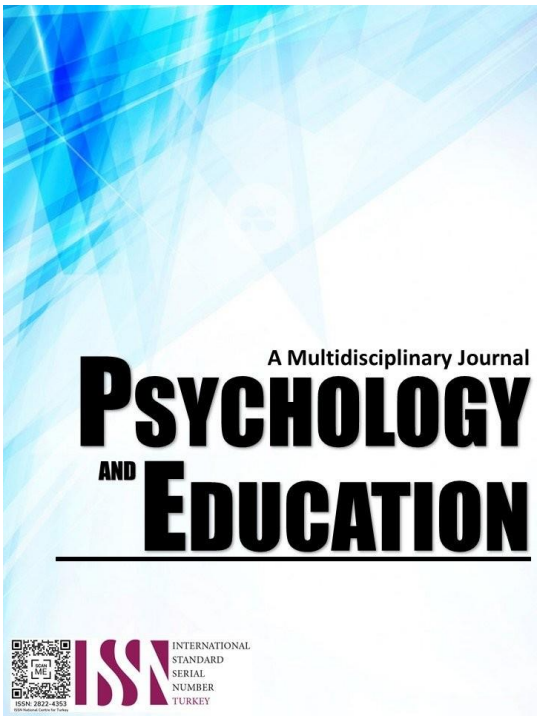
UNLEASHING THE POTENTIAL INFLUENCE OF FLIPPED CLASSROOM UTILIZATION TOWARDS THE STUDENT'S ACHIEVEMENT IN MATHEMATICS



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Research Article

Unleashing the Potential Influence of Flipped Classroom Utilization towards the Student's Achievement in Mathematics

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Abstract

The flipped classroom enables teachers to accommodate the different needs of their students. With in-class activities, learning gaps and strengths can be addressed individually, allowing a more personalized approach to teaching. This research assessed the potential influence of the Flipped Classroom utilization towards the mathematics achievement in Rational Functions competencies of the Grade 11 Computer Systems Servicing and General Academic Strand students of Talisay City National High School in Talisay City Division for the school year 2023-2024. A descriptive-correlational research design was utilized in this study using a survey questionnaire and achievement test. There were 134 respondents in the sample, and it was selected using simple random sampling from the population of the students at Talisay City National High School. The data were statistically analyzed through percentage, frequency counts, weighted mean, and Pearson-r correlational test for significant relationships. The findings revealed that the level of acceptability in terms of the pedagogical aspect of the utilization of the flipped classroom significantly influences the student's academic achievement in Mathematics. The researcher highly recommends that the Flipped Classroom Utilization Enhancement Plan be implemented and could serve as a supplementary strategy in addressing the students' varied learning needs, particularly in mathematics.

Keywords: *mathematics, flipped classroom, content, pedagogical, technical, mathematics achievement*

Introduction

One of the key elements in any nation's progress is education. It is an essential instrument for developing an educated and skilled workforce that will aid in the development of the nation. Math education is one of the abilities on which one nation concentrates. Due to the fact that it serves as the foundation for many other disciplines like physics, engineering, and economics, mathematics is one that is extremely important in education (Maass et al., 2019). Critical thinking and problem-solving abilities are developed through mathematics education (Harjo et al., 2019). It instructs students in information analysis, pattern recognition, relationship analysis, and logical inference. These abilities are highly regarded in the job and essential for achievement in many different fields. However, despite the importance of mathematics education, many students struggle with the subject and perform poorly academically (Guinocor et al., 2020).

Australia is one of the nations that struggles the most with mathematics. Every three years, the OECD's Programme for International Student Assessment (PISA) evaluates the math, science, and reading abilities of 15-year-olds. Australia's performance in math has been falling since 2003 (Morsy et al., 2018). Australian math students are, on average, 14 months behind where they were 20 years ago, and 46% of 15-year-olds do not match the required level of math ability (Thomson et al., 2019).

In South Africa, regional assessments like the Southern and Eastern Consortium for Monitoring Education Quality (SACMEQ) and international assessments like the Trends in Mathematics and Science Study (TIMSS) have shown low learner achievement levels, which is consistent with the country's math performance issues. According to the TIMSS, between 68% and 90% of African boys and girls in Grade 8 did not meet the low international benchmark in mathematics (Mullis et al., 2012), and regrettably, no appreciable improvement was noted in the TIMSS 2007 or TIMSS 2011. South Africa continues to do poorly in mathematics, according to the 2015 TIMMS report, despite an improvement in Grade 9 math performance from the results of 2011 (Reddy et al., 2016).

One of the Southeast Asian countries going through the same trends, pressures, and worries is the Philippines. Filipino students exhibited poor performance in the 2018 Programme for International Student Assessment (PISA) math evaluation, with over half securing scores beneath the minimum proficiency threshold. Filipino students score poorly or unsatisfactorily in mathematics, according to studies (Capuno et al., 2019; Pentang et al., 2023). Additionally, the mean percentage score in mathematics on the National Achievement Test went below expectations (Lacia, 2019) Students from public schools also performed worse compared to private schools (Bernardo et al., 2022).

The DepEd National Report of the Philippines (2019) states that the Philippines came in second to last place among the participating nations in the most recent Programme for International Student Assessment (PISA) 2018. Filipino pupils scored an average of 353 points in mathematics literacy, substantially below the OECD average of 489 points (Indefenso & Yazon, 2020). Many factors influence students' arithmetic proficiency, as shown by the grades they receive. The first one is students from Generation Z, which refers to 21st-century learners who prefer technology-based instruction and are digital natives (Cilliers, 2017). Technology has given students in Generation Z access to a variety of tools and learning styles. Video-based learning has made today's learners increasingly reliant on it (Kumar & Mamgain, 2023). Gen Z learners also prefer video-based learning and applied learning, where they can see a demonstration of the lesson repeatedly (Seemiller & Clayton, 2019). Technology has a positive and statistically significant effect on students'

mathematics achievement. Technology is effective when it is used (a) to create and design a collaborative and communicative learning environment where students have chances to collaborate and interact with each other and (b) as support for mathematics problem-solving and mathematics conceptual development (Ran et al., 2022).

The ability of individuals to be accountable for their own learning presents a fundamental obstacle in the learning process. Learning becomes more effective when students assume ownership of their education and give learning a purpose (Nzesei, 2015 as cited by Cardino Jr. and Cruz, 2020). Generation Z learners prefer to learn mathematics subjects through online instruction or learning through technology involvement compared to face-to-face instruction (Edwards & Rule, 2013). In addition, Dutton et al. (2002) found in a study involving 364 students that online students outperformed those who took the same course in a classroom setting and students who believe that using technological tools to learn mathematics, economics, and computer science has a positive impact on their academic performance.

The teacher's teaching style is an additional factor that predominately predicts learners' mathematical achievement (Saritas & Akdemir, 2009). Teachers should use the most effective teaching strategies that correspond to the specific aims and exit outcomes in order to facilitate the acquisition of knowledge. Teachers used teacher-centered strategies more frequently in mathematics subjects than student-centered ones to convey knowledge to students throughout the conventional era. Since 21st-century learners differ significantly from those of previous generations, this strategy has a negative impact on their performance. In every area of the educational setting, blended learning was statistically superior to traditional learning (Makhdoom et al., 2013). Compared to the traditional style of learning, which emphasizes a teacher-centered approach, technology-based learning is a useful learning tool to aid students in acquiring appropriate mathematical knowledge (Wijaya et al., 2022).

The amount of time allotted to each subject at school also has an impact on the achievement of learners in math classes. Yeşil Dağlı (2019) found out that the amount of instructional time may have a ceiling effect and that the peer makeup of classrooms may mediate that effect. Deped Order No. 013 s. 2018 states that students in grades 11 and 12 are given two hours each subject over a six-week period for Core Curriculum subjects, Applied Track subjects, and Specialized subjects. Additionally, mathematics only has 80 hours per semester because it is a core subject. The teacher does not have enough time to cover all of the competencies that the Department of Education mandated teachers to teach. With this, teachers would only need to spend 3 to 4 hours per week teaching 5 to 6 competencies or more. Another approach must be put into practice, one that teaches students how to improve their arithmetic ability while simultaneously addressing all the subject competencies.

It has been observed that Talisay City, Cebu Division, has the same ongoing issues and concerns as the grade 11 learners in the Technical Vocational and Livelihood Track and Academic Track, which both have a General Mathematics subject. Cababat and Pespeñan (2023) found out that the students' numerical skills in both Academic and TVL tracks with the mean score of 3.99 and 2.76 respectively were categorized as developing level of proficiency and the findings clearly implied that both groups of students had an adequate grasp of numbers and operations, but this was insufficient because accurate calculations involve the interpretation of mathematical data.

This research assessed the potential influence of the Flipped Classroom utilization towards the mathematics achievement in Rational Functions Competencies of the Grade 11 students at Talisay City National High School in Talisay City Division for the school year 2023-2024 as the basis for crafted Flipped Classroom utilization enhancement plan.

Research Questions

This research assessed the potential influence of the Flipped Classroom utilization towards the mathematics achievement in Rational Functions competencies of the Grade 11 students at Talisay City National High School in Talisay City Division for the school year 2023-2024 as the basis for crafted Flipped Classroom Utilization Enhancement Plan. Specifically, it answered the following sub-problems:

1. What is the respondent's demographic profile in terms of:
    1.1. age and gender;
    1.2. parents' highest educational attainment; and
    1.3. combined family monthly income?
2. What is the level of acceptability in the utilization of the flipped classroom approach in the teaching-learning process of the Rational Function competencies in terms of:
    2.1. content;
    2.2. pedagogical; and
    2.3. technical Aspects?
3. What is the level of mathematics achievement in Rational Function competencies of the respondents?
4. Is there a significant relationship between the level of acceptability of flipped classroom utilization and the mathematics achievement of the respondents?
5. Based on the findings of the study, what Flipped Classroom utilization enhancement plan can be crafted?

Literature Review

This study theorizes that the utilization of the flipped classroom model is an effective strategy to improve the student's academic achievement. This is supported by the theory of Social Constructivism by Vygotsky, 1978.

According to Vygotsky (1978), as cited in Mcleod (2024), every function in the child's cultural development appears twice: first, on the social level and, later on, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This notion implies that learning is a social activity and underpins the active role of students in building their own knowledge. Furthermore, Mcleod (2024) defined constructivism as a learning theory that places an emphasis on students taking an active role in creating their own understanding. Learners actively construct mental images, reflect on their experiences, and add new information to their paradigms as opposed to merely receiving it. This promotes deeper understanding and knowledge acquisition. The constructivist learning theory's key characteristic is that it places a strong emphasis on the student-centered learning approach. Teachers' roles in this form of classroom are limited to those of facilitator, guide, and mentor; students take the lead in all learning activities. Students are the focus of the instructional activity.

Bergmann and Sams (2012) developed a new mode of teaching with the integration of new technologies which is called the Flipped classroom, a teaching strategy that completes the transfer of knowledge outside of the classroom and achieves internalization inside of it. The "Flipped Classroom" concept refers to how simple it is to digitally record lectures and post them online for student access outside of conventional learning periods. This mode of teaching incorporates the constructivist learning theory where students serve as the primary unit of cognition, the focal point of the entire group, and the active creators of meaning.

According to Xu and Shi (2018), constructivist learning theory plays a significant role in a flipped classroom. It is crucial to the process of self-directed learning. It also has a significant impact on how flipped classrooms are developed and promoted in the future, both domestically and internationally. Flipped learning backed up by constructivist theory, should empower learners to be involved in communicating, imaginative, and collaborative activities during knowledge construction (Sharma, 2018). Flipped learning and instructional videos strengthen constructivism's underlying ideas and premises by allowing for inquiry-based learning outside of class.

According to Serin (2019), technological advancements give students great opportunities to access and explore knowledge independently. With the flipped classroom, the time spent in class on course explanations is transferred outside of the classroom, and it also aims to get students to utilize experience the application of such information/knowledge during class to absorb the students' knowledge. The flipped classroom has significant potential for helping students develop 21st-century abilities.

According to Mujtaba et al. (2022), flipped classroom model enhanced student engagement, increased student's learning experiences, improved students' outcomes, supported meaningful construction of active knowledge and experiential learning, satisfaction, confidence, creativity, problem-solving skills, more retention, application skills, and ICT skills, and improvement in attendance and reduction in course withdrawal after the pandemic situation. Correspondingly, the study was supported by the theory of Cooperative Learning by Vygotsky. Cooperative learning refers to more than two people achieving common learning goals through mutual interaction and assistance as well as responsible sharing (Choi & Norton-Meier, 2014 as cited in Qiang, 2018).

Munir et al. (2018) pointed out that cooperative learning served as an essential foundation for the flipped classroom. The cooperative learning approach is applied to a flipped classroom setting where students watch a video of the teacher's prepared material before class to get prepared. When the students attend class, a cooperative learning approach is evident, and the students collaborate in learning exercises in small groups. The modern classroom now places a significant emphasis on technological literacy. The incorporation of technology into a conventional learning environment aid in the creation of meaningful learning experiences and fosters favorable attitudes and interactions toward technology. Technology integration models are theoretical frameworks created to support educators in thinking thoroughly and critically about the use of technology in the classroom.

According to DepEd Order No. 16 s. 2023 "Revised Guidelines on the Implementation of the Department of Education Computerization Program", public schools and DepEd offices shall be provided with appropriate, quality, and equitable technologies that would enhance the teaching, learning, governance, and operation processes, practices, programs, and policies to meet the challenges of the modern age consistent with the Department's MATATAG: Bansang Makabata, Batang Makabansa framework, and the State's policy. The revised guideline aims to provide globally competitive quality education, based on a pedagogically sound curriculum that is at par with international standards through the Department of Education Computerization Program (DCP). This envisioned creating a more inclusive, innovative, and effective education system that prepares learners and educators for the challenges and opportunities of the digital era by embracing the opportunities presented by technology.

Mishra and Kohler (2006) proposed a Technology Integration model to be integrated into the Pedagogical Content Knowledge (PCK) framework by Lee Shulman's 1986 work. It was named the TPACK model, an acronym for Technological Pedagogical Content Knowledge. The TPACK model identifies overlaps between the three fundamental components of technological implementation and integration into a learning environment. The optimum state is where all three of these contexts come together in the combined TPACK competency, where technology is successfully incorporated into a learning environment, meeting both pedagogical and content-based knowledge in a meaningful and beneficial way for both learners and teachers.

Adams (2019) concluded that the TPACK model offers an optimal blend of pedagogical, content, and technological skills for educators to deliver a holistic educational experience. In many ways, the model assumes that offering this level of educational experience is possible; yet there are numerous challenges and obstacles that prevent proper technological integration within the classroom. Moreover, TPACK provides a number of opportunities for fostering successful teaching in many contexts. It opens up numerous possibilities for the creation of technology-integrated instructional materials. Hence, TPACK has significant implications for teacher education (Zaidi and Hussain, 2019).

Methodology

Research Design

A correlational research design investigates relationships between variables without the researcher controlling or manipulating any of them (Bhandari, 2023). Thus, this study uses a descriptive correlational design to determine the relationship between the level of acceptability in the utilization of the Flipped Classroom and the student's academic achievement in learning Rational Function competencies. Simple random sampling was employed to determine the number of respondents. Lastly, the data was analyzed using appropriate statistical tools such as frequency distribution, percentage formula, weighted mean, and Pearson-r correlation.

Respondents

In determining the respondents of the study, two strands were chosen as respondents in this study namely Computer Systems Servicing and the General Academic strand because of the following criteria explicitly: the Computer System Servicing (CSS) of the Information and Communication Technology (ICT) strand opts to maximize their learnings in the different aspects such as the arts, mathematical concepts, and information technology through the integration of advanced technology and this strand would be more likely to choose IT related courses on the Higher Education; while the General Academic Strand's (GAS) curriculum offered few courses in Mathematics and this strand could freely choose any college degree programs such as Education, Humanities, Social Sciences, Engineering and even IT related courses. The respondents of the study were the Grade 11 students from Computer Systems Servicing (CSS) A and B; and General Academic Strand (GAS) A and B in TCNHS. The selected respondents were expected as the research respondents because they are students taking General Mathematics. In ensuring the validity and reliability of the samples, simple random sampling was utilized.

Table 1. *Distribution of the Respondents*

Name of Sections	*N*	*n*	*%*
CSS A	35	35	26.12
CSS B	35	35	26.12
GAS A	35	35	26.12
GAS B	29	29	21.64
Total	134	134	100.00

Instruments

The questionnaire was composed of three parts: the demographic profile of the students, the level of acceptability in the utilization of the Flipped Classroom Approach and the student's academic achievement in General Mathematics. The researcher utilized a questionnaire adopted from the survey questionnaire by Ursua (2023) "Impact of the Flipped Classroom on Civil Engineering Students' Learning of Differential Calculus" which is related to Flipped Classroom Approach studies in assessing the level of acceptability of the researcher-made video lesson. There were four video lessons which cover the most essential learning competencies in Rational Functions such as represents real-life situations using rational functions (M11GM-Ib-1), distinguishes rational function, rational equation, and rational inequality (M11GM-Ib-2), solves rational equations and inequalities (M11GM-Ib-3), represents a rational function through its: (a) table of values, (b) graph, and (c) equation. (M11GM-Ib-4), finds the domain and range of a rational function (M11GM-Ib-5), determines the: (a) intercepts; (b) zeroes; and (c) asymptotes of rational functions (M11GM-Ic-1), graphs rational functions (M11GM-Ic-2), solves problems involving rational functions, equations, and inequalities (M11GM-Ic-3) (DepEd, 2022). Assessment tools were adopted from the General Mathematics Self-learning Kit by Hermoso and Elliot (2021) of DepEd-Talisay City Division which was used to determine the level of mathematics achievement of the respondents in Rational Function competencies. A Likert scale of the level of acceptability was used to measure the acceptability in the utilization of the Flipped Classroom Approach in terms of the content, pedagogical, and technical aspects. The performance rating score was used to determine the mathematical achievement of the respondents.

Procedure

The collected data was gathered using the following stages:

Preliminary Stage. The researchers secured a transmittal letter to the Schools Division Superintendent for approval in conducting a research study. Then, the approved letter was handed to the School Head/ Principal to permit the researcher to conduct the research study in the respective schools. Lastly, the researcher was referred to the Research Coordinator to coordinate with the General

Mathematics teacher. Data Gathering Stage. The researcher conducted an orientation with the subject teacher and the chosen respondents of the study to discuss the ethics and objectives of the research study; and the integration of the Flipped Classroom Approach in the teaching-learning process of the Rational Function competencies. On the last day, when the competencies were already covered, the respondents were given ample time to evaluate the level of acceptability in the utilization of the Flipped Classroom Approach. Consequently, the achievement test was administered to assess the student's performance of such competencies.

Post Data Gathering Stage. Tabulation of the data was done after the retrieval of the questionnaires and achievement test scores. All the gathered data were subjected to statistical computation with the help of the statistician. The last steps were the interpretation, analysis, and presentation of the data.

Data Analysis

The gathered data from the survey questionnaires and achievement test scores were tabulated and organized. Additionally, the data were treated and analyzed using the subsequent statistical tools:

Frequency Count. This was used for tallying the number of respondent's responses on their demographic profile and scores in achievement tests.

Percentage. This was used to determine the proportion from the total respondent's demographic profile and scores in achievement tests.

Weighted Mean. This was used to determine the respondents' level of acceptability in the utilization of the Flipped Classroom Approach.

Pearson's r. This was used to determine the relationship between the level of acceptability in the utilization of the Flipped Classroom Approach and the mathematics achievement of the respondents.

Ethical Considerations

The researchers followed all standards when performing the study, including those pertaining to ethics. This study would be subject to an ethical review and permission from the appropriate authorities before being carried out. The researchers inquired whether the respondents would be prepared to participate in the study with their complete agreement. The researchers would ensure that all research activities, particularly data collecting (survey questionnaires), met the highest standards for protecting human rights and safety. Participants' rights had to be adequately communicated as part of the survey method, and the researchers made sure that respondents were protected from unintended harm in the areas of privacy and informed consent.

Results and Discussion

This part presents the analyses and interpretations of the data gathered from the study which aimed to determine the profile of the respondents in terms of their age, gender, parents' highest educational attainment, and combined family monthly income. This also assess the students' level of acceptability in the utilization of the flipped classroom approach in terms of content, pedagogical and technical aspect and mathematics achievement. Furthermore, the relationship of the students' level of acceptability in the utilization of the flipped classroom approach and mathematics achievement was also considered.

With the help of the respondents' answers to the survey questionnaire, the following results and findings are hereby presented and discussed as follows:

Table 2. *Age and Gender of the Respondents*

Age (in years)	*Female*		*Male*		*Total*	
	f	*%*	*f*	*%*	*f*	*%*
19 and above	3	2.24	10	7.46	13	9.70
17-18	13	9.70	26	19.40	39	29.10
15-16	25	18.66	57	42.54	82	61.19
Total	41	30.60	93	69.40	134	100.00

Profile of the Respondents

This section presents the profile of the respondents in terms of their age, gender, parents' highest educational attainment, and combined family monthly income.

Age and Gender

Age and gender are considered important variables that need to be determined in this study which could help in explaining the results of the study. Data gathered are presented in Table 2 below.

As shown in Table 2, there were 41 out of 134 respondents who are female students which comprised 30.60 percent of the respondents while there were 93 or 69.40 percent of them were male students. Twenty-five or 18.66 percent of the female students were 15-16 years

old followed by 13 or 9.70 percent of them were 17-18 years old. Moreover, there were three or 2.24 percent of them whose age were 19 years old and above. There were 57 or 42.54 percent of the male students were 15-16 years old followed by 26 or 19.40 percent of them were 17-18 years old and only 10 or 7.46 percent of them had age 19 years old and above.

This distribution of the age of the respondents implies that many of them attended school at the appropriate age in the 11th grade in the Senior High Level as determined by the Department of Education. It can also be distinguished that there were students who are older than the expected age at this grade level. Some of them were unable to continue their education due to their financial circumstances. This means that one of the factors contributing to the delayed enrollment at some levels may be the inability of their families to provide the funds necessary to meet their educational needs and that could affect the academic achievement of the students.

Peconcillo et al. (2020) claimed that financial constraint as one of the reasons some students stopped schooling, which led to their enrolment history with a gap. As a result, older students are more likely to have poor academic performance compared to younger ones (Jacob,2011, as cited in Peconcillo et. al ,2020). In addition, Gabales et al. (2022) revealed that the student's age is correlated to the mathematics performance, which implies the younger students were more competent than the older ones. In concurrence with these findings, disparities in academic achievement based on age can worsen educational inequalities and gender greatly plays a significant role in students' academic development.

Parents' Highest Educational Attainment

Parents' highest level of education attained is regarded as a crucial variable that must be established for this study in order to support the findings. Data gathered are presented in Table 3 below.

Table 3. *Parents' Highest Educational Attainment*

Educational Attainment	*Mother*		*Father*	
	f	*%*	*f*	*%*
With Master's Units	0	0.00	1	0.75
College Graduate	16	11.94	13	9.70
College Level	26	19.40	19	14.18
High School Graduate	45	33.58	37	27.61
High School Level	19	14.18	19	14.18
Elementary Graduate	13	9.70	12	8.96
Elementary Level	12	8.96	20	14.93
No Formal Schooling	1	0.75	1	0.75
No Response	2	1.49	12	8.96
Total	134	100.00	134	100.00

As shown in Table 3, in both parent's highest educational attainment, the High School Graduate has the greatest number of responses in which there were 45 or 33.58 percent of the respondent's mother and 37 or 27.61 percent of the respondent's father while there were 19 or 14.18 percent with High School Level as the highest educational attainment in both parents. Moreover, only one or 0.75 percent of respondent's mother has No Formal Schooling and 12 or 8.96 percent has Elementary Level as the mother's high educational attainment. On the other hand, one or 0.75 percent of respondent's father has With Master's Units similarly with No Formal Schooling.

It is evident from the results that both parents' highest educational attainment was high school graduate which can be also considered as one of the indicators of the student's academic performance. The educational attainment of the parents plays a significant role in their children's education in which they could offer academic assistance to the diverse educational needs especially in Mathematics subject.

The high educational attainment of parents is associated with higher math performance in youth (Assari et al., 2020). Furthermore, Gabales et al. (2022) found that fathers with good academic backgrounds are significantly correlated with students' mathematics performance, which indicates that fathers having better educational attainment showed better mathematical performance. Evidently, parents with higher levels of education can have a profound impact on a child because they often possess greater knowledge and skills, which they can pass on to their children through direct instruction, informal learning experiences, and role modeling. Additionally, they often place a greater emphasis on the value of education and academic achievement. They may instill in their children the importance of learning, encourage them to set high academic goals, and provide the necessary support and resources to help them succeed.

Combined Family Monthly Income

Combined Family Monthly Income is recognized as a significant variable that must be developed for this study in order to help explain the results. Data gathered are presented in Table 4 below.

As shown in Table 4, most of the respondents have a Combined Family Monthly Income of 10,000 pesos and below comprising 60 or 44.78 percent of the total respondents followed by 10,001-15,000 pesos Combined Family Monthly Income with 31 or 23.13 percent of the respondents. However, the 25,0001-30,000 pesos and 20,0001-25,000 pesos got the least number of responses for Combined

Family Monthly Income with two or 1.49 percent and eight or 5.97 percent respectively. Apparently, the result suggests that the majority of students come from low-income homes.

Table 4. *Combined Family Monthly Income*

Monthly Income (in pesos)	*f*	*%*
Above 30,000	13	9.70
25,001-30,000	2	1.49
20,001-25,000	8	5.97
15,001-20,000	20	14.93
10,001-15,000	31	23.13
10,000 and below	60	44.78
Total	134	100.00

Peconcillo et al. (2020) assert that students with a high level of socio-economic status performed better than the middle-class students, and the middle-class students performed better than the students with a low level of socio-economic status. In contrast with this finding, it is important to recognize that a multitude of factors beyond socioeconomic status alone influence academic performance. While socioeconomic status undoubtedly plays a role in educational outcomes, it is overly simplistic to suggest that it is the sole determinant of academic success. There are instances where students from lower socioeconomic backgrounds excel academically due to factors such as resilience, access to quality education, supportive family environments, and individual motivation.

Level of Acceptability

This section presents the level of acceptability of Utilizing the Flipped Classroom Pedagogy in Learning the Rational Functions in terms of Content, Pedagogical, and Technical which are presented in Tables 5,6,7 and 8, respectively.

Table 5. *Level of Acceptability of Utilizing the Flipped Classroom Pedagogy in Learning the Rational Function in terms of Content*

S/N	*Indicators*	*WM*	*SD*	*Verbal Description*
1	Provides clear and accurate video instruction and presentation.	4.16	0.83	Acceptable
2	Presents an independent, self- contained instruction, and contain accurate step-by-step solution.	4.26	0.78	Totally Acceptable
3	Provides ways to evaluate the work in addition to clearly stated objectives.	4.16	0.86	Acceptable
4	Provides a complete set of learning opportunities, organized around well-defined topics.	4.25	0.83	Totally Acceptable
5	The structure of the video is well-organized with a clear beginning, middle and end	4.32	0.78	Totally Acceptable
	Aggregate Weighted Mean	4.23		Totally Acceptable

Legend: 4.21-5.00-Totally Acceptable; 3.41-4.20- Acceptable, 2.61-3.40- Moderately Acceptable ; 1.81-2.60-Unacceptable; 1.00-1.80-Totally Unacceptable

The level of acceptability of the students towards the video lesson in terms of the content is presented in Table 5. Data shows that item 5 got the highest weighted mean of 4.32, which is considered Totally Acceptable. However, item 1 and 3 received the lowest weighted mean of 4.16 which means that the content of the video lesson in these areas is only Acceptable. In general, the Content of the video lesson is Totally Acceptable with an average weighted mean and a standard deviation of 4.23 and 0.82, respectively.

An essential tool for delivering curriculum in many flipped, blended, and online classes, educational videos have emerged as a significant component of educational institutions. The content of the video instructions plays an integral part of the teaching-learning process where the emphasis of the key concepts and ensuring the excellent pace must be prominent because students can rewatch the videos again if they still have unclear understanding of the lesson which can lead to enhancing the perceived learning value of the students.

Brame (2017) converged the recommendations to use the instructional videos effectively and efficiently as follows: 1.Shorten videos and focus on learning objectives; 2. Use audio and visual components to communicate the necessary portions of a description; 3. Think about how to make these components complementary rather than redundant; 4. Signaling should be used to draw attention to key concepts or ideas; 5. To increase interest, use a conversational, passionate tone; 6. Use guiding questions, interactive elements, or related homework assignments to embed videos in a framework of active learning. In agreement with these recommendations, it is advised to adopt a conversational and passionate tone in instructional videos can foster a more engaging and immersive learning environment, stimulating students' interest and motivation. Finally, incorporating guiding questions, interactive elements, or related assignments encourages active learning and facilitates deeper comprehension by prompting students to apply newly acquired knowledge in practical contexts.

The level of acceptability of the students towards the video lesson in terms of Pedagogical is presented in Table 6. Four out of five statements were considered as Totally Acceptable. Item 3 has the highest weighted mean of 4.36, in which they believed that they were

able to learn at their own pace with instant playback, rewind and pause.

Table 6. *Level of Acceptability of Utilizing the Flipped Classroom Pedagogy in Learning the Rational Function in terms of Pedagogical*

S/N	*Indicators*	*WM*	*SD*	*Verbal Description*
1	I have watched the video many times to better understand the topic.	4.07	0.78	Acceptable
2	Instructional videos helped me better comprehend the competencies in Rational Functions.	4.25	0.84	Totally Acceptable
3	I am able to learn at my own pace with instant playback, rewind and pause.	4.36	0.75	Totally Acceptable
4	The instructional videos enable me to be highly productive in class.	4.21	0.82	Totally Acceptable
5	The Flipped classroom approach is motivating and fun way to learn General Mathematics.	4.31	0.77	Totally Acceptable
	Aggregate Weighted Mean	4.24		Totally Acceptable
	Aggregate Standard Deviation		0.79	

However, item 1 has the lowest weighted mean of 4.07 but is still considered as Acceptable which can be understood that a student may rewatch the videos multiple times to better understand the topic. In general, the acceptability of the video lesson in terms of Pedagogical is Totally Acceptable with aggregate weighted mean of 4.24 which implies that Flipped classroom can assist individuals to notice, absorb, and retain the presentation's key ideas with its Pedagogical approach. A recorded lecture video, together with an experienced faculty member and students, may give students with an overall, in-depth understanding of the lecture topic (Alyoussef, 2022).The recorded video offers the flexibility for students to review the content at their own pace and convenience, while the presence of the faculty member allows for clarification of any confusing points and additional insights. Furthermore, interaction with peers fosters collaborative learning, enabling students to share perspectives, ask questions, and engage in discussions, ultimately leading to a more comprehensive grasp of the subject matter. Overall, this integrated approach maximizes the effectiveness of the learning process and contributes to deeper learning outcomes in accordance with the findings.

Table 7. *Level of Acceptability of Utilizing the Flipped Classroom Pedagogy in Learning the Rational Function in terms of Technical Aspect*

S/N	*Indicators*	*WM*	*SD*	*Verbal Description*
1	The audio is clear, free from background noise, and the speaker's voice is audible.	4.26	0.76	Totally Acceptable
2	The texts on the video lesson used appropriate font style and size that are clear and easy to read.	4.42	0.76	Totally Acceptable
3	The video quality is well-lit so that the presenter or content is clearly visible.	4.32	0.79	Totally Acceptable
4	The instructional videos are accessible for me to learn anytime and anywhere.	4.32	0.76	Totally Acceptable
5	The length of the instructional video ensured to meet the objectives effectively.	4.36	0.78	Totally Acceptable
	Aggregate Weighted Mean	4.34		Totally Acceptable
	Aggregated Standard Deviation		0.77	

The level of acceptability of the students towards the video lesson in terms of the Technical Aspect is presented in Table 7. All the statements were considered as Totally Acceptable. Item 2 has the highest weighted mean of 4.42, in which they believed that the texts on the video lesson used appropriate font style and size that are clear and easy to read. In general, the acceptability of the video lesson in terms of Technical Aspect is Totally Acceptable with aggregate weighted mean of 4.34. The results suggest that good quality and accessible instructional videos can help students in learning the lesson. The student's interest towards learning the specific subject matter could increase through the integration of the new technology in the learning environment.

According to Fernández-Martín (2020), the incorporation of technology and its use in teaching methods is viewed as a solution that inspires a 21st-century learner, raises interest in the subject and the content it covers, and, as this research has demonstrated, improves knowledge acquisition. Furthermore, Hoshang et al. (2021) asserted that a flipped classroom approach enabled by technology helps students grasp the topics better and become more interested in classroom activities. This also allows students to concentrate more throughout class. Undoubtedly, the findings emphasize the transformative potential of technology in education, highlighting its ability to enhance student engagement, interest, and learning outcomes. By embracing innovative teaching methods enabled by technology, educators can create dynamic and enriching learning environments that empower students to thrive in the 21st century.

Table 8 shows the summary on the Level of Acceptability of the respondents in the utilization of the Flipped Classroom Pedagogy in learning the Rational Function. Among the three aspects, the Technical Aspect has the highest aggregate weighted mean of 4.34 which is considered as Totally Acceptable. Data reveals that the utilization of the flipped classroom pedagogy is totally acceptable by the respondents as a new approach in learning Mathematics. It is evident from the table that all the aspects in terms of content, pedagogical

and technical aspect were considered as Totally Acceptable where there is a Grand Mean and Grand Standard Deviation of 4.27 and 0.79,respectively.

Table 8. *Summary on the Level of Acceptability of Utilizing the Flipped Classroom Pedagogy in Learning the Rational Function*

	WM	*SD*	*Verbal Description*
Content	4.23	0.82	Totally Acceptable
Pedagogical	4.24	0.79	Totally Acceptable
Technical	4.34	0.77	Totally Acceptable
Grand Mean	4.27		Totally Acceptable
Grand Standard Deviation		0.79	

It is significant to take into account the substance of the video instructions in order to improve their assessment of the experience's educational value. According to Brame (2017), it is necessary to remember the three essential factors of cognitive load, elements that influence engagement, and elements that promote active learning to maximize the benefit from most instructional videos. Significantly, the positive educational outcomes could emanate through the utilization of such pedagogy and securing high-quality instructional and accessible videos can aid students in understanding the lesson. In the integration of flipped classroom pedagogy, three elements must take into consideration such as the content, pedagogy and technical aspect in order to have a meaningful teaching-learning experience.

Level of Mathematics Achievement

This section presents the level of mathematics achievement of the students using the Flipped Classroom Pedagogy for learning Rational Functions, as shown in Table 9.

Table 9. *Level of Mathematics Achievement of the Respondents*

Level	*Numerical Range*	*f*	*%*
Outstanding	33-40	52	38.81
Very Satisfactory	25-32	37	27.61
Satisfactory	17-24	34	25.37
Fairly Satisfactory	9-16	11	8.21
Poor	0-8	0	0.00
Total		134	100.00
Mean			28.30
St. Dev.			7.44

The student's level of mathematics achievement is presented in Table 9. Data shows that there are 52 or 38.81 percent which is categorized as Outstanding. However, there are 11 or 8.21 percent falls in the category of Fairly Satisfactory. The results reveal that the performance of the respondents as a whole is Very Satisfactory with an average mean of 28.30.

It is apparent from the results that the Flipped Classroom Pedagogy has a positive influence towards mathematical achievement where most of the students have far exceeded expectations and have thoroughly mastered the competencies. Hoshang et al., (2021) found out that students in flipped classrooms obtain considerably greater scored and assessed learning outcomes than students in regular classrooms and are similarly satisfied with the learning environment. Moreover, the flipped classroom approach significantly improves the students' mathematical learning performance (Wei et al., 2020). These findings emphasize the potential of flipped classrooms as a valuable pedagogical strategy for promoting active learning, engagement, and academic success among students.

Relationship between Level of Acceptability and Mathematics Achievement of the Respondents

This section presents the relationship between the respondent's level of acceptability towards the mathematical achievement which is presented in Table 10.

Table 10. *Test of significant relationship between the acceptability of flipped classroom utilization and the mathematics achievement of the respondents*

Variables	*r-value*	*Strength of Correlation*	*p - value*	*Decision*	*Result*
Content and Mathematics Achievement	0.120	Negligible Positive	0.167	Do not reject Ho	Not Significant
Pedagogical and Mathematics Achievement	0.204*	Negligible Positive	0.018	Reject Ho	Significant
Technical and Mathematics Achievement	0.158	Negligible Positive	0.069	Do not reject Ho	Not Significant

**significant at p<0.05 (two-tailed)*

Table 10 reflects the test on significant relationship between the level of acceptability and mathematics achievement of the respondents. Using the Pearson product moment correlation test, the result shows a p- value yields a 0.018 which is less than 0.05 suggesting that there is significant relationship between the Pedagogy and Mathematics Achievement thereby rejecting the null hypothesis. The finding implies that the Pedagogical aspect has a significant influence towards the student's mathematics achievement. According to

Fernandez- Martin, et al. (2020), the integration of Flipped Classroom Pedagogy led to an improvement in students' knowledge and attitudes towards mathematical content and discipline. Indeed, with the Flipped Classroom Pedagogy where students engage with instructional materials before class and then participate in active learning activities during class time, effectively promotes deeper comprehension and a more positive outlook on mathematics. By shifting the traditional lecture-based model to one that prioritizes active engagement and hands-on learning, students not only gained a stronger grasp of mathematical concepts but also developed a more favorable perception of the discipline.

On the other hand, test on significant relationship between Content and Mathematics Achievement and the Technical and Mathematics Achievement as p-value yields 0.167 and 0.069 respectively which is greater than 0.05 suggesting that there is no significant relationship thereby not rejecting the null hypothesis. The result suggests that the content and technical aspects do not necessarily affect the mathematics achievement of the students. However, students' attitudes towards learning and their cognitive ability would mostly determine their academic achievement regardless of how the lessons were delivered and instructional materials were prepared. Semeraro et al. (2020) found out that general cognitive ability was the best predictor of mathematical proficiency. Moreover, Hwang and Son (2021) discovered a positive relationship between students' attitudes toward mathematics and mathematics achievement. These findings revealed that the following students are more likely to have high mathematics achievement: (a) those who enjoy studying mathematics and participating in mathematics-related activities, (b) those who believe that learning mathematics will result in a positive outcome (e.g., academic success and job opportunities), and (c) those who have confidence in their mathematical abilities.

Conclusions

In accordance with the findings of the study, it can be concluded that the respondent's demographic profile in terms of age, gender, parent's highest educational attainment, and combined family income can be considered as significant factors in students' level of acceptability to the Flipped classroom and academic achievement in Mathematics. Furthermore, the level of acceptability of the respondents in the utilization of the flipped classroom in terms of content and technical aspects of the flipped classroom does not appear to have a significant influence on academic achievement in Mathematics. Hence, students' attitudes toward learning and cognitive abilities would mostly influence their academic success regardless of how the topics were presented or the preparation of the instructional materials. However, the pedagogical approach significantly impact academic achievement in Mathematics for the respondents. Thus, the Flipped Classroom approach could be seen as a valuable alternative for delivering the curriculum, catering to the diverse needs of students. Evidently, this approach has the potential to enhance students' performance in Mathematics. As highlighted by Wei et al. (2020), the Flipped Classroom method has been shown to significantly improve students' mathematical learning outcomes.

In view of the research's findings, it is highly recommended that the crafted Flipped Classroom Utilization Enhancement Plan be adopted as a supplementary pedagogy in augmenting the performance of the respondents in Mathematics.

Output of the Study

This part presents the crafted Flipped Classroom Utilization Enhancement Plan which aimed to improve the performance of Grade 11 students in Mathematics at Talisay City National High School.

Utilization Enhancement Plan

Rationale

Traditional classrooms typically focus on passive learning, in which learners passively absorb information during lectures. On the other hand, the flipped classroom method encourages active learning because students engage with instructional materials independently before class. A shift from a passive to an active learning environment is supported by studies demonstrating that active learning promotes student engagement and information retention. One advantage of the flipped classroom is that students can learn at their own pace. Students can return to and review materials whenever they choose, which suits different learning methods and individual needs. This adaptation can result in improved comprehension and a more equitable learning environment.

The flipped classroom allows educators to meet the various requirements of their students. Individual learning gaps and strengths can be addressed through in-class activities, supporting a more individualized approach to teaching. Additionally, it encourages students to build digital literacy skills in an increasingly digital society. They become proficient in using online resources and technological tools, equipping them for the needs of the twenty-first-century workforce. The flipped classroom concept prepares educators as well as learners for the future of learning as education evolves and adapts to technological breakthroughs. It provides students with the knowledge and skills they will need to flourish in an information-driven, technology-centered environment.

In conclusion, implementing the flipped classroom paradigm is driven by its potential to produce a more interesting, individualized, and successful learning environment. Thus, this pedagogical approach coincides with current educational research and addresses students' changing needs in the twenty-first century, making it a great intervention strategy for educators looking to improve their teaching techniques and student outcomes.

Objectives

- With the implementation of this utilization enhancement plan, it is expected that the following objectives are achieved:
- Shall have increased student's performance in Mathematics.
- Shall have provided a student-centered classroom atmosphere that encourages student participation and engagement.
- Shall have built digital literacy skills of the students.
- Shall have improved educators' teaching techniques in response to 21st-century learners need.

Scheme of Implementation

In order that the proposal will be known to all the teachers of Talisay City National High School, it is planned that this proposal will be presented to the principals, guidance coordinators, and all the teachers of the school. It is planned that the topic of this study will be disseminated to the teachers prior to the acceptance of the students in school. The teachers will be given copies of the suggested activities and matrix of the proposal. Evaluation will follow.

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