level of mathematics anxiety of the students between the group exposed to a Flipped Classroom and the group exposed to a Non-Flipped Classroom in the posttest. This was also true to the identification on whether the difference recorded on the mathematics performance in the retention test was significant or not.

## 5. Presentation, Analysis and Interpretation of Data

### 5.1 Students' Mathematics Anxiety in Flipped and Non-Flipped Classrooms

Table 1 exhibits the level of mathematics anxiety of the students in both class groups before the implementation of a Flipped Classroom and the Non-Flipped Classroom. This table includes the weighted mean per mathematics anxiety statement, qualitative descriptions and interpretations.

The table shows the five (5) mathematics anxiety statements with highest means before the intervention that are interpreted with higher anxiety levels in both groups. For the students who were assigned to be placed under the implementation of a Flipped Classroom, the five (5) statements are "I worry that I will not be able to get a good grade in my mathematics subject" (4.27), "I worry that I will not be able to do well on mathematics tests" (3.89), "I am afraid to give an incorrect answer during my mathematics class" (3.69), "I worry that I will not be able a 'line of 9 grade' in my mathematics subject" (3.60), and "I get nervous when taking a mathematics test" (3.58). On the other hand, for those students assigned to be placed under the Non-Flipped Classroom as the control group, the following five (5) statements gained the highest means; and they are "I worry that I will not be able to get a good grade in my mathematics subject" (4.24), "I worry that I will not be able to do well on mathematics tests" (3.96), "I get nervous when taking a mathematics test" (3.58), "I get tense when I prepare for a mathematics test" (3.53), and "I am afraid to give an incorrect answer during my mathematics class" (3.44).

Based on these results, the students' Mathematics anxiety is at its highest negative mark if the concerns are on the results of mathematics tasks, which includes mathematics grade, score on a mathematics test and even the performance in a mathematics recitation or participation. This is supported on how Dalan (2004) perceive what achievement is. If the instruction is considered as a quality one and not just a mediocre instruction, students achievement is highly possible. This makes the students fear what grade or score they may get if they do not consider the quality of instruction as being quality.

In addition, anxiety is also being experienced by the students more during the preparation on a mathematics task or test that are considered to be traditional practices. As supported by Mutodi (2014), traditional mathematics practices do increase anxiety in most of the students. The way the students prepare themselves, if not fruitful, creates more anxious behavior. This is the reason why students feel so worrisome during their preparation on mathematical tasks.

The highest in both groups and the only mathematics anxiety statement that reached a mean that is described as "usually" and interpreted as "severe anxiety" is the statement on getting good grade in Mathematics. Students are getting more anxious and more frequent to be anxious if the concern now is grades. Students know that grades are reflections of their learning and even if Mathematics is just like any subject that are given enough attention by the educational system, grades in Mathematics are said to be considered as 'hard to get'.

Aside from the five (5) statements with the highest means, Table 1 also shows the Mathematics anxiety statements that the respondents shared to experience only mild or low anxieties. For those students in the Flipped Classroom, their responses revealed the statements "I feel stressed when listening to mathematics instructors in class" (2.44) and "I get nervous when I have to use mathematics outside of school" (2.51) have the least concern to be anxious about in dealing with Mathematics learning. However, the students in the other group revealed that the statement "I worry that I will not be able to use mathematics in my future career when needed" is least of a concern.

**Table 1:** Students' Levels of Mathematics Anxiety before Intervention

| **Mathematics Anxiety** | **Group** | | | | | |
|---|---|---|---|---|---|---|
| | **Flipped Class n=45** | | | **Non-Flipped Class n=45** | | |
| | **Mean** | **QD** | **QI** | **Mean** | **QD** | **QI** |
| 1. I get tense when I prepare for a mathematics test. | 3.51 | Often | H | 3.53 | Often | H |
| 2. I get nervous when I have to use mathematics outside of school. | 2.51 | Seldom | MI | 2.64 | Sometimes | MO |
| 3. I worry that I will not be able to use mathematics in my future career when needed. | 3.09 | Sometimes | MO | 2.49 | Seldom | MI |
| 4. I worry that I will not be able to get a good grade in my mathematics subject. | 4.27 | Usually | S | 4.24 | Usually | S |
| 5. I worry that I will not be able to do well on mathematics tests. | 3.89 | Often | H | 3.96 | Often | H |
| 6. I feel stressed when listening to mathematics instructors in class. | 2.44 | Seldom | MI | 2.73 | Sometimes | MO |
| 7. I get nervous when asking questions in class. | 2.93 | Sometimes | MO | 3.27 | Sometimes | MO |
| 8. Working on mathematics homework is stressful for me. | 2.64 | Sometimes | MO | 2.78 | Sometimes | MO |
| 9. I worry that I do not know enough mathematics to do well in future mathematics subjects. | 3.16 | Sometimes | MO | 3.36 | Sometimes | MO |
| 10. I worry that I will not be able to complete every assignment in a mathematics subject. | 3.38 | Sometimes | MO | 3.11 | Sometimes | MO |
| 11. I worry I will not be able to understand mathematics. | 3.47 | Sometimes | MO | 3.36 | Often | H |
| 12. I worry that I will not be able a "line of | 3.60 | Often | H | 3.42 | Often | H |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 9 grade" in my mathematics subject. | | | | | | |
| 13. | I worry that I will not be able to learn well in my mathematics subject. | 3.53 | Often | H | 3.31 | Sometimes | MO |
| 14. | I get nervous when taking a mathematics test. | 3.58 | Often | H | 3.58 | Often | H |
| 15. | I am afraid to give an incorrect answer during my mathematics class. | 3.69 | Often | H | 3.44 | Often | H |
| Mean | | 3.31 | Sometimes | MO | 3.28 | Sometimes | MO |

| Range | Qualitative Description (QD) | Qualitative Interpretation (QI) |
|---|---|---|
| 4.21-5.00 | Usually | Severe Anxiety (S) |
| 3.41-4.20 | Often | High Anxiety (H) |
| 2.61-3.40 | Sometimes | Moderate Anxiety (MO) |
| 1.81-2.60 | Seldom | Mild Anxiety (MI) |
| 1.00-1.80 | Never | No Anxiety (N) |

These responses are aligned to the statement of Nambatac (2015) where the discussion falls on the perceived usefulness of the concepts. Students somehow know the true purpose of Mathematics and that is why they do not develop much anxiety on using Mathematics. These seemed to be of least concerns since they are more on the futuristic use and aspect of Mathematics learning. Students are not that worried in the use of Mathematics outside the walls of the classroom and even in its implications to their future careers. These concerns do not add to the students' anxiety in dealing with Mathematics. Surprisingly, students are also not that concerned nor continued to show mathematics anxiety if it is during the lecture of a mathematics instructor in class. These means that the said to be "Teacher-Factor" does not necessarily add to the anxiety that the students experienced during mathematics classes.

The weighted mean score of the students' responses, as shown in Table 1, depicts that the overall anxiety of the students in Mathematics classes are in moderate level; 3.31 for students in the Flipped Classroom group while 3.28 for students in the Non-Flipped Classroom group. These, further, explain that students, generally sees mathematics learning, preparation and interaction which includes anxiety and confidence is in moderate normal level. This finding conforms to the discussion of Nambatac (2015) that clarifies students' confidence on Mathematics as a subject area as being moderately confident.

Table 2 presents the computed level of anxiety of the students in Mathematics as a subject after the implementation and non-implementation of the Flipped Classroom. This table also shows the comparison of the Mathematics anxiety statements' weighted mean in both groups.

**Table 2:** Students' Levels of Mathematics Anxiety after Intervention

| Mathematics Anxiety | Group | | | | | |
|---|---|---|---|---|---|---|
| | Flipped Class n=45 | | | Non-Flipped Class n=45 | | |
| | Mean | QD | QI | Mean | QD | QI |
| 1. I get tense when I prepare for a mathematics test. | 3.33 | Sometimes | MO | 3.59 | Often | H |
| 2. I get nervous when I have to use mathematics outside of school. | 2.44 | Seldom | MI | 2.45 | Seldom | MI |
| 3. I worry that I will not be able to use mathematics in my future career when needed. | 2.62 | Sometimes | MO | 2.73 | Sometimes | MO |
| 4. I worry that I will not be able to get a good grade in my mathematics subject. | 4.20 | Often | H | 4.34 | Usually | S |
| 5. I worry that I will not be able to do well on mathematics tests. | 3.73 | Often | H | 4.18 | Often | H |
| 6. I feel stressed when listening to mathematics instructors in class. | 2.40 | Seldom | MI | 2.68 | Sometimes | MO |
| 7. I get nervous when asking questions in class. | 2.84 | Sometimes | MO | 3.39 | Sometimes | MO |
| 8. Working on mathematics homework is stressful for me. | 2.47 | Seldom | MI | 2.64 | Sometimes | MO |
| 9. I worry that I do not know enough mathematics to do well in future mathematics subjects. | 3.22 | Sometimes | MO | 3.20 | Sometimes | MO |
| 10. I worry that I will not be able to complete every assignment in a mathematics subject. | 3.27 | Sometimes | MO | 3.14 | Sometimes | MO |
| 11. I worry I will not be able to understand mathematics. | 3.38 | Sometimes | MO | 3.61 | Often | H |
| 12. I worry that I will not be able a "line of 9 grade" in my mathematics subject. | 3.18 | Sometimes | MO | 3.61 | Often | H |

| Range | Qualitative Description (QD) | Qualitative Interpretation (QI) |
|---|---|---|
| 4.21-5.00 | Usually | Severe Anxiety (S) |
| 3.41-4.20 | Often | High Anxiety (H) |
| 2.61-3.40 | Sometimes | Moderate Anxiety (MO) |
| 1.81-2.60 | Seldom | Mild Anxiety (MI) |
| 1.00-1.80 | Never | No Anxiety (N) |

**Table 2:** Students' Levels of Mathematics Anxiety after Intervention (*continued…)*

| **Mathematics Anxiety** | **Group** | | | | | |
|---|---|---|---|---|---|---|
| | **Flipped Class n=45** | | | **Non-Flipped Class n=45** | | |
| | Mean | QD | QI | Mean | QD | QI |
| 13. I worry that I will not be able to learn well in my mathematics subject. | 3.38 | Sometimes | MO | 3.36 | Sometimes | MO |
| 14. I get nervous when taking a mathematics test. | 3.22 | Sometimes | MO | 3.91 | Often | H |
| 15. I am afraid to give an incorrect answer during my mathematics class. | 3.51 | Often | H | 3.77 | Often | H |
| Mean | 3.15 | Sometimes | MO | 3.37 | Sometimes | MO |

| Range | Qualitative Description (QD) | Qualitative Interpretation (QI) |
|---|---|---|
| 4.21-5.00 | Usually | Severe Anxiety (S) |
| 3.41-4.20 | Often | High Anxiety (H) |
| 2.61-3.40 | Sometimes | Moderate Anxiety (MO) |
| 1.81-2.60 | Seldom | Mild Anxiety (MI) |
| 1.00-1.80 | Never | No Anxiety (N) |

Table 2 also shows the five (5) statements that exhibit the highest mathematics anxiety in the group of students who experienced the Flipped Classroom. The statements are "I worry that I will not be able to get a good grade in my mathematics subject" (4.20), "I worry that I will not be able to do well on mathematics tests" (3.73), "I am afraid to give an incorrect answer during my mathematics class" (3.51), "I worry I will not be able to understand mathematics" (3.38), and "I worry that I will not be able to learn well in my mathematics subject" (3.38).

For those students who experienced the Non-Flipped Classroom, they tallied the five (5) highest means for these six (6) statements; "I worry that I will not be able to get a good grade in my mathematics subject" (4.34), "I worry that I will not be able to do well on mathematics tests" (4.18), "I get nervous when taking a mathematics test" (3.91), "I am afraid to give an incorrect answer during my mathematics class" (3.77), and "I worry I will not be able to understand mathematics" and "I worry that I will not be able a "line of 9 grade" in my mathematics subject" (both 3.61).

The results exemplified the fact that in the group that undergone the Flipped classroom, the students in it experienced lower anxiety levels than those undergone the Non-Flipped classroom. More responses fell under the "Sometimes" description for the Flipped group being interpreted as "Moderate Anxiety". This means that the Flipped Classroom might have increased positive interaction and opportunities that made the students feel less anxious and worrisome on mathematics effect. Pagtulon-an and Tan (2018) supported this in their study when they found out that students feel more confident in what they do if they are engaged in a regular practice and study.

Of course, still, there are three statements that fell in the "often" interpreted as "high anxiety, but what is commendable is the absence of a "usually" description on a

statement that can be interpreted as "severe anxiety". This means that even if anxiety still presents itself in the mathematics learning, students not worry too much. Students seemed to be more confident and not focusing on the ability of Mathematics to instill fear. Recognizably, the weighted means of the two different groups, as shown in Table 2, detected both "sometimes", 3.15 for the Flipped Classroom while 3.37 for Non-Flipped Classroom, which can be both interpreted as "moderate anxiety.

What is amazing to this data is the fact that the level of mathematics anxiety recorded by the students under the implementation of the Flipped Classroom is lower than that of the Non-Flipped group. This is due to the structure of the Flipped Classroom that gave the students enough preparation outside and before the class. Fear on the upcoming tests, oral recitations or even in asking and answering questions in class are being cared of and slowly diminishing because of the availability of the instruction done outside the class. This may be further supported by Table 3 below.

**Table 3:** Summary of Students' Level of Mathematics Anxiety

| | **Group** | | | |
|---|---|---|---|---|
| **Mathematics Anxiety** | **Flipped Class** | | **Non-Flipped Class** | |
| **Description *(Interpretation)*** | **Before** | **After** | **Before** | **After** |
| Usually *(Severe Anxiety)* | 1 | 0 | 1 | 1 |
| Often *(High Anxiety)* | 6 | 3 | 6 | 6 |
| Sometimes *(Moderate Anxiety)* | 6 | 9 | 7 | 7 |
| Seldom *(Mild Anxiety)* | 2 | 3 | 1 | 1 |
| Never *(No Anxiety)* | 0 | 0 | 0 | 0 |

The levels of students' mathematics anxiety for those exposed to Flipped Classroom concentrated on the center, the "moderate anxiety" portion, after its implementation. This means that students became more assertive when it comes to their fears in learning Mathematics which also includes the result of learning to which they fear more before the implementation. The comparison to the Non-Flipped group is clearly observable as the result of the levels of students mathematics anxiety for those under the Non-Flipped Classroom is virtually the same as it was before.

The "usually" description that is interpreted as "severe anxiety" for both groups before the intervention is on the statement "I worry that I will not be able to get a good grade in my Mathematics subject", 4.27 for Flipped Classroom group while 4.24 for Non-Flipped Classroom group. But after the implementation, this statement only received "often" interpreted as "high anxiety" with weighted mean 4.20 for the Flipped Classroom group while being retained in the "usually" description with weighted mean 4.34 for the Non-Flipped Classroom. This is a clear indication that students who undergone the Flipped Class are not that worrisome anymore about getting good grades since they are now more equipped in the Flipped structure. While for the Non-Flipped Class, the mean actually rose up and stayed up in the "severe anxiety". This means they were not able to experience opportunities to feel prepared and to learn enough to not to fear getting "not-so-good" grades.

### 5.2 Students' Mathematics Performance in Flipped and Non-Flipped Classrooms

Table 4 displays the distributed performance of the students in the two randomly selected groups, the Flipped and the Non-Flipped Classrooms, during the pretest. This also illustrates the number of students that were classified according to the degree of their performance when their Pretest scores are examined against the approved Revised Transmutation Table used in CMULHS, and the corresponding relative frequencies.

**Table 4:** Students' Levels of Mathematics Performance in the Pretest

| Range | Level of Proficiency | Group | | | | Qualitative Interpretation |
|---|---|---|---|---|---|---|
| | | Flipped Class n=45 | | Non-Flipped n=45 | | |
| | | f | % | f | % | |
| 94%-100% | Exemplary | 0 | 0% | 0 | 0% | Very High Performance |
| 88%-93% | Above Average | 0 | 0% | 0 | 0% | High Performance |
| 82%-87% | Average | 0 | 0% | 0 | 0% | Moderate Performance |
| 75%-81% | Below Average | 1 | 2.22% | 1 | 2.22% | Low Performance |
| 65%-74% | Deficient | 44 | 97.78% | 44 | 97.78% | Very Low Performance |
| Mean Score/MPS | | 19.60 | 72.00% | 19.82 | 72.00% | |

Here, it can be observed that the performance of the two groups are similar in terms of the number of students classified with the level of proficiency and degree of mathematics accomplishment. In the group that was assigned randomly to be placed under the implementation of the Flipped Classroom, only one (1) student or 2.22% of the class was classified with "below average" level of proficiency that can be further interpreted to be of low performance. The rest of that group, with 44 students or the 97.78% of the class, fell within the level classification of "deficient" which is equivalent to very low performance.

The group placed under the implementation of a Non-Flipped Classroom recorded the same number of scores and proficiency classification with the first group, the Flipped Classroom group. For both groups, observably, no score reached an equivalent that can be interpreted as "moderate performance" nor even higher than that.

Aside from the percentage and distribution of performance, the pretest score performance of the students, for the group of students randomly selected to be the Flipped Classroom group, the recorded mean score is 19.60 which is equivalent to 72% and interpreted as "deficient". The mean score of the Non-Flipped Classroom group is virtually the same. They got a mean score of 19.82. This is equivalent to 72% and identified as also "deficient". Both groups are, in overall, in very low performance and can be said to be of the similar level.

This finding is in parallel to the results of Catli (2016). The trend, in terms of students' mathematics performance, during pre-tests, is low since students do not have the foundation yet on what the topics and the mathematical concepts are. It is also the reason for the overall performance of each group. Though one in each group reached

the next level of proficiency, generally, the results showed the lack of prior understanding for all students.

The distribution of the students' mathematics performance presented in Table 5 is the results of the posttest for both groups. The table contains the frequency and percentage of students that were classified in varying degrees of proficiency and performance through the use of the transmuted grades of their scores in the Revised Transmutation Table of CMULHS. Also included is the improved mean score of each group and the corresponding percentage equivalent.

**Table 5:** Students' Levels of Mathematics Performance in the Post-Test

| Range | Level of Proficiency | Group | | | | Qualitative Interpretation |
|---|---|---|---|---|---|---|
| | | Flipped Class n=45 | | Non-Flipped n=45 | | |
| | | f | % | f | % | |
| 94%-100% | Exemplary | 4 | 8.89% | 8 | 17.78% | Very High Performance |
| 88%-93% | Above Average | 4 | 8.89% | 8 | 17.78% | High Performance |
| 82%-87% | Average | 8 | 17.78% | 14 | 31.11% | Moderate Performance |
| 75%-81% | Below Average | 10 | 22.22% | 11 | 24.44% | Low Performance |
| 65%-74% | Deficient | 19 | 42.22% | 4 | 8.89% | Very Low Performance |
| Mean Score/MPS | | 33.40 | 78.00% | 40.20 | 85.00% | |

The number of students with posttest score equivalents varied apparently between the two groups that undergone the presence or absence of a Flipped Classroom. This means that there are observable improvement in the performance of the students in both groups.

The overall performance of the Non-Flipped Classroom, 40.20 or 85.00%, is far better than the overall performance of the Flipped Classroom group, 33.40 or 78.00%. The respective interpretations were also different from each other. The Flipped Classroom group recorded a "low performance" while the Non-Flipped Classroom group exhibited a "moderate performance".

These results are similar to what Ciubal-Fulgencio and Tan (2018) declared that when different styles or method of instruction are implemented, varying levels of learning are recorded. However, in this case, it is witnessed that the massive change in the performance of the students from the pre-test to the posttest belonged to the group without the implementation of the Flipped Classroom. Few of the things that may be factors of this are the new style of discussion the students were not expecting to. Nevertheless, it can be observed that there is still improvement on the mathematics performance of the students under the Flipped Classroom. This is due to the opportunities for the students to be engaged in class and even outside the class. Bersano (2016) supported that students encounter meaningful learning experiences if they are engaged in the learning activity.

Sixteen (16) days after the posttest was the implementation of a retention test to measure the ability of the students in each group to retain information and probable

improvement of performance. The scores and all necessary information such as percentage and classification are presented in Table 6.

**Table 6:** Students' Levels of Mathematics Performance in the Retention Test

| Range | Level of Proficiency | Group | | | | Qualitative Interpretation |
|---|---|---|---|---|---|---|
| | | Flipped Class n=45 | | Non-Flipped n=45 | | |
| | | f | % | f | % | |
| 94%-100% | Exemplary | 9 | 20.00% | 7 | 15.56% | Very High Performance |
| 88%-93% | Above Average | 4 | 8.89% | 14 | 31.11% | High Performance |
| 82%-87% | Average | 12 | 26.67% | 13 | 28.89% | Moderate Performance |
| 75%-81% | Below Average | 11 | 24.44% | 10 | 22.22% | Low Performance |
| 65%-74% | Deficient | 9 | 20.00% | 1 | 2.22% | Very Low Performance |
| Mean Score/MPS | | 38.00 | 83.00% | 41.38 | 86.00% | |

In the retention test, the number of reclassified performance increased. The two groups exemplified improvements in their performance, specifically, the Flipped Classroom group. This group reached the moderate level of performance from just having "low performance" in the posttest. This means that with the implementation of the Flipped Classroom, students' retention scores improved much that it was not that observable during the posttest but very obvious now during the retention test. Honor as cited by Villaver (2014) viewed this as possible as long as positive classroom environment and interactive teaching approaches are employed. The realization of a Flipped style of classroom instruction paved way to healthy exchange of ideas inside the class, guided instruction and preparedness before the instruction time. This might be a great factor why retention, for the Flipped Classroom, was maximized, not to mention, the free and available use of instructional materials even after the instruction. The Non-Flipped Classroom, similarly, also showed great improvement in the overall performance.

The overall mean scores of both groups are now noticeably closer than it was during the posttest, with just 3.00% difference on the overall equivalent grades. Further comparisons of the recorded performances of both groups during posttest and retention test are shown in Table 7.

**Table 7:** Summary Comparison of Students' Mathematics Performance

| Mathematics Performance *(Interpretation)* | Group | | | | | |
|---|---|---|---|---|---|---|
| | Flipped Class | | | Non-Flipped Class | | |
| | Pre-Test | Post-test | Retention Test | Pre-Test | Post-test | Retention Test |
| Exemplary *(Very High Performance)* | 0 | 4 | 9 | 0 | 8 | 7 |
| Above Average *(High Performance)* | 0 | 4 | 4 | 0 | 8 | 14 |
| Average | 0 | 8 | 12 | 0 | 14 | 13 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *(Moderate Performance)* | | | | | | |
| Below Average *(Low Performance)* | 1 | 10 | 11 | 1 | 11 | 10 |
| Deficient *(Very Low Performance)* | 44 | 19 | 9 | 44 | 4 | 1 |
| Mean Score | 19.60 | 33.40 | 38.00 | 19.82 | 40.20 | 41.38 |

Looking at the data of Table 7 thoroughly, it can be recognized that as the time progressed on the implementation of the Flipped Classroom, the students in that group fundamentally improved as more students rose up in higher performance range scale. In addition, the overall performance also gradually increased. This is also true for the Non-Flipped Classroom group. However, from the posttest to pretest, there was meaningful difference in the experimental Flipped Classroom group, from 33.40 to 38.00 (4.60), than in the control Non-Flipped Classroom group, from 40.20 to 41.38 (1.18). This is in support by the analysis of Minao (2013) and Temur (2007) as cited by Catli (2016) where academic achievement of the students in the experimental group are more meaningful in their favor.

### 5.3 Comparison of Students' Mathematics Anxiety between Flipped and Non-Flipped Classrooms

The next tables reflect the comparison of mathematics anxiety levels of the students belonged in the two different randomly chosen groups. Table 8contains the necessary descriptive statistics such as mean score and standard deviation while Table 9 contains information with regards to whether the measured difference is significant enough or to decide not to reject the hypothesis put forward by the researcher.

**Table 8:** Comparison of Students' Anxiety Levels in the Post-Test

| Group | N | Mean | SD |
|---|---|---|---|
| Flipped Class | 45 | 3.147 | 0.651 |
| Non-Flipped Class | 45 | 3.374 | 0.654 |
| Total | 90 | 3.260 | 0.659 |

**Table 9:** Analysis of Covariance (ANCOVA) of Anxiety Posttest Scores

| Source | SS | df | MS | F-value | Sig. |
|---|---|---|---|---|---|
| Group | 1.375 | 1 | 1.375 | 5.185 | 0.025** |
| Pre-test (Covariate) | 14.415 | 1 | 14.415 | 54.369 | 0.000 |
| Error | 23.066 | 87 | 0.265 | | |
| Total | 995.397 | 90 | | | |

Note: ** – significant at 0.05 level

The mean scores of the responses between the two groups are almost similar to one another. However, the students in the Flipped Classroom showed a lower mathematics anxiety value of 3.147 with dispersion of 0.651 than the students in the Non-Flipped Classroom with a mathematics anxiety value of 3.374 and a dispersion value of 0.654. A lower mathematics anxiety value recorded by the experimental group means that students under the implementation of the Flipped Classroom became less anxious, afraid and worrisome on what Mathematics is, what mathematics tasks are, what mathematics could give and create for them and even on what mathematics instruction and preparations are. Shannon (2008) supported this concept of utilization of hands-on exercises and frequent interaction that made the students feel a low-anxiety atmosphere. This may be due to the fact that students were given enough time to prepare outside the class through 'off-the-class' instructional videos and more interaction inside the class as mentioned by (Szparagowski, 2014).

Furthermore, the said 'upper hand' of the experimental Flipped Classroom to the Non-Flipped Classroom is further proven significant as presented in Table 9. The computed probability value for the difference of the mathematics anxiety mean scores is 0.025 ($p<0.05$). This means that the overall mathematics anxiety of the group with the implementation of the Flipped Classroom is significantly lower than that of the Non-Flipped Classroom group. With this, the null hypothesis which talked on having no significant difference between the two groups is rejected.

This showed that the use of a Flipped Classroom improves and regulates anxiety during a Mathematics instruction and even after that. This is rather a contradiction to Bersano's (2016) results that students were still very anxious after solving mathematics problems. Flipped Classroom's design of classroom instruction proved beneficial in creating an atmosphere where students feel positive towards mathematics classes and Mathematics as a whole.

One student said that mathematics 'became easier to be understood'. This is, for that student, due to the influence of the instructional videos that made them more prepared than the usual instruction. Classroom activities were also became more interesting to do because students feel that they are doing and learning it with a group and with the instant help of the researcher whenever they need them. Few students even discoursed that they became more excited on what the next mathematics concepts are and how are these explained in the videos. They were also became ecstatic to always attend classes because of the new flow of instruction and interaction. These findings are supported by Mutodi (2014). The best way to reduce anxiety now is on the application of teaching methods which are focused on student directed classes, on more discussions and on less lecture. Flipped Classroom addressed these concerns due to catering of healthy competition and tension during the class as proven by a remarkable difference of its mathematics anxiety mean score.

### 5.5 Comparison of Students' Mathematics Performance between Flipped and Non-Flipped Classrooms

Tables 10 and 11 show the comparison of mathematics performance between the Flipped Classroom group and the Non-Flipped Classroom group. The following tables present the mean performance of the respective groups laid against the approved Revised Transmutation Table of CMULHS and whether the differences on them are considered to be significant. As such, the researcher will be able to reject or not the second hypothesis of this study.

**Table 10:** Comparison of Students' Mathematics Performance in the Post-Test

| Group | N | Mean | SD |
|---|---|---|---|
| Flipped Class | 45 | 79.733 | 7.539 |
| Non-Flipped Class | 45 | 85.178 | 6.985 |
| Total | 90 | 82.456 | 7.727 |

**Table 11:** Analysis of Covariance (ANCOVA) of Performance Posttest Scores

| Source | SS | df | MS | F-value | Sig. |
|---|---|---|---|---|---|
| Group | 648.885 | 1 | 648.885 | 13.394 | 0.000** |
| Pre-test (Covariate) | 432.672 | 1 | 432.672 | 8.931 | 0.004 |
| Error | 4214.706 | 87 | 48.445 | | |
| Total | 617217.000 | 90 | | | |

Note: ** – significant at 0.05 level

Flipped Classroom documented a mean performance of 79.733% with a standard deviation of 7.539. On the other hand, the Non-Flipped Classroom detailed a mean performance of 85.178% with a standard deviation of 6.985. There is a clear distinction between the performances of both groups in the posttest. Though the performance of the Flipped Classroom improved from that of their pre-test results, it was recorded that the performance of the group under the Non-Flipped Classroom are better than the performance of the students in the Flipped Classroom. Sparks (2013) shared the same sentiments after the conduct of the Flipped Classroom. He mentioned that although flipping does work for some students, increase in learning does not necessarily appear in all of the students. These may be possible to students' lack of participation to the instruction done outside the classroom. Some students under the Flipped Classroom, during the first sessions, were not able to experience enough time and resources in the 'outside-the-classroom' instruction as much as what is expected to them. The Flipped Classroom though, in this study, were given opportunities to be prepared enough before the discussion.

The utilization of Flipped classroom was still very positive because the two groups were incomparable in the beginning of the intervention as indicated in the significant pretest (covariate). However, the teacher-researcher noticed a positive attitude of the students in the experimental group who happened to be the low performing group during the conduct of the study. Levy et. al. (2011) also pointed out that one factor that may affect the implementation of the Flipped Classroom is the

quality of time the students use in outside instruction. Where there may still be improvements, it just doesn't work to the whole group.

This finding is supported by the probability value of the comparison in Table 11. The computed p-value was 0.000 ($p<0.05$) which means that there is significant difference and the hypothesis of no difference is rejected in favor of the control group, the Non-Flipped Classroom group. It seemed that the students under the Non-Flipped showed great improvement in their performance. This may be a product of familiarity of the lecture-discussion flow inside the class and the assignment method done outside the class that students are already use to. Flipped Classroom, during this time, failed to show comparable, if not significant, performance to the group of no implementation. A factor maybe for this result is the fact that the randomly selected group that experienced the Flipped Classroom is students who were CMU BOR-approved non-qualifiers while the randomly selected group that experienced the Non-Flipped Classroom are students who were ULHSAT qualifiers.

Nevertheless, the measure of dispersion recorded by the students of the Flipped Classroom (7.539) is large enough to say that some scores of performance are higher than the mean. This means that even if the overall performance is low, some students did well under the Flipped Classroom. These students are those students who, in the first sessions, did what was expected for them to do.

**Table 12:** Comparison of Students' Mathematics Performance in the Retention

| Group | N | Mean | SD |
|---|---|---|---|
| Flipped Class | 45 | 83.267 | 8.291 |
| Non-Flipped Class | 45 | 86.311 | 6.557 |
| TOTAL | 90 | 84.789 | 7.588 |

**Table 13:** Analysis of Covariance (ANCOVA) of Performance Retention Scores

| Source | SS | df | MS | F-value | Sig. |
|---|---|---|---|---|---|
| Group | 200.863 | 1 | 200.863 | 3.474 | $0.056^{ns}$ |
| Pre-test (Covariate) | 252.989 | 1 | 252.989 | 4.720 | 0.033 |
| Error | 4663.455 | 87 | 53.603 | | |
| Total | 652149.000 | 90 | | | |

Note: ns – not significant at 0.05 level

Flipped Classroom's performance in the retention test reached a mean equivalent of 83.267% with a standard deviation of 8.291. The Non-Flipped Classroom, on the other hand, still logged a high mean equivalent of 86.311 and a standard deviation of 6.557. This shows that after sixteen (16) days, students in both groups retained important information of the mathematics concept taught in class as shown in Table 12. But in this case, the highlight goes to the Flipped Classroom. Notice that the performance of the students who were part of the Flipped Classroom is high enough to say that the Flipped Classroom helped in the retention of the students. Marlowe (2012) also observed similar changes the students' performance. The low performing students increased their semester grades and this was due to opportunities given to the students. These

opportunities that are present in the Flipped Classroom are the instructional videos given to be viewed outside and prior to the classroom instruction schedule, healthy exchange of ideas during the classroom instruction schedule, more student interaction due to already identified and learned mathematical concepts, and activities done inside the class. These are in contrary to the structure of the Non-Flipped Classroom where the discussion is done during the classroom instruction schedule, where the sole dispenser of information is the teacher, where mathematical concepts are new to the students and where an activity is given to be done outside the class in the form of assignments or home works.

Another great factor for the improvement of performance is also the presence of instructional videos. Retention became more possible because of the way the students learned the mathematics concepts. In comparison to the Non-Flipped Classroom where students learn concepts through lecture-discussions, the Flipped Classroom students learned them through viewing and understanding concepts with the aid of technology and supplemented by activities inside the class that caters more interaction. Kharmann (2016) even discussed that students appreciate the discussion more if delivered properly through video tutorials and discussions. Similar to what Catli (2016) discussed that conceptual retention is being enhanced with the integration of technology.

Flipped Classroom became comparable in nature with the Non-Flipped Classroom.

Table 13 depicted a probability value of 0.056 ($p>0.05$) that is considered as a non-significant value and thus, failing to reject the null hypothesis. This means that the Flipped Classroom (83.267) performed statistically comparable to the Non-Flipped Classroom (86.311) in terms of their retention scores. Further, this may be interpreted that regardless of the presence or absence of the Flipped Classroom, knowledge retention exists. But the amazing thing here is the improvement brought by the Flipped Classroom from their posttest to retention test scores recorded in the previous Table 7.

This means that the implementation of the Flipped Classroom do not necessarily worsen the mathematics performance of the students nor drastically improve it. Just like what Szparagowski (2014) mentioned that it does not necessarily show that the students under the Flipped Classroom will do far better than that of the students under Non-Flipped Classroom. But still, Flipped Classroom has the potential to increase retention ability of those low performing students as a result of these investigation.

## 6. Conclusions and Recommendations

Based on the findings of this study, the following conclusions are made:

Mathematics performance of the students under the Flipped Classroom during the pretest, posttest and retention test are very low performance, low performance and moderate performance, respectively. On the other hand, the mathematics performance of the students under the Non-Flipped Classroom are very low performance, moderate performance and moderate performance for the pretest, posttest and retention test, respectively.

The mathematics anxiety of the students in the pretest for both under the Flipped Classroom and Non-Flipped Classroom is moderate. Similarly, in the posttest, both classrooms recorded moderate anxiety.

The difference in the mathematics performance of the students on the posttest is significant in favor of the Non-Flipped Classroom. However, in the retention test, there is no significant difference on the mathematics performance of the students between the two groups. The resulted mathematics performance for both groups became comparable.

As for the difference on the mathematics anxiety of the two groups, the results showed to be statistically significant. The mathematics anxiety of the students in the posttest is significant in favor of the Flipped Classroom.

Based on the summary of findings and conclusions of the study, the following recommendations are specified. Included in this portion are recommendations for researchers interested on the application of the Flipped Classroom in other classroom settings.

Mathematics teachers may use the necessary and available technology to enhance learning. Teachers may also consider the concept of having prepared instructions done outside the class schedule. Teachers are encouraged to refrain from using home based activities like assignments as a final summary of the previous lesson, but rather, to use them as an introduction and pre-discussion of the next lesson. Mathematics teachers are also challenged to learn making interactive instructional videos and to create online portals which can be used as e-classrooms. The researcher also recommends future researches on the application of the Flipped Classroom on other mathematics subjects and competencies. Also, since the respondents of this study are Grade 7 students that can be classified as 'adjusting' high school students, the researcher also recommends a study of a Flipped Classroom on more matured high school students, preferably Grade 9 or Grade 10 students.

Mathematics educators are encouraged to apply the Flipped Classroom model in class improve the students anxiety level and create more meaningful and healthy exchange of ideas inside the class. In connection to this, teachers are encouraged to prepare plenty of activities inside the class and maximize the class with interaction rather than pure lecture-discussion. The time outside will also be used for learning rather than just giving activities through assignments that are not necessarily teacher-guided and feedback-oriented. For future researches, more mathematics anxiety statements may be considered as well, more probably on the anxiety towards learning mathematics with the use of technology. With this, the application of the Flipped Classroom through instructional videos will be part of the anxiety questionnaire.

For the future researchers who are interested in the Flipped Classroom, the inclusion on the level of computer or technology-related literacy of the students may be considered. This is to provide better comparison on the mathematics performance of the students. Longer duration or more sessions are also recommended to provide a better baseline on the retention capability of the students.

Flipped Classroom can be utilized for classroom situations where students are showing signs of high anxiety. For future researches, a third mathematics anxiety measurement, probably to be scheduled during with the retention test of the mathematics performance will be conducted. This is to measure the extent of the effectiveness of the Flipped Classroom in improving mathematics anxiety.

Teachers, administrators and other curriculum makers are encouraged to embed the Flipped Classroom model in the curriculum guide and course syllabi in at least one grading period. Administrators are advised to provide an improved school e-learning site or e-library that students can use to access instructional videos posted by their instructors on selected online learning sites. It is also recommended that teachers will be given trainings and opportunities to develop video making skills and online portal system applications. For future studies, other learning systems where the instructional videos are also recommended, preferably, offline systems so that students can still access them even without the internet. In addition, mobile learning with the use of students' mobile phones must also be considered as a medium of instruction outside the class.

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