

Flipped Classroom: As Academic Support for Basic Calculus

Reynaldo G. Gamon, Jr.

Eastern Visayas State University, Lino Gonzaga Avenue, Tacloban, City, 6500, Philippines

Corresponding Author: Reynaldo G. Gamon, Jr.

E-mail: reynaldojr.gamon@gmail.com

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ABSTRACT

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This study investigated the effectiveness of the flipped classroom as an academic support strategy in improving the Basic Calculus performance of Grade 11 STEM students at Himay-angan National High School. Employing a pre-experimental one-shot case study and descriptive survey design, the research compared third-quarter Basic Calculus grades from two cohorts: SY 2022–2023, which utilized traditional instruction, and SY 2023–2024, which implemented the flipped classroom approach. Students' perceptions of and difficulties with the flipped classroom were also examined using validated questionnaires. Findings revealed that students exposed to the flipped classroom achieved higher academic performance, with a statistically significant difference in grades compared to those taught through traditional methods. Students' perceptions of the flipped classroom were generally moderate to positive, indicating improved preparedness, engagement, self-paced learning, and collaborative opportunities. However, students also reported moderate difficulties, particularly in accessing online materials, managing time to watch instructional videos, and adapting to increased out-of-class workload. Despite these challenges, the overall results suggest that the flipped classroom effectively supports learning by promoting independent study, active classroom engagement, and constructivist learning processes. The study concludes that the flipped classroom is a viable and impactful academic support strategy for enhancing Basic Calculus learning outcomes among Senior High School STEM students and recommends its wider adoption with appropriate resources and instructional support.

1. Introduction

1.1 Background of the Study

Making mathematics easy to be learned by students is one of the most challenging difficulties that mathematics teachers undertake. There are just three factors that contribute to students' difficulties with mathematics: teachers, students themselves, and the environment that limits their interactions. If one or more of these three elements are overlooked, most of the student's potential may be wasted (Langoban, 2020). With this, student support services in mathematics are crucial for the success in learning the subject, which revolves around the support system teachers made that will hit the different learning styles of the students and will pass through the borders of limited interactions between peers and teachers. As asserted, students who were less proficient in mathematics were initially the primary

focus group for mathematics support, although access to support services has never been exclusive to them (Lawson, Grove, & Croft, 2022). With this, academic support student services play a critical role in addressing students' various needs that will lead to an increase students' success and a more positive overall learning experience. Particularly in Senior High School, specialized subjects like Basic Calculus in the Science, Technology, Engineering, and Mathematics (STEM) Strand, other learning modalities have emerged as an academic support, as blended learning has largely supplanted purely traditional teaching systems. According to Binoy (2024), one type of blended learning that has gained popularity is the flipped classroom, which has been shown to increase student engagement and performance.

Moreover, there were numerous studies that support the effectiveness of the flipped classroom. According to the study of Wey-Amaewhule and Mohammed-Shittu (2024), using the flipped classroom approach improves the mathematical performance of Generation Z (born 1995-2009) and Alpha (born 2010-2024). Based on the results, it was suggested that administrators provide instructors with new strategy training and that teachers implement cutting-edge teaching techniques like the flipped classroom to improve student engagement and performance. Further, in a flipped applied mathematics classroom study of Salami (2024), a satisfactory level of student perception and an enhanced learning experience in terms of interest, engagement, and illumination are revealed. To maintain student engagement and boost academic achievement, it was suggested by the study's findings that math teachers at all levels should always look for student-driven teaching strategies like the flipped classroom. Moreover, in the study of Aquino (2024), the pretest results show that the performance of the flipped and non-flipped classes was equal. In contrast to the non-flipped class, the flipped class demonstrated a statistically significant improvement in the posttest and in-class activities. Furthermore, it was discovered that the flipped class performed identically in both group and individual in-class tasks. The findings demonstrated that after the activation, demonstration, application, and integration phases of instruction, the flipped classroom technique may be used to achieve the requisite competencies in theorem proof.

In relation to the status of basic education in the Philippines, Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) 2022 highlighted that all data in the Philippines were deemed suitable for reporting since they satisfied the PISA quality standards. However, its ranking is still the same in the PISA 2018 results, which indicates that it continues to lag behind other nations in terms of critical thinking, problem-solving skills, and effective communication. In math, low achievers got stronger while high achievers' performance remained relatively stable. Besides, 16% of pupils achieved at least Level 2 competency in mathematics, which is much lower than the OECD average of 69% across all nations. Without explicit guidance, these students are at least able to comprehend and identify the basic mathematical representations of common situations. Moreover, nearly all Filipino learners achieved Level 5 or 6 on the PISA mathematics exam, which indicates that they were not among the country's top math achievers (OECD average: 9%). At these levels, learners can choose, assess, and compare suitable approaches to problem-solving for complicated circumstances as well as represent them numerically. In the aspect of teaching, Philippines moved above average on the OECD standard, 79% of students stated that the teacher demonstrates interest in each student's learning in most math classes (OECD average: 63%), and 81% said the teacher provides additional assistance to pupils as needed (OECD average: 70%). In terms of conducive environment to study mathematics, approximately 26% of Filipino students reported that they could not focus well in most or all lessons (OECD average: 23%), 29% said they did not pay attention to the teacher (OECD average: 30%), 41% said using digital devices caused them to become distracted (OECD average: 30%), and 37% said that other students' use of digital devices distracted them (OECD average: 25%). These statistics show that many students study mathematics in environments that are not conducive to learning. When mobile phone usage is prohibited on school grounds, students were, on average, less likely to report becoming distracted while using digital devices across all OECD countries. Lastly, in terms of modalities implemented during the pandemic, 41% of students reported having difficulty understanding tasks at least once a week during remote learning, and 34% reported having trouble finding someone who could assist them with their coursework (OECD averages: 34% and 24%). In educational institutions where students maintained good performance and felt more like they belonged; fewer students had issues with distance learning (OECD, 2023). Overall, these findings and analysis captured the mainstream dilemma of poor performance in Mathematics on many Filipino learners in the international standard.

In this study, as among of the concerns stipulated in the PISA 2022 report, learners' focus on learning and difficulty to understand the mathematics lessons, and bothered in obtaining someone who can assist them, the flipped classroom will be implemented as an academic support to Basic Calculus class, in terms of study skills development and

assistance to their learning styles for the principle of students' holistic development, to test its effectiveness and impact to the learners of all Grade 11 STEM students, considering the justification for the creation of mathematics support, one could assume that students that attend are having difficulty and are at risk of failing. However, the situation is more complicated because many students who are capable in mathematics are accessing support (Lawson, Grove, & Croft, 2022). Furthermore, to determine the students' perceptions and difficulties on flipped classroom. Through the result of the study, the researcher will probably suggest and recommend flipped classroom as an effective academic support to enhance the academic performance of the learners in Basic Calculus in the Senior High School.

1.2 Statement of the Problem

This study will attempt to test the impact of flipped classroom as an academic support on Basic Calculus subject of Grade 11 – STEM students of Himay-angan National High School, Division of Southern Leyte.

Specifically, it sought to answer the following:

1. What is the status of student-respondents, Grade 11 – STEM, Basic Calculus Third Quarter Grades on:
 - 1.1. SY 2022 – 2023; and
 - 1.2. SY 2023 – 2024?
2. What is the status of student-respondents, Grade 11 – STEM SY 2023 – 2024, in terms of:
 - 2.1. flipped classroom perceptions; and
 - 2.2. flipped classroom difficulties?
3. Is there a significant difference between the Basic Calculus Third Quarter Grades on Grade 11 – STEM student – respondents on SY 2022 – 2023 and SY 2023 – 2024?
4. Is there a significant difference between the students' flipped classroom perception and difficulties?

1.3 Significance of the Study

This study is intended to be a modest contribution to the Senior High School Teachers teaching Basic Calculus and the mathematics educational society in the ongoing study of the impact of flipped classroom as an academic support, and for the benefit of the entire educational system, specifically to the students.

School Administrators. The findings of this study will help them to come up with plausible idea to help their teachers to provide academic support to the students towards Basic Calculus and other Mathematics subjects. Also, this will help them to propose and endorse programs and projects for uplifting academic performance of the students in the subject.

Teachers. The result of the study will help Basic Calculus teachers and even Mathematics teachers to utilize flipped classroom as an academic support to increase students' success and provide more positive overall learning experiences and opportunities to the subject. It is hope that they will be more encouraged to venture on this strategy, as an academic support, to boost learners' academic performance and self-development in learning the subject.

Students. It is hope that the findings of this study will boost the academic performance in the Basic Calculus subject. Also, it could aide higher level of support and development of independent learning approach that will lead to the attainment of the best output in the subject' activities and enhance the ability in solving Basic Calculus and other mathematics problems. Furthermore, they will be more interested to take college courses that call for mathematical focus or related.

Researchers. This study will contribute and provide researchers with valuable information for further researchers on having academic support in Basic Calculus subject in Senior High School with regards to flipped classroom.

1.4 Objectives of the Research

This study aims to determine the impact of flipped classroom as an academic support on the students' Basic Calculus academic performance. Explicitly, on the effect of flipped classroom students' perceptions and difficulties on Basic Calculus. Hence the following objectives should be done to attain the set target. First, review the related literature on flipped classroom, as an academic support, with its definition and focus on its perceptions and difficulties. Second, integrate the strategy into the Basic Calculus subject of Grade 11- STEM students. Third, conduct a survey on flipped classroom students' perceptions and difficulties. Fourth, request the Basic Calculus grades of the previous SY and present SY Grade-11 STEM class. Last, analyzed the data and reported the findings.

2. Related Literature and Theoretical Framework

2.1 Related Literature and Studies

Education evolves constantly, and it is aligned with the demands of the current situation. In the present generation, developments in information and communication technology have had a massive impact on educational institution wherein blended learning has developed with the prospective for transforming educational institutions by supplementing traditional classroom settings and improving student learning outcomes (Bangalan & Hipona, 2020).

With this, technology advancements in education have recently resulted in the rise of new teaching approaches such as flipped learning (also known as inverted learning). It is a relatively new strategy in which students become familiar with topics outside of the classroom through videotape lessons, articles, and online tools. Unlike traditional learning, in Flipped classrooms, students actively participate in problem-solving activities that require the use of prior knowledge (Acarol, 2019). Further, it is a distinctive approach of digital teaching wherein the fundamental contents of the lesson are covered through online teaching materials, such as uploaded teaching videos, and are further explored interactively during in-person class (Vogelsang & Ollermann, 2019).

Moreover, flipped classroom aims to supplement the traditional lecture style with a more dynamic classroom experience for students (Segumpan & Tan, 2018). It is consisting of two parts: interactive learning activities during the lesson and individual instruction (Fernandez, Fernando, & Gloriana, 2021). This strategy meets the needs of students by enhancing their critical thinking and problem-solving skills (Aljaraideh, 2019). Besides, it is highly beneficial in learning during the pandemic COVID-19 (Betaubun, 2021). As emphasized, pre-class learning student commitment and in classroom activities active involvement are critical to the success of flipped classroom (Lam, Lau, & Chan, 2019).

2.2 Academic Support

Academic support can refer to a wide range of instructional approaches, educational services, or school resources offered to children to help them accelerate their learning progress, catch up with their peers, meet learning requirements, or just thrive in school (The Glossary of Education Reform, 2013). Additionally, academic support refers to the resources and initiatives that students receive to help them achieve academically. It can take several shapes and be implemented in a variety of ways depending on the situation (Ashmore, 2018).

In this study, flipped classroom was used as academic support to Basic Calculus. Since in the study of Bergfjord and Heggernes (2016) found out that flipped classroom has a positive result. Among the interesting outcomes, students claim that they prepare better for lectures, are more satisfied with the course overall, and receive somewhat higher grades. In particular, fewer students obtain extremely low grades. Moreover, the flipped classroom methodology enhances both learning outcomes and the learning process, whereas assessment methodologies in a conventional, non-flipped classroom typically focus solely on learning outcomes and fail to evaluate the learning process (Lam, Lau, & Chan, 2019).

However, in the study of Pandow, Inan, and S (2020), the results did not show that using the flipped learning approach greatly enhanced students' academic support activities. This finding could be explained by the fact that the approach is novel. The investigation could be repeated in the future to compare results and better understand the long-term impacts of the flipped strategy.

2.3 Flipped Classroom

Various studies revealed a significant impact of flipped classroom on the teaching learning process, as an academic support to the students. Wherein, in line with the quality of classroom time, flipped classroom has been developed to improve quality teaching and learning process because it is an engaging and a student-centered approach. It is an

innovation which allows students to improve their participation, motivation, and communicative skills (Namaziandost, Ziafar, & Neisi, 2020).

Segumpan and Tan (2018) revealed that both groups' mathematical performance improved significantly following the implementation. In the retention test, the mathematics performance of students exposed to the Flipped Classroom was significantly equivalent to that of students exposed to the Non-Flipped Classroom. However, the study of Santiago, Balic, Santos, Paragas, & Estrada (2021) showed that Flipped Classroom greatly improved students' concept mastery more than the lecture-discussion method. Also, it was believed that the improvement in concept mastery of student is a better approach than the latter. Also, Fernandez, Fernando, and Gloriana (2021) found that students' post-test scores in flipped classrooms were significantly higher than in traditional classrooms.

The results stated were possible to come up because with flipped classroom, learners felt more in control when going to understand the lesson because they were able to view the videos repeatedly. One of the participants additionally mentioned that he felt geared up for the online lesson after studying the video the night before. Learner-participants describe their experience with flipped classrooms using phrases such as self-motivation and independence (Fernandez, Fernando, & Gloriana, 2021)

2.4 Flipped Classroom Students' Perception

Flipped Classroom in the outlook of students' perception is highly significant to be looked forward to seeing its valuable impact to students. In the aspect of students' engagement, flipped classroom rise it based on the teacher and student assessments of student participation were satisfactory (Alebrahim, 2016). Moreover, Yeoman's (2018) study found that students' preferences for flipped learning and its effectiveness had improved.

The findings indicated in the study of Acarol (2019) that Flipped Learning has a favorable impact on student success and participation. According to the findings, both students and teachers have favorable attitudes regarding Flipped Learning, and students are extremely motivated in these classrooms. Additionally, Namaziandost, Ziafar, and Neisi (2020), showed that the learners' attitude toward using flipped classrooms was significantly positive. Further, concluded and suggested to educators to use the flipped classroom to build better learning environments for the students and attain a better learning outcome.

The study's findings of Pandow, Inan, and S (2020) revealed that the flipped learning strategy had a significant effective impact on academic achievement, learning, development, and overall student performance. It demonstrates that the flipped approach aids students become self-learners, which is an important skill for the present generation of students.

Further in Calculus, Bangalan and Hipona's (2020) study found that flipped classroom increased students' motivation and confidence in learning Calculus, improved their engagement in guided and independent learning activities, and helped them better understand mathematical concepts.

Subsequently on the study of Betaubun (2021), in the implementation of flipped classroom, students exhibited a neutral attitude and a reasonably excellent degree of learning experience. But Aburayash (2021) found a positive association between students' attitudes toward education and the flipped classroom technique, as well as their relationship to self-learning skills.

2.5 Flipped Classroom Students' Difficulties

Flipped Classroom, as a new strategy, it is inevitable to face difficulties to educational institutions. In the side of students, difficulties in flipped classroom were highly observed. Some studies put emphasis on this.

Al-Zahrani (2015) found out that there were numerous difficulties associated with the flipped classroom, particularly the students' limited preparation for this teaching approach. Thus, students must be prepared to use the flipped classroom and equipped with suitable e-learning resources. In addition, it is crucial to consider students' study learning areas and provide useful in-class activities.

The findings of McNally, et al (2017) revealed that, while students may find the flipped classroom a bit harder, student outcomes and active participation in class activities strengthen when teachers use theoretical insights to inform their flipped teaching strategy, incorporate evaluation into the structure of their flipped classroom, and flip the entire class.

In general, flipped classroom, for the past decade, showed numerous impacts to students' academic performance to different subjects. In Mathematics, it is highly recommended to be used as an academic support to make learning more impactful and possible to the diverse students using approach of learning the lesson in the students' preferred studying time outside the class hour and this will make them able to engage and participate in the given in-class activities of the teacher. However, there are some difficulties will be facing to this strategy due to some resources constraints and other factors that will hinder the effectiveness of this strategy. But these difficulties are manageable if given enough time and focus to be resolved.

2.6 Theoretical Framework

This study anchored on constructivism learning theory and will be discussed on this part in relation to flipped classroom, as an academic support, students' perceptions and difficulties, and academic performance.

Constructivism learning theory underscores learners' active engagement with acquiring their own understanding. Rather of passively collecting information, students reflect on their experiences, construct mental representations, and incorporate new information into their systems of thought. This fosters deeper learning and comprehension (Simply Psychology, 2024). Moreover, constructivism is a learning theory that claims that information is best obtained through mental reflection and active processing (Mascolo & Fischer, 2005).

In this study, constructivism learning theory was applied to the integration of flipped classroom as an academic support to the Basic Calculus subject. Since, in this subject, academic support is highly needed to help the students learn better and master the different vital topics, as foundational to higher education mathematics. It is needed to understand better the contents and engage on the various given activities. Hence, flipped classroom as an academic support will give learners the opportunity to learn the subject more satisfactorily.

Further, the flipped classroom strategy allows the learners to learn the content through the teacher's made audio-video lessons (AVLs). This helps them explore the concept independently before in-class, letting them to shape a deeper understanding and learning in which students acquire through mind reflection and active processing. Further, during the in-class activities, students can participate in the given activities because they already have the knowledge and confidence to accomplish it. In addition, the students' perceptions and difficulties of flipped classroom will be unveiled to its significance on the aspect as an academic support.

Figure 1 shows the theoretical framework of the study. This study anchors from constructivism learning theory. The SY 2023 – 2024 Grade 11 – STEM students of Himay-angan National High School were the respondent of the study. Moreover, the SY 2022 – 2023 Grade 11 - STEM students Basic Calculus third quarter grades will be tested on its significance with the current SY and same quarter. The study is focused on the impact of flipped classroom as an academic support to Basic Calculus wherein flipped classrooms students' perceptions and difficulties were also tested to its significance.

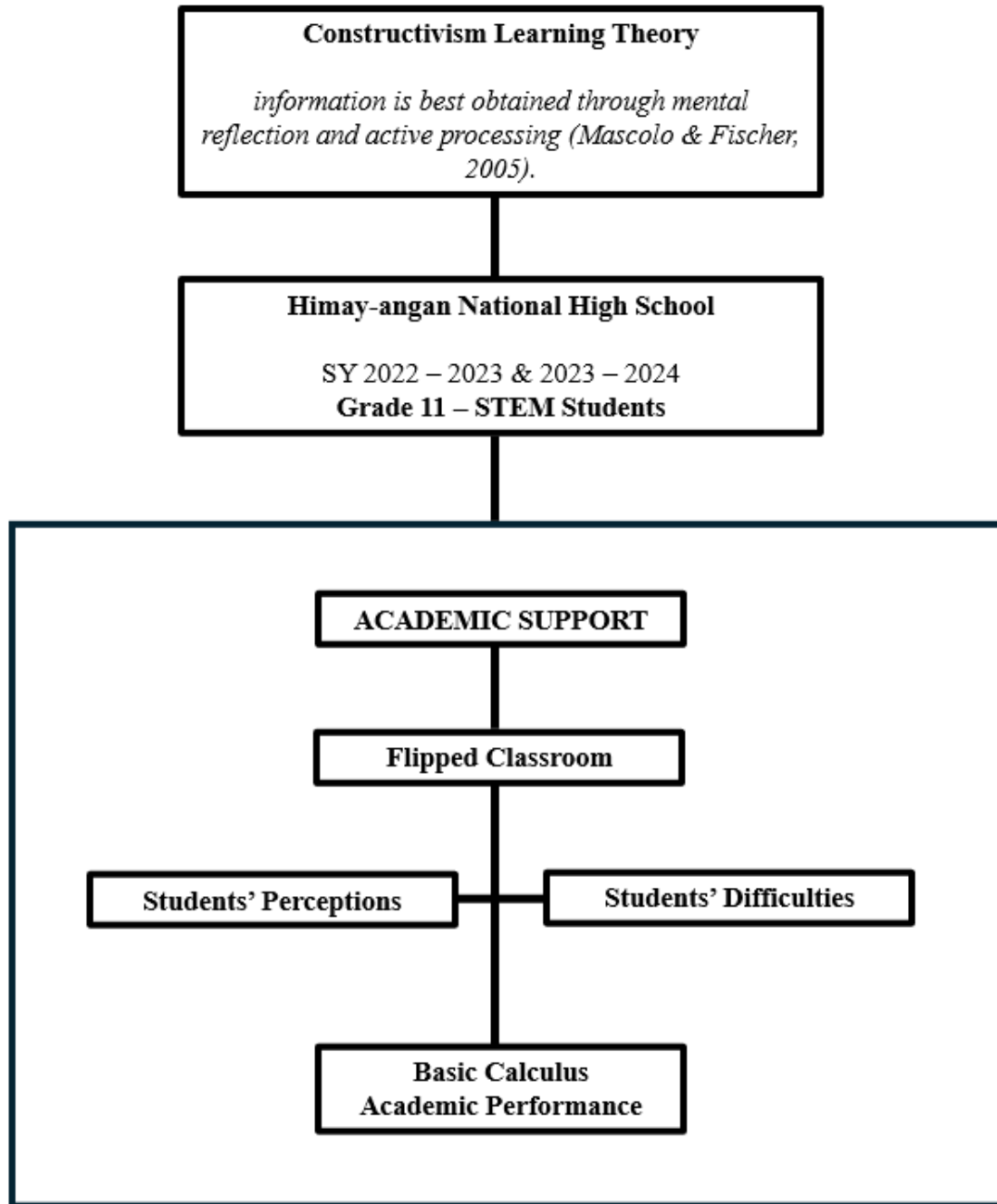


Figure 1. Theoretical Framework of the Study

3. Methodology

3.1 Research design

In terms of research design, this study used both a pre-experimental one-shot case study and a descriptive survey to collect the data needed. For pre-experimental one-shot case study research design, the third quarter grades on SY 2023 – 2024 Grade 11 – STEM students on Basic Calculus were collected, wherein academic support was implemented, and to be tested with a significant difference against SY 2022 – 2023 Grade 11 – STEM students' third

quarter grades, where the traditional method of teaching was employed. Further, for the descriptive survey research design, data were collected through questionnaires for flipped classroom students' perceptions and difficulties, and it was administered in-person. With the use of these designs, the impact of the flipped classroom on Basic Calculus, as an academic support, on the Grade 11 – STEM students using the GPA and flipped classroom students' perceptions and difficulties can be determined.

This study was conducted at Himay-angan National High School, Himay-angan, Liloan, Southern Leyte. It was founded in 1970, named as Himay-angan Barangay High School. Presently, the school offers both junior and senior high school basic education. In senior high school, the school has complete strands in academic track and two strands for technical and vocational track. In the current school year 2023-2024, it has a total enrollment of 605, with 367 junior high enrollees and 238 senior high enrollees.

The research instruments used in this study were the Students' Perception with Flipped Classroom Questionnaire of Aljaraideh (2019), students' difficulties with the flipped classroom questionnaire of Al-Zahrani (2015), and the Basic Calculus grades of the Grade 11 – STEM students both SYs 2022 - 2023 and 2023 - 2024. The questionnaire was composed of two parts. Part I presented the flipped classroom students' perception with 30 number of items using the five-point Likert Scale (1 – Does not agree at all, 2 – agree a little, 3 – agree moderately, 4 – agree a lot, and 5 – agree exactly). It was used to measure the level of perceptions of students on flipped classroom. Part II presented the students' difficulties with flipped classroom questionnaire with 8 number of items, used to measure the level of difficulties using the five-point Likert Scale with the same description on part I. This instrument was given at the end of the third quarter, as an evaluation on the flipped classroom integration on the Basic Calculus subject. Further, ample time was given to the respondents to answer the 38 items.

Prior to the conduct of the study, the researcher secured a permission to conduct the study from the office of the school principal. Upon the approval, before the start of the third quarter, an orientation on flipped classroom was conducted to the respondent-class. For the entire third quarter school days of Basic Calculus, the flipped classroom teaching strategy was implemented as an academic support. Then, at the end of the quarter, the administration of the questionnaire was conducted and the grades of the students on Basic Calculus were collected. The data from the responses of the flipped classroom students' perception and difficulties were also collected. The results were tallied, summarized, and subjected to data analysis.

Moreover, this study used the following statistical treatment after the data were collected, classified, and tabulated. **Mean** was used for the status of the student-respondents in terms of Basic Calculus grades for SYs 2022 – 2023 and 2023 – 2024 and flipped classroom students' perceptions and difficulties. **Wilcoxon Rank Sum Test** was used to determine whether there is a statistically significant difference between two independent samples. In this study, the Grade 11 – STEM students SY 2022 – 2023 and SY 2023 – 2024 Basic Calculus Third Quarter grades. Lastly, **T-Test for Comparing Two Dependent Samples** was used to examine whether there is a significant difference between two dependent samples. In this study, to examine the significance difference between flipped classroom students' perceptions and difficulties.

3.2 Research Population Profile

The respondents of this study were the Grade 11 STEM students for the SY 2023 – 2024 of Himay-angan National High School for the Third Quarter Grades, students' perceptions, and difficulties. Also, Grade 11 STEM students for SY 2022 – 2023 for the Third Quarter Grades to be compared to the present SY. All students enrolled in Basic Calculus class on each SY were automatically selected as participants on this study. Thus, no sampling procedure was done in this study.

Table 1. Distribution of Student-respondents of the Study

SY	Grade Level	Section	Track	Strand	Male	Female	Total	Percentage
2022-2023	11	Dolomite	Academic	STEM	10	9	19	100%
2023-2024	11	Dolomite	Academic	STEM	15	11	26	100%
Total							45	100%

4. Presentation of Data

This part discusses the data and results presented in tables. The analysis of data was done using appropriate statistical tests and interpretation followed with the support from related studies.

Table 2 up to Table 4 present the status of student-respondents in terms of Basic Calculus Third Quarter Grades for SYs 2022 – 2023 and 2023 – 2024 and flipped classroom students' perceptions and difficulties.

Table 2 revealed that the Basic Calculus Third Quarter Grades in SY 2023 – 2024 with a mean of 91.4, where academic support using flipped classroom was implemented, is higher than SY 2022 – 2023 with a mean of 90.2. This result coincides with the study of Wey-Amaewhule and Mohammed-Shittu (2024), using the flipped classroom approach improves the mathematical performance. Moreover, matches to the findings of Fernandez, Fernando, and Gloriana (2021) that students' post-test scores in flipped classrooms were significantly higher than in traditional classrooms. Besides, the result shows that academic support using flipped classroom, with a greater number of respondents compared to without academic support, has an impact on the Basic Calculus grades. Furthermore, this indicates that utilizing the said academic support is crucial to the learning and success of the Basic Calculus subject.

Table 2. Status of Student – respondents in terms of Basic Calculus Third Quarter Grades

Grades	N	Mean
SY 2022 – 2023	19	90.2
SY 2023 – 2024	26	91.4

Table 3 revealed that among the indicators of students' perceptions of flipped classroom as an academic support, the students gave the four indicators the top mean rating. I frequently pause or repeat parts of the videos in order to increase my understanding of the material with a mean of 3.96. Then, with a mean of 3.69, I feel that watching videos and taking notes contribute efficiently to my learning. Lastly, both have a mean of 3.62, I try to learn as much as possible while watching the videos and learning foundational content prior to class greatly enhances my understanding of material. Overall, 3.18 mean indicates that students' perceptions of flipped classroom are considered moderate.

The results are consistent with the findings of Acarol (2019) that students have favorable attitudes regarding Flipped Learning, and extremely motivated in the classrooms. Additionally, learners' attitude toward using flipped classrooms was significantly positive (Namaziandost, Ziafar, & Neisi, 2020). Moreover, a positive association between students' attitudes toward education and the flipped classroom technique, as well as their relationship to self-learning skills (Aburayash, 2021).

The results reveal that, in terms of academic support, the flipped classroom instructional materials such as videos, that was given in advance for self-study, have a great help in understanding the lesson of Basic Calculus, it contributed efficiently to their learnings. Thus, this help the student's study skills development and fits to their learning style, which is crucial for long term and part of holistic student development. Hence, instructional videos, i.e. teachers' made videos, have an essential contribution to produce better insight and performance in the subject.

Table 3. Status of Student-respondent in terms of Flipped Classroom Students' Perceptions

Indicator	Mean (Interpretation)	
I feel that watching videos and taking notes contribute efficiently to my learning.	3.69 (High)	3.18 (Moderate)
With flipped classroom model, I feel more prepared for my exam.	2.81 (Moderate)	
I like watching the lessons on video.	2.96 (Moderate)	
I try to learn as much as possible while watching the videos.	3.62 (High)	
I wish more teachers use the flipped or inverted classroom model.	2.85 (Moderate)	
I frequently pause or repeat parts of the videos in order to increase my understanding of the material.	3.96 (High)	
Flipped classroom encourages me to practice critical and creative thinking.	3.20 (Moderate)	
Learning foundational content prior to class greatly enhances my understanding of material.	3.62 (High)	
Flipped classroom gives me the opportunity to ask more questions inside the classroom.	3.08 (Moderate)	
Flipped classroom attracts my attention to learning and teaching process.	3.00 (Moderate)	
With flipped classroom, we have to do more work out of the classroom.	3.24 (Moderate)	
Flipped classroom can be a suitable teaching strategy.	3.31 (Moderate)	
Flipped classroom can improve interest in exploring topics.	3.35 (Moderate)	
I felt prepared to complete subject tasks in class after listening to the video content.	3.15 (Moderate)	
Flipped classroom is more engaging than the traditional classroom.	2.58 (Low)	
Flipped classroom gives me less class time to practice the concepts of the subject.	2.92 (Moderate)	
Flipped classroom reduces the effort to understand the basic knowledge of the subject matter.	3.04 (Moderate)	
Flipped classroom, along with delivery of content outside class and problem solving in class, is an instructional method appropriate for my specialization.	3.27 (Moderate)	
I am more motivated to learn the concepts of the subject via the flipped classroom.	2.96 (Moderate)	
Flipped classroom improved collaborative learning.	3.44 (High)	
Flipped classroom can improve interest in class.	3.48 (High)	
I got the ability to self-pace my learning with flipped topics.	3.23 (Moderate)	
Flipped classroom gives me greater opportunities to communicate with other students.	3.31 (Moderate)	
I believe that I am able to learn material with flipped classroom instruction better than with traditional lecture-based instruction.	2.73 (Moderate)	
I would recommend flipped classroom to a friend.	3.42 (High)	
Flipped classroom matches my learning style.	2.81 (Moderate)	
I feel the mastering learning through flipped classroom improved my academic achievement.	3.12 (Moderate)	

Flipped courses did not limit my interaction with teachers.	2.85 (Moderate)	
I feel that mastering learning through flipped classroom improved my subject understanding.	3.19 (Moderate)	
Flipped classroom learning has reduced my dependency on the teacher.	3.27 (Moderate)	

Legend: 4.21-5.0 –Very High, 3.41-4.20 –High, 2.61-3.40 –Moderate, 1.81-2.60 –Low, 1.00-1.80 –Very Low Manowong (2016) Likert Scale

Table 4 on the other hand revealed that students gave the three indicators the top mean rating. I had difficulties accessing the subject online tools and materials with a mean rating of 3.08. Also, with a mean rating of 2.88, the flipped classroom required more work than traditional lectures. Then, I lacked time to watch the video-recorded lectures and other subject materials with a mean rating of 2.73. Overall, 2.64 mean indicates that students felt a moderate difficulty in flipped classroom as an academic support on Basic Calculus.

The results supported Al-Zahrani (2015) findings that there were various obstacles connected with the flipped classroom, particularly the students' limited preparation for this teaching approach. Accordingly, students must be prepared to use the flipped classroom and equipped with suitable e-learning resources.

Since the flipped classroom is novel to the students, evidently difficulties on adjustments in terms of coping up with the given video lessons and activities are inevitable. With that flipped classroom required more work to the learners, due to some adjustments to learner-centered approach, compared to traditional lecture method of teaching. Moreover, internet issue and gadgets to be used hinders the accessibility of the video lessons. Lastly, time constraints issue which need to be manage by the students so that they can watch the video lessons before the in-class session.

Table 4. Status of Student-respondent in terms of Flipped Classroom Students' Difficulties

Indicator	Mean (Interpretation)	2.64 (Moderate)
I was not adequately prepared to integrate the flipped classroom	2.42 (Low)	
The flipped classroom required more work than traditional lectures	2.88 (Moderate)	
Subject tools and materials were not sufficiently prepared	2.58 (Low)	
Subject objectives were not sufficiently clear to me	2.50 (Low)	
I did not receive sufficient feedback during the in-class activities	2.42 (Low)	
I lacked time to watch the video-recorded lectures and other subject materials	2.73 (Moderate)	
Subject objectives were not sufficiently clear to me	2.54 (Low)	
I had difficulties accessing the subject online tools and materials	3.08 (Moderate)	

Legend: 4.21-5.0 –Very High, 3.41-4.20 –High, 2.61-3.40 –Moderate, 1.81-2.60 –Low, 1.00-1.80 –Very Low Manowong (2016) Likert Scale

Tables 5 and 6 show the results of testing the significant differences between Grades, students' perceptions and difficulties in flipped classroom as an academic support on Basic Calculus.

Based in the group descriptive table, SY 2023 – 2024 with an academic support using flipped classroom has a higher median score (92.5) compared to SY 2022 – 2023 without an academic support (90.0). But the standard deviation of

SY 2023 – 2024 (2.87) is quite greater than SY 2022 – 2023 (1.86). The result of the Wilcoxon Rank Sum Test yielded a value of $W = 175$ with a p-value of 0.048 which is less than 0.05. Thus, concluded that there is a significant difference between the median scores of SY exposed to the academic support using the flipped classroom and SY without the academic support. This is an accord with the findings of Pandow, Inan, and S (2020) that the flipped learning strategy had a significant effective impact on academic achievement, learning, development, and overall student performance. Hence, flipped classroom as an academic support is effective and have significant impact on the academic performance of the students in Basic Calculus.

Table 5. Significant Difference between the Third Quarter Grades on Grade 11 – STEM SYs 2022 – 2023 and 2023 – 2024

Group Descriptives

	Group	N	Median	SD
Grades	SY 2022 – 2023	19	90.0	1.86
	SY 2023 - 2024	26	92.5	2.87

Independent Samples T-Test

		Statistic	p
Grades	Mann-Whitney U	175	0.048

Note. $H_a \mu_{SY\ 2022-2023} < \mu_{SY\ 2023-2024}$

Based on the descriptive table, the mean students' perceptions score is higher (3.18) compared to mean students' difficulties scores (2.65). Likewise, in standard deviation, students' perception showed 0.526 compared to 0.384 of students' difficulties. In the normality test, using Shapiro-Wilk's Test, the p-value is 0.111 and greater than 0.05. Thus, the data are assumed to be normally distributed. Moreover, the result of the Paired Samples T-Test yielded a t-value of 4.00 with a corresponding p-values of $<.001$ which is less than 0.05. Thus, it is concluded that there is a significant difference between the flipped classroom students' perceptions and difficulties. The result is supported by the study of Bangalan and Hipona's (2020) that flipped classroom increased students' motivation and confidence in learning Calculus, improved their engagement in guided and independent learning activities, and helped them better understand mathematical concepts. Thus, even with the difficulties, still a positive perception on the flipped classroom, as an academic support, has a significant impact to the students and it is evidently showed on their grades in Basic Calculus.

Table 6. Significant Difference between the Students' Flipped Classroom Perceptions and Difficulties

Descriptives

	N	Mean	SD
Students' Perceptions	26	3.18	0.526
Students' Difficulties	26	2.65	0.384

Normality Test (Shapiro-Wilk)

		W	p
Students' Perceptions	- Students' Difficulties	0.937	0.111

Normality Test (Shapiro-Wilk)

	W	p
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Note. A low p-value suggests a violation of the assumption of normality

Paired Samples T-Test

			statistic	df	p
Students' Perceptions	Students' Difficulties	Student's t	4.00	25.0	< .001

Note. $H_a: \mu_{\text{Measure 1}} - \mu_{\text{Measure 2}} > 0$

4.1 Findings

1. The status of mean scores of students – respondents in terms of Basic Calculus in the Third Quarter Grades for SY 2023 – 2024 is higher compared to SY 2022 – 2023.
2. The status of student – respondents in terms of flipped classroom students' perceptions is moderate. While, for students' difficulties is moderately difficult.
3. There is a significant difference between the median scores of SY exposed to the academic support using the flipped classroom and SY without the academic support.
4. There is a significant difference between the flipped classroom students' perceptions and difficulties.

5. Conclusions

Flipped classroom, as an academic support, gives impact and effective in the students' performance in Basic Calculus, generally evident in the grades compared in the study. Besides, students were optimistically positive on their perceptions on the flipped classroom even though they encountered some difficulties on accessing the video materials and time constraints. With that, it plays an essential role in the student' study skills development and learning styles which is important for their long-term success in mathematics and holistic development. As the constructivism learning theory insisted that learning is best obtained through active mental processing and reflection in which suitable in learning Basic Calculus to be independent learners and enhance the student's analysis and critical thinking. Thus, flipped classroom is highly suggested to be used as academic support on the subject.

5.1 Recommendations

From the findings and conclusion, the following recommendations are offered:

1. It is highly recommended to used flipped classroom as an academic support that will help the students' learning to be improved and attained better performance. Further, improved their study skills development and learning styles which are crucial for long term success and holistic development.
2. In relation to video instruction, it must be quality assured before uploading and disseminating it to the students.
3. Instructional materials, such as videos and other learning materials, must be given to the student or uploaded to the online platform on time. Possibly, it will be available also offline so that accessibility will not be an issue.
4. Another similar study can be done with a greater number of respondents to validate the significance of the result.

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