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Flipped Learning Approach: Mathematics Learning Achievement, Attitudes, and Self-Regulation

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ABSTRACT

As a response to the advancement in modern technology, teaching techniques have also evolved over the years. That is why teachers adapted to these changes and tried to use more novel approaches to enhance the way students acquire information, learn, and meet their needs. One of these innovations and teaching trends is the flipped learning approach. The new lesson is implemented using this instructional approach, which requires students to watch videos at home for their lesson and complete their homework in class the next day, with the teacher facilitating and encouraging his or her students individually. Thus, this study was conducted with the general objective of determining the effectiveness of using the flipped learning approach in teaching mathematics and its effects on mathematics learning achievement, students' attitude, and level of self-regulation. A pre-test – post-test quasi-experimental research design was used in this research. Data collection tools such as the researcher-made mathematics achievement test, "Attitudes Towards Mathematics Checklist," and "Academic Self-regulated Learning Scale" were administered to the two groups of grade-12 senior high school students who served as the experimental and the control groups as the basis of comparison. Results revealed that employing flipped learning as an approach to teaching mathematics positively affects students' mathematics learning achievement. It also impacts students' attitudes towards mathematics favorably and has also been proven to increase self-regulation levels. The T-test results revealed a significant difference between the post-test results of the control and experimental groups. It implies that the post-test scores of the students exposed to the flipped learning approach increased significantly. It also means that the experimental group is performing better as compared to the control group.

1. Introduction

"Digital Natives" are the individuals born, reliant, and become most comfortable in this modern era of technology. These drastic changes have influenced these individuals in technology, such as instantaneous and multi-tasking devices like laptops, smartphones, iPods, computers, and the like. The ubiquity of these devices also influences the way people acquire and access information and how people communicate, from direct human-to-human forms to higher-tech on-screen and online platforms.

McNutt (2013) argues that this prevalence of technology impacts how people relate to one another and how students learn. He also added that since teenagers spend an increasing amount of time daily engaging with audio, visual, and textual knowledge through television, video games, and computer technology, it is prudent for teachers to use these communication technologies to help their students.

Teaching methods have developed over time as a result of this revolution in digital technology. As a result, teachers have adjusted to these changes and attempted to use more innovative ways to improve how students absorb knowledge, learn, and meet their needs. With the consideration of individual learners' varied needs, several different teaching methods have been tested, and they have shown promise in helping students improve learning in the classroom.

One of these innovations and teaching trends is the flipped learning approach. Students are given initial information in the flipped classroom outside the school, reversing the conventional and teacher-driven learning framework and using class time to develop their knowledge base by having a more student-centered approach (Bergmann & Sams, 2012). In this instructional approach, the new lesson is introduced by requiring students to watch videos at home for their lesson and complete their homework in class the following day, with the teacher facilitating and supporting his/her students individually. Though some research documented the benefits and effectiveness of using the flipped learning approach, some researchers noted some drawbacks and contradicting data using the flipped learning approach. As reported by Godwin (2013), there is no theoretical basis for studies on how well-flipped classrooms perform to date.

With this information, this work aims to contribute to the body of information, helping to provide evidence and examine how well students are learning by determining the effectiveness of the flipped learning approach and its effect on students' learning achievement, attitudes, and self-regulation.

The study's findings are of great help to the learners who are the primary recipients of this innovative instruction. As the implementer of this significant change in classroom instruction, teachers can also modify their approaches for more constructive and meaningful contributions in teaching the subject. The data presented in this study may give them the idea to venture into new trends in teaching by employing a student-centered method and having the willingness to develop lifelong learners with strong critical thinking skills, such as analyzing problems and applying previously learned material to solve problems with the use of technology. Moreover, the outcomes of this study can provide the school curriculum planners, information on innovations in the teaching approaches by looking into the present scope of mathematics, improving the curricular content, and applying the flipped learning approach as an intervention in teaching mathematics in the school curriculum for the improvement of classroom instruction and in enhancing the learning of 21st-century learners. The parents being stakeholders in education, can be benefitted from this study by providing them with sufficient data that will let them see the breakthrough of such advancement in the teaching-learning instruction that assures a high standard and quality learning experience for their children.

The main thrust of this study was to determine the effectiveness of using Flipped Learning Approach in teaching the topics Fundamental Counting Principle, Permutation, and Combination to the grade twelve Senior High School students at Bohol Wisdom School for the first semester of the academic year 2019 – 2020.

Specifically, the following questions were the focus of this study:

1.What is the demographic profile of the respondents in the control group who are exposed to the teacher-directed approach and experimental group who are exposed to the flipped learning approach in terms of:

- 1.1 pre-test and post-test scores on the mathematics learning achievement.
- 1.2 attitude;
- 1.3 level of self-regulation?

2. Is there a mean gain difference in the pre-test and post-test scores of the students in the control and experimental groups?

3. Is there a significant difference between the results of the students in the control and experimental group in terms of:

- 3.1 mathematics learning achievement;
- 3.2 mean gain from the pre-test and post-test;
- 3.3 attitude;
- 3.4 level of self-regulation?

2. Literature Review

This study is anchored on engagement theory. It is a framework designed and developed by Kearsley &Schneiderman (1999) for technology-based teaching and learning. It is also based on creating successful collaborative teams as students engage in their course work to make effective learning meaningful to someone outside the classroom. In conformity with the theory, students must be actively involved in meaningful activities, using valuable tasks and interacting with others.

Meaningful activities generally activate students' cognitive process, namely problem solving, creating, evaluating, reasoning, and decision making. It will then lead to learners taking ownership of their learning that fosters creativity, significance, and authenticity as they construct new knowledge from their experiences. The students participate actively and connect with the learning content, learning tasks, and the learning environment.

The theory of engagement is based on building effective collaborative teams working on essential projects outside the classroom. Its basic tenets are summarized as "relate," which highlights characteristics such as communication and social skills involved in team effort; "create," which considers learning as a creative, purposeful activity; and "donate," which encourages learners to align their learning with a broader engagement in the community (Kearsley & Schneiderman, 1999).

According to Gunuc and Kuzu (2014), class interaction necessitates students' cognitive, emotional, and behavioral responses to both in- and out-of-class events. Cognitive engagement applies to students who participate in their learning, assess their needs accordingly, and appreciate mental challenges, including learning commitment, learning interest, learning goals, self-regulation, and preparation. It has a significant relationship with the ability to learn. Emotional engagement includes the students' reactions to their teacher, peers, the course content, and the class, including behaviors, preferences and beliefs, and the sense of belonging to a group. At the same time, Behavioral engagement includes the involvement of students in academics, their actions, their class attendance, and their class involvement. Hence, in this study, the students' mathematics achievement represents cognitive engagement and emotional engagement, while self-regulation represents behavioral engagement.

Another theory that supports this study is the academic self-regulated learning theory of Barry J. Zimmerman (1986). Dr. Zimmerman characterized self-regulation as learners' beliefs about their desire to respond to inappropriate actions, thoughts, feelings, and behaviors to pursue worthwhile academic goals while monitoring and self-reflecting on their progress towards achieving a goal (Zimmerman, 2000).

The theory embodies strategies utilized by the learners in the different learning contexts of the self-regulation process. These techniques (Zimmerman & Martinez -Pons, 1986) were defined as follows: (1) self-evaluation refers to the ability of learners to evaluate or assess the progress of the quality of their learning outcomes; (2) organizing and transforming pertains to the efforts of students to restructure their study materials or paraphernalia to aid them in learning and enhances their academic performance; (3) goal-setting and planning indicate the learner's ability to set academic plans necessary for timing, sequencing and planning for achieving the academic tasks; (4) seeking information relates to efforts done by students to provide additional information from library resources, printed materials and internet or online sources in accomplishing an assignment; (5) keeping records and monitoring means the capacity of students to list down results, accomplishments, and any related events. Furthermore, (6) self-consequences refer to students' imagination or arrangement of punishments or rewards for failure or success; (8) rehearsing and memorizing refers to students' need to remember and rehearse learning lessons through repetition and continuous practice; and finding social assistance refers to students' propensity to seek help from (9) peers and (10) teachers, and (11) adults. Reviewing records exhibits the students' competence to reread (12) notes, (13) textbooks, or (14) tests as well as to browse from online sources in preparation for the class; and (15) others which include the learning strategies of the students that are elicited from siblings, parents, teachers or peers, and all other isolated strategies. These mentioned strategies utilized by self-regulated learners will be considered in this research to determine whether the flipped learning approach affects students' self-regulation.

In the study conducted by Effeney et al. (2013), students with high academic performance tend to be more self-regulated, using more self-regulated strategies than their peers with lower academic performance. Besides, these learners employ learning strategies that are more self-directed and self-reliant, making them capable of becoming independent learners who do not involve more capable learners. However, learners with low self-regulation tend to have lower academic performance. They use strategies that associate with seeking and asking for social assistance from their peers.

Similarly, Dix (2009) described self-regulated learners as individuals who can persevere amidst difficulty solving problems or face challenges as they learn. Zimmerman & Kitsantas (2005) characterized high self-regulated students as individuals who can focus on their studies, control their learning, set goals and plan in advance to obtain high scores in exams, and use strategies to recall instructions previously learned. They are conscious of when they do not know a fact or have a skill. Compared to their passive classmates, students with a high level of self-regulation actively seek out information when needed and take responsibility for their mastery. When confronted with obstacles such as poor learning conditions, they are confused due to teachers' lessons and instructions; they encounter difficulty comprehending textbooks and other learning materials, self-regulated learners always find a way to succeed.

The findings of Magno et al. (2012) presented that self-regulation and learning strategies build on the achievement skills of students to become effective even in a short period. Valle et al. (2008) have shown a statistically significant positive correlation between self-regulated process and achievement in mathematics and that high levels of self-regulation follow high academic achievement and vice versa. Hence, self-regulation is an effective indicator of quality learning.

Several studies and research support the claim that the student's success in mathematics depends on the learners' attitude towards the subject. It is said that this attitude is the deciding factor of their performance, willingness to learn, choice of action,

and response to challenges. Andamon & Tan (2018) described the attitude as values, feelings, which encompasses emotions and behaviors that would affect how individuals think, act, behave, and its consequences for teaching and learning are significant.
Mullis et al. (2001) also exposed that attitudes determine their interest, level of engagement towards a given task, and personal effort in doing the task. Similarly, Veresova & Mala (2016) stated that the students' achievement gets better if the students' attitudes towards the subject and school are positive.

Negative attitudes towards the subject result in bias and tendencies such as anxiety and fear. It would also result in non-productive practices that hinder the students from discovering Mathematics' richness and appreciate the value of the subject. Consequently, students tend to exhibit boredom, poor participation and engagement, less motivation, and behavioral problems such as class or lesson avoidance with this negative disposition. On the other hand, when students have these positive feelings and are focused on positive attitudes to the subject, they appear to be dynamic and interactive, would not easily give up when confronted with challenging tasks, and are more inspired to excel in the subject, as they appreciate, enjoy and care about the topic (Langat, 2015).

Since education is vital in the development and progress of a nation, it is but fitting and proper that those educators, administrators, curriculum planners, and all those involved in the education system must also answer this call. Three factors have been identified to exert influences on the learning of the students, namely: the teacher, the student, and the classroom. With the highest consideration that the teacher is the vital factor in the teaching-learning process, appropriate steps and proper selection of teaching strategies must be considered, making mathematics appealing, engaging, and relevant to the students.

The 1987 Philippine Constitution legally supports the importance of Science and Mathematics in primary education, Article II Section 17, which states that in order to cultivate patriotism and nationalism, stimulate social change, and encourage human growth in its entirety, the State shall give priority to education, science, and technology, the arts, culture, and sport.

It is further stipulated in Section 3, Paragraph 2 of the same Constitution, which stresses that critical and innovative thinking should be promoted by all educational institutions and science and technical expertise.

For how many decades have teachers used conventional lectures in the classroom. Students were introduced to new lessons or new content within the classroom and were given homework to reinforce what was discussed in class. In this case, whenever students had a problem with their homework, they will not complete their tasks and bring this to class the next day, left unanswered, and ask the teacher how to do it. The teacher will then check assignments in a class by discussing the answers on the given assignments while reviewing the lecture from the previous day while entertaining or covering questions from the homework.

As a result, several researchers have discovered several disadvantages to the conventional teaching style, according to Brame (2013). In addition to that, revealing information about modern student learning styles has been brought to the frontline of education. It leads teachers to move away from traditional teaching methods because students have changed from the passive students of previous generations to 21st-century learners who construct their learning from trial and error.
According to Brunsell & Horejsi (2013), students are required to listen to lectures and learn knowledge by taking notes in the conventional classroom, and it has been shown that this teaching method is ineffective, inefficient, and irrelevant to today's students.

That is why researchers and educators have chosen to design a curriculum in the classroom that will suit today's learners ' needs. One of those recent ideas in the field of education is using the flipped approach to learning.

While some of the basic ideas behind the flipped classroom have been around since 1990, Aaron Sams and Jonathan Bergmann, two Colorado high school chemistry teachers, popularized the flipped classroom in 2007. Sams and Bergmann started flipping their chemistry classes to respond to the problem that many students who came from far distances had to travel from home to school to attend the class and other school-related activities (Bergmann & Sams, 2012). They found out that, upon flipping their class, their students' test scores improved. With these results, they tried and started to publish their findings, posted their lectures online, and created a non-profit organization whose general objectives aim at helping other teachers flip through their classes. Upon receiving positive feedback from students and teachers, their website, flippedlearning.org, continues to grow in just a few years and has over 22,000 registered users who are active followers of Sams and Bergmann and employ flipped learning in their classroom.

The School Achievement Services of the Flipped Learning Network and Person established four foundations of successful flipped learning. F-L-I-P's four foundations are flexible environment, learning culture, intentional content, and professional educator Network, F. L. (2014).

The first pillar reflects learning environments that are dynamic and flexible. Educators have the goal of making their classroom instruction engaging, encouraging, and one that fosters collaboration. They are flexible in adjusting their classrooms by incorporating different strategies and methods such as working in groups, doing academic research, doing self-study, doing projects, and assessing.

Accordingly, flipped learning enhances these aspects in developing learning opportunities through maximizing classroom time since the topic has been introduced outside the classroom. With this scenario, learning objectives are attained and explored in greater depth with more classroom interactions with the teacher's supervision. Educators make the most of their time and one's most valuable element in classroom instruction by maximizing students' interaction among peers, active participation, and collaboration in testing students' understanding.

The second pillar, learning culture, introduces a paradigm change from teacher-centered to student-centered learning. It portrays a transition from learners as receivers of information and knowledge to explorers of knowledge, and instead of being the sole source of knowledge and sage on the stage, the teacher serves as a facilitator, mentor, and guide. It deviates from the usual practice that the teacher is the only content authority in the classroom that provides students with information. There is a purposeful change from a teacher-centered atmosphere to a student-centered classroom in the flipped learning model, where in-class time is dedicated to face-to-face classroom interactions, building connections among peers, and enhancing student engagement.

The third pillar is intentional content, which depicts a teacher's instructional decisions. Those decisions cover the concerns involving the contents to teach using videos and tools where students are allowed to discover and explore themselves. Network, F. L. (2014) stressed that flipped educators should use suitable learning content to maximize classroom time while employing different methods and strategies, including problem-based learning, peer learning, active learning strategies, and consideration of the corresponding grade level and subject matter content.

Lastly, the last pillar talks about professional educators. Considered the most important pillar, it highlights the significant role of educators in the flipped learning approach. A flipped educator, "less visibly prominent," has to be aware of the strategies and methods to maximize time with the learners. They are expected to assess when and what to change direct instruction to the individual student from the whole class.

In the book by Aaron Sams and Jonathan Bergmann, "Flip Your Classroom" (2012), they argue: there is no single, standard and correct way of flipping your class... flipping your class has something to do with a mindset: turning attention away from the educator and focusing on the learning process and the student. Every teacher who chooses to flip will do so differently.

This concept is not new, as teachers have long required students to complete their assignments before discussing the subject in class the next day. As Brame (2013) has stated, the acquisition of new knowledge can be obtained around an online video of the instructor's presentation on the material, researching websites approved for classroom use, or simply reading the material beforehand. It is where students have the opportunity to maximize classroom time to enhance and deepen the things they initially learned by answering the worksheets at school, doing investigation and laboratory experiments, collaborating in discussions and classroom debates, or doing higher thinking class projects. Bergmann and Sams (2012) characterize the flip classroom framework as follows: "what is conventionally completed in class is already done at home, and what has been customarily performed as assignments is already done in class."

In addition to that, they added that there were no single correct and exact ways to flip a class. It was confirmed by Nolan & Washington (2013), who also noted that there are several ways to fully or partially flip the classroom, with no one method being shown to be superior to another.

In a traditional flipped classroom, Sams and Bergmann (2012) explain, students arrive to class having watched an assigned video lecture the evening before entering the class. Class begins with a short question-and-answer session to allow students to clarify any confusion from the video assigned to them. Following this, students typically engage in a hands-on inquiry-based activity for the remainder of the class period while the teacher surveys the classroom and offers one-on-one support to students. This class structure then continues daily; the daily lesson is consistently delivered through video format, outside of school hours, and never through teacher-directed lessons. They believe that this method of restructured teaching allows for a better opportunity to assist

students with a problem or struggle with the lesson and allows for more vital class discussions with the teacher as the facilitator that gives immediate feedback and the class is focused on the students.

The flipped classroom provides a platform for Bergmann and Sams (2012) to incorporate online and face-to-face teaching, which leads to what is regarded as a "blended classroom." Aside from that, it challenges the role of teachers being facilitators, coaches, and mentors from being the source and disseminators of knowledge.

According to the Electronic Education Report [EER] (2011), teachers who used flipped learning have reported positive classroom results. They also observed that students are actively engaged and more hands-on by collaborating with their peers and teachers to solve problems. Educators also noticed that students started taking control of their learning with the help of the teacher who gives immediate feedback whenever students have questions and problems on the material instead of trying the homework and struggling to complete a task because of missing information and encountered difficulty along the way with no one guiding or facilitating them. With the flipped classroom, students, while viewing the supplementary materials such as videos at home, can pause to go back and rewind the lecture, find unanswered responses, and review unclear details. Bergmann and Sams (2012) also outlined some of the beneficial effects of the flipped classroom, including versatility, individualized attention, adjustments in the management of the classroom, transparency in the education of students where parents can supervise and access the content to monitor the education path and progress of the students.

The study conducted by Gaughan (2014) also supported the findings that the flipped classroom is a "success" as most students participated with enthusiasm and understanding in the class discourse. Another confirmation from the study of Ruddick (2012) shows improvements in the scores of the flipped class students compared to the scores of the students in a traditional classroom. He demonstrated that the average student scored higher in the flipped class and that the number of students scoring at or above the exam level was high.

Despite all those documented benefits to using the flipped classroom approach, some educators noted some drawbacks, and some data contradict each other in terms of using the flipped classroom. According to Ash (2012), using traditional lectures online rather than flipping the classroom did nothing to shift the learning for students.

Springen (2013) emphasized that students who showed apathy before employing the flipped classroom would be apathetic after flipping even when given more freedom in the educational approach. In the same way, Arnold-Garza (2014) and Nielsen (2012) observed negative views of the flipped classroom as they discover that many individuals consider the traditional classroom more than the flipped classroom. Goodwin and Miller (2013) also stated, "To date, there is no basis for scientific research to show exactly how well flipped classrooms are working."

Based on the related studies, it was found out that some related articles and publications employ the use of flipped classrooms in their teaching instructions, getting students' and teachers' perceptions about the approach. However, very little statistical evidence quantifies how much students learn from this teaching style, and some even contradict one another (Hamdan et al., 2013).

Thus, with the theories mentioned above on engagement and self-regulation, legal bases, and related studies that gave support to this work and served as the basis in the conduct of this study, this created a significant spark to the researcher's interest pursue this research. Therefore, this research aimed to signal pathways to the curriculum and provide evidence to evaluate how well students learn using the flipped approach to learning. Furthermore, it is pursued to identify if it affects the students' learning achievement, attitudes, and self-regulation.

3. Methodology

This study employed the pre-test – post-test quasi-experimental research design to assess the impact of the flipped learning approach on students' learning achievement, attitudes towards mathematics, and level of self-regulation. This design is a type of experimentation that determines whether an intervention has an intended effect on the research participants with similar characteristics and will enable the researcher to draw interpretations, come up with an analysis, and provide conclusions on how the flipped learning approach affects the variables under study.

Two groups were involved in the study. One section was assigned for experimental design, and another section was designated for the control group. The control group, Group A, was composed of one class of the research respondent. These students were exposed to the teacher-directed approach in teaching topics fundamental counting principle, permutation, and combination in their Statistics and Probability classes. Conventional instructional materials were used, such as visual aids, textbooks, and

exercises/skill-building activity worksheets. The teacher discussed the lessons, planned the activities, and directed the students to implement the exercises and other learning activities.

The experimental group, Group B, was composed of the other class of the research respondent. These students were exposed to the flipped learning approach in learning the same topics, fundamental counting principle, permutation, and combination in their Statistics and Probability classes. Lessons were introduced to integrate technology, such as supplementary materials specifically prepared videos, talking PowerPoint, and online websites to reflect on and go over before discussing the topic.

3.1 ***Research Participants***

A total of 67 students from two Grade 12 sections of Bohol Wisdom School Senior High School Department were the study participants. The researcher utilized the said class to control the teacher factor. Students were grouped in heterogeneous sectioning as declared by Bohol Wisdom School. Consideration was also noted into whether the control group and the experimental group had a significant difference in terms of their previous mathematics grade to check whether the two groups are comparable for the conduct of this research. The class showed no significant difference in their previous grades in mathematics, making the two groups similar for such study. Consideration was also considered in selecting the two sections based on the daily schedule and whether the class falls on a morning or an afternoon to control the environment variables aside from controlling the teacher factor. A tossed coin was done from the two sections to determine which class was the experimental and control groups.

3.2 Research Instruments

The study utilized the pre-test and post-test for the students' mathematics learning achievement, the attitude scale, and the academic self-regulated learning scale, which were given after the intervention was conducted.

1. Mathematics Learning Achievement Test.

A researcher-made questionnaire was utilized in this study. The pre-test and post-test results were the basis in determining the students' learning achievement in mathematics in the chosen topic under study. The preparation and validation of the test were as follows:

a. ***Planning the test***. The study made use of a researcher-made test that contained 30 items that were in multiple-choice format. The topics chosen were the fundamental counting principle, permutation, and combination, which are the prerequisite topics and skills needed in the Probability and Statistics class. The researcher used the Table of Specification, which served as a guide in the questionnaire. The test items were taken and selected from the mathematics teaching manuals of the DepEd. The questionnaire was subjected to review by mathematics teachers and presented to the research adviser for possible comments, suggestions, and enrichment.

b. ***Pilot Testing.*** The researcher-made test was subjected to pilot testing to other grades twelve classes that were not part of the control and experimental groups.

c. ***Item Analysis.*** An item analysis was conducted to analyze individual items on the test after the questionnaires were collected, gathered, and checked. The total number of students who have taken the said test was 100 in all. A reliability index of 0.78 was achieved by using Cronbach's alpha which signified that the results of the tests were reliable. Correct answers in each item were tallied and tested utilizing the difficulty and discrimination indices. Results came out that none of the items were to be rejected. For categorization of an item, the intersection of the difficulty and discriminating levels was utilized. The effectiveness of the distractors was also assessed using the options in each item, which have been classified as good, fair, or bad based on the comparison of the upper and lower groups. None of the items had a bad distractor.

2. Attitude Scale

The researcher borrowed an open-sourced instrument which is the attitude towards mathematics checklist of Prado (1995), in which the said attitude scale had a reliability coefficient equal to 0.82. When the attitudinaire was pilot tested on the students, it had a reliability index of 0.89 using Cronbach's alpha. It suggests a high degree of internal consistency in the statements of the scale. The test, which consisted of 25 items, was on a Likert scale. Students answered by checking the box under the following descriptions: SA – strongly agree; A – agree; U – undecided; D – disagree; and SD – strongly disagree. The scoring for positive was 5 to 1, where five corresponds to strongly agree, and one is for strongly disagree. In terms of the negative statements, reversed scoring was applied. Every score interval that was obtained has a corresponding qualitative description. The composite mean of the students' attitude scale was interpreted using the five class intervals, which were classified as highly positive, positive, neutral, negative, and highly negative.

To identify the students' attitude towards mathematics, the weighted mean was used to get the average of the attitudinal items.

Numerical Rating	Weight	Description	Interpretation
4.21 – 5.00	5	Strongly Agree	highly positive
3.41 – 4.20	4	Agree	positive
2.61 – 3.40	3	Undecided	moderately positive
1.81 – 2.60	2	Disagree	negative
1.0 – 1.80	1	Strongly Disagree	highly negative

3. Academic Self-Regulated Learning Scale

To develop the needed data for students' level of self-regulation, the researcher utilized an open-sourced instrument called the ASRL-S. Permission was also sought to employ and use such instruments in this research. The Academic Self-Regulated Learning Scale (ASRL-S) yields numerical scores that provide an overall indication of the presence of self-regulation characteristics. It was developed by Dr. Carlo Magno (2010) to measure students' self-regulation from high school to college-level, which had a reliability coefficient equal to 0.87. It also resulted in a 0.92 reliability index using Cronbach's alpha when pilot tested the students.

On a Likert scale, participants were asked to rate how much they agreed or disagreed with each statement, described as strongly agree, agree, disagree, and strongly disagree. The seven factors of this scale include memory, goal setting, self-evaluation, seeking assistance, environmental structuring, learning responsibility, and organizing. Scores were computed using the weighted means of each factor. The weighted mean was interpreted as follows: strongly disagree indicates "very low self-regulation"; disagree denotes "low self-regulation"; agree would be taken as "high self-regulation"; and strongly agree signifies "very high-self regulation."

The composite mean was used to get the Academic Self-Regulated Learning Scale items average following this scaling and interpretation to identify low and high self-regulated learners.

Numerical Rating	Weight	Description	Interpretation
3.26 – 4.00	4	Strongly Agree	very high self-regulation
2.51 – 3.25	3	Agree	high self-regulation
1.76 – 2.5	2	Disagree	low self-regulation
1.00 – 1.75	1	Strongly Disagree	very low self-regulation

3.3 Research Procedure

Gathering of Data. First, the researcher sought permission and approval from the Head of the Administrative Team through the Department Principal of Bohol wisdom School to conduct the study to the Grade 12 senior high students who are enrolled for the academic year 2019 – 2020. Upon the approval to conduct the study, the researcher was supposed to give the control and experimental groups a pre-test before the intervention.

Before the study, the researcher also gathered the students' final grades in their previous mathematics classes. It was done to determine whether the control group and the experimental group had a significant difference in terms of their previous mathematics grade and to know whether the two groups are comparable for the conduct of this research.

The study followed the following procedure:

Preparation of the Lesson Plan. The lesson plan or the instructional plan for the control group was the existing lesson plan or instructional plan for Statistics and Probability. Meanwhile, the group of students being experimented in the study exposed to the flipped learning approach used a different lesson plan or instructional plan for the experimental group. The researcher followed the objectives, specific topic, and time allotted, 60 minutes per session. The class had four times per week to meet, and the lesson lasted for two weeks.

Pilot Testing. The questionnaire was put through its paces in a pilot test on other grades 12 classes who were not part of the control and experimental groups. The researcher-made questionnaire was subjected to an item analysis to know the items retained or need revisions.

Pre-test Administration. Before the study started, the pre-test was given to both groups to assess the entry knowledge of the students on the topic under study about fundamental counting principle, permutation, and combination.

Experimentation: Traditional Method (Control Group)

1) ***Setting the objectives.*** Being the source of information sets the stage for learning by showing the students what they have to acquire and expected. The teacher informed the students of the lesson objectives.

2) ***Presenting the new material.*** The teacher discussed the concepts and the central organizing idea of the lesson; presented examples to illustrate each idea; summarized and referred back to the main idea. A consistent discussion of the lessons and paper-and-pencil test was highly used.

3) ***Giving of Assignment.*** Students' homework was assigned after the lecture, at the end of class time, and completed at home independently. Checking of assignments was done the next day.

The exact process was done for the entire duration of the two weeks.

Experimentation: Flipped Learning Approach (Experimental Group)

1) ***Choosing what type of flipped classroom.*** The researcher has employed the standard - inverted classroom in this research. It is the classic flipped classroom where the students are requested to go over the video lectures and other learning materials that are prerequisites before entering the classroom. Much of the time, all facets of a subject are translated into video lectures in this kind of flipped classroom. The class time is reserved for the students to practice the concepts that were studied at home. The teacher will facilitate this.

2) ***Choosing a lesson to flip.*** This research focused on the topics fundamental counting principle, permutation, and combination, which are prerequisite knowledge and skills needed in the Statistics and Probability class. Learning competencies and objectives were based on the DepEd Curriculum Guide.

3) ***Deciding what material to flip.*** In this case, due to limitations in time, instead of creating one's videos, the researcher utilized curated material found on YouTube. Videos taken from YouTube were selected correctly and screened by the teacher to suit the learners and align with the topic. The chosen videos were consistently between 10 – 12 minutes long to ensure the students had reasonable viewing time, as suggested by Bergmann and Sams (2012).

4) ***Making students responsible for their learning.*** At the first session of the class, students were oriented about how the following days will go through in class. Class expectations and rules were set to inform students of their accountability. Students always need to know what the teacher expects them to do with the content with this orientation.

5) ***Orienting students on the modes of technology to be used.*** The students were asked to download the Edmodo application and were given the class link or code to join. Edmodo is an educational platform that is free to use. It also complements the teacher's lessons and allows them to improve the methods of communication with the students outside class. Reminders and tasks were also given using the said application. Videos and instructions were uploaded to the class group in the Edmodo application. Due to some students' requests, a copy of the video was also forwarded to the class group on Facebook.

Meanwhile, those students who opted to ask for a copy of the video due to problems with internet connections were also given a copy of the video using a flash drive so that they can view it at home using their laptop or computer. The students have either an option to view the material through online or offline viewing.

6) ***Giving assignments to students.*** Students were instructed to view the video provided by the teacher at home or during their free period before they enter the class. Their only task was to access the lesson's material before entering class.

7) ***Monitoring students to ensure they view the material***. Students in the experimental group were also encouraged to take down important information found in the video. They were given a prompt worksheet to determine and monitor whether they watched the video. Once the students enter the class, the prompt worksheet was submitted, and the teacher randomly selects students to recap and summarize what the video is all about. A short question and answer session allows students to clarify any confusion from the video assigned to them.

8) ***Practicing and reinforcing students' learning.*** Following the short question and answer session, the students received the activity (which used to be the assignment in the traditional classroom) that corresponded or aligned to the video. Students are engaged in a hands-on-inquiry based activity while the role of the teacher was to check and survey the classroom when a student needs help upon answering the activity. Students who had questions raised their hands and discussed them with the teacher as an individual, pair activity, in small groups, or through peer work. Their activities were identical to the control group activities but were done in smaller group settings. Real-time feedback to students was done in the activity or during peer interaction to correct misunderstandings and errors on the activity given.

9) ***Observing and taking down notes.*** The researcher observed and took down notes on what is going on with the students and the class. When the researcher takes the track on which part of the lesson or what concept most of the students had questions, what questions are repeatedly asked by the students, which student needs more attention, and the like, it gave the researcher a hint and a signal whether to proceed to the next concept or skill or give another video material to reinforce lessons students are having difficulty with.

10) ***Assessing the different activities.*** The researcher employed various ways to have formative assessments and check the activities. Some activities were checked using checking out loud, asking students to compare their answers, giving students the answer key, and comparing them with their answers, asking volunteers to explain and write their answers on the board. Formative assessments have been considered but put more emphasis on the process, focusing on the activities.

The same procedure was repeated for the experimental group in the span of 8 meetings to complete the lessons about the Fundamental Counting Principle, Permutation, and Combination.

Post-Test Administration. A post-test is a test given to a set of students used to assess the academic performance of the group exposed to the treatment. After the experiment, the post-test was administered to both groups to determine the students' learning achievement in Mathematics. The Academic Self-Regulated questionnaire and the Attitude towards Mathematics Checklist were also given after the intervention was done.

The pre-test and post-test results were tallied, tabulated, and subjected to statistical analysis, which was the basis for interpretation.

4. Results and Discussion

The flipped learning approach positively affected mathematics learning achievement, resulted in a positive attitude towards mathematics and yielded a high level of self-regulation among the students.

Based on the results of the data gathered, the following are the highlights of the findings of the study:

1. Students' Mathematics Learning Achievement

In the pre-test result, most of the students in both the control and experimental groups belonged to the fairly satisfactory and did not meet the expectations category with 69% and 88%. Statistical analysis showed no significant difference between the control and experimental groups' pre-test results. It would imply that the two groups have more or less the same level of entry knowledge on the topic before the given intervention. There is a significant difference between the pre-test and post-test scores of both control and experimental groups. It means that the students' scores of the two groups increased and improved. However, the experimental group had higher mean scores as compared to the control group. The students in the experimental group exposed to the flipped learning approach had a higher mean gain with a 9.77 difference compared to the control group exposed to the teacher-directed approach with a mean gain difference of 5.53. The T-test results revealed a significant difference between the post-test results of the control and experimental groups. It implies that the post-test scores of the students exposed to the flipped learning approach increased significantly. It also means that the experimental group is performing better as compared to the control group.

2. Attitude towards Mathematics

Students in the control group exposed to the teacher-directed approach had a negative attitude towards mathematics, while students in the experimental group exposed to the flipped learning approach manifested a positive attitude. The attitudes of the students in the control group and the experimental group vary significantly. A significant difference does exist between the means of the control group of 2.55 to that from the experimental group with a mean of 3.42.

3. Level of Self-Regulation

Results revealed that the students in the control group had low self-regulation while the experimental group had an interpretation of high self-regulation. A significant difference does exist between the means of the control group of 2.44 to that from the experimental group with a mean of 2.86 in terms of the students' responses in the Academic Self-Regulated Learning Scale.

5. Conclusion

The research aimed to provide evidence to evaluate how well students learn using the flipped approach to learning. Furthermore, it is pursued to identify if it affects the students' learning achievement, attitudes, and self-regulation. As collectively shown in the findings, the researcher concluded that employing flipped learning as an approach to teaching mathematics has a positive effect on the mathematics learning achievement of students. There is a significant difference between the results of the pre-test and post-test scores of both control and experimental groups. It means that the students' scores of the two groups increased and improved. However, the experimental group had higher mean scores as compared to the control group. It also means that the experimental group is performing better as compared to the control group.

It also has a positive effect on students' attitudes towards mathematics. A significant difference exists between the attitudes of the students in the control group and the experimental group. It has also been proven that the flipped learning approach increases students' level of self-regulation. The students in the experimental group who were exposed to the flipped learning approach performed and learned better compared to the control group exposed to the teacher-directed approach. Engaging students, increasing student interaction, maximizing class time, and immediate feedbacking show the significant impact and improvement towards the students as they become flexible, self-reliant, and take ownership and responsibility for their learning.

The researcher concludes that flipped learning approach can be a good alternative for teaching mathematics. Mathematics teachers are suggested to employ the flipped learning approach and craft self-regulated oriented instructional plans as an alternative instructional approach to improve mathematics teaching and learning. Teachers who are handling Mathematics are encouraged to employ the flipped learning approach in other topics aside from the topics being utilized in this study. A continued suggestion would be an extension of time during the intervention and implementation of the flipped classroom and may consider other factors or variables not mentioned in this study. Future researchers may conduct similar studies that wish to investigate the effectiveness of the flipped learning approach involving different topics in mathematics.

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References

[1] Andamon, J., & Tan, D. A. (2018). Conceptual understanding, attitude, and performance in mathematics of grade 7 students. *International Journal of Scientific & Technology Research*, *7*(8), 96-105.

[2] Arnold-Garza, S. (2014). The flipped classroom teaching model and its use for information literacy instruction. Communications in Information Literacy, *8*(1), 9.

[3] Ash, K. (2012). Educators evaluate flipped classrooms. *Education Week, 32*(2), s6-s8.

[4] Brame, C. (2013). Flipping the classroom. Retrieved from: https://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/

[5] Bergmann, J., & Sams, A. (2012). Flip your classroom: Reach every student in every class every day. *International Society for Technology in Education*.

[6] Brunsell, E., & Horejsi, M. (2013). Flipping Your Classroom in One" Take." *The Science Teacher*, *80*(3), 8.

Dix, A. C. (2009). Teachers' beliefs and practices about self-regulated learning in secondary mathematics classrooms. University of Florida.

[7] Effeney, G., Carroll, A., & Bahr, N. (2013). Self-Regulated Learning: Key strategies and their sources in a sample of adolescent males. *Australian Journal of Educational & Developmental Psychology*, 13.

[8] Goodwin, B. and Miller, K. (2013). Research says evidence on flipped classrooms is still coming in, Educational *Journal of Information Systems Education*, *Vol. 25*(1) Spring 2014 10 Leadership, *vol. 70*, no. 6 (Mar. 2013), pp. 78-80. Retrieved from http://www.ascd.org/publications/educational-leadership/mar13/vol70/num06/Evidence-on-Flipped-Classrooms-Is-Still-Coming-In.aspx

[9] Günüç, S., & Kuzu, A. (2014). Factors influencing student engagement and the role of technology in student engagement in higher education: campus-class-technology theory. *Turkish Online Journal of Qualitative Inquiry*, *5*(4), 86-113.

[10] Hamdan, N., McKnight, P.E., McKnight, K., & Arfstrom, K. (2013). A review of flipped learning. Flipped Learning Network. Upper Saddle River, NJ: Pearson Education, Retrieved June 9, 2019, from URL::http://www.flipped learning. org/ cms/lib07/VA01923112/Centricity/ Domain/41/ LitReview _FlippedLearning.pdf

[11] Johny, L., Lukose, L., & Magno, C. (2012). The assessment of academic self-regulation and learning strategies: can they predict school ability. *Educational Measurement and Evaluation*, *3*, 77-89.
[12] Kearsley, G., & Schneiderman, B. (1999). Engagement theory: A framework for technology-based learning and teaching. *Educational Technology*, 38(5), 20-23.
[13] Langat, A. C. (2015). Students' attitudes and their effects on learning and achievement in Mathematics: A Case study of public secondary schools in Kiambu County, Kenya. Unpublished a Research Project, submitted in partial fulfillment of the requirements for the Degree of Master of Education of Kenyatta University. Available online also at https://ir-library. Ku. ac.ke/bitstream/handle/123456789/10911/Students.
[14] McNutt, J. (2013). *Flipping the classroom*. *Queen's Education Library*.
[15] Mullis, I. V., Martin, M. O., Gonzalez, E. J., O'Connor, K. M., Chrostowski, S. J., Gregory, K. D., ... & Smith, T. A. (2001). Mathematics benchmarking report: TIMSS 1999—Eighth grade. Chestnut Hill, MA: International Study Center.
[16] Network, F. L. (2014). The Four Pillars of FLIP™.
[17] Nielsen, L. (2012). Five reasons I'm not flipping over the flipped classroom. *Technology & Learning*, *32*(10), 46-46.
[18] Nolan, M. A., & Washington, S. S. (2013). Flipped out: Successful strategies for improving student engagement. Paper presented at Virginia Tech's Conference on HigherEducation Pedagogy, Blacksburg, VA.
[19] Ruddick, K. W. (2012). Improving chemical education from high school to college using a more hands-on approach. The University of Memphis.
[20] Sammel, A., Townend, G., & Kanasa, H. (2018). Hidden expectations behind the promise of the flipped classroom. *College Teaching*, *66*(2), 49-59.
[21] Springen, K. (2013). Flipping the classroom: A revolutionary approach to learning presents some pros and cons. *School Library Journal*, *59*(4), 23.
[22] Valle, A., Núñez, J. C., Cabanach, R. G., González-Pienda, J. A., Rodríguez, S., Rosário, P., ... & Muñoz-Cadavid, M. A. (2008). Self-regulated profiles and academic achievement. *Psicothema*, *20*(4), 724-731.
[23] Verešová, M., & Malá, D. (2016). Attitude toward school and learning and academic achievement of adolescents. In 7th International Conference on Education and Educational Psychology, Published by Future Academy.
[24] Zimmerman, B. J., & Pons, M. M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal*, *23*(4), 614-628.
[25] Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key subprocesses?. Contemporary educational psychology, *11*(4), 307-313.
[26] Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In Handbook of self-regulation (pp. 13-39). Academic Press.
[27] Zimmerman, Barry J., and Anastasia Kitsantas. "The Hidden Dimension of Personal Competence: Self-Regulated Learning and Practice." (2005).