Journal of Mathematics and Statistics Studies
ISSN: 2709-4200
DOI: 10.32996/jmss
Journal Homepage: www.al-kindipublisher.com/index.php/jmss

JMSS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Attitudes and Performance of Grade 11 Students in Pre-Calculus Using Strategic Intervention Material

Jonathan O. Etcuban[1] ✉ Cirilo B. Daculara, Jr.[2], Mayette A. Cutab[3], Suzette C. Lapiña[4] and Bell S. Campanilla[5]
[1]Faculty, Associate Professor, College of Education, Cebu Technological University, Cebu City, Philippines
[2]Teacher, Department of Education-Toledo City Division, Toledo City, Philippines
[3]Teacher, Department of Education-Cebu City Division, Cebu City, Philippines
[4]Teacher, Department of Education-Danao City Division, Danao City, Philippines
[5]Faculty, Assistant Professor, College of Info and Comm Tech, Cebu Technological University, Cebu City, Philippines
Corresponding Author: Jonathan O. Etcuban, **E-mail**: joetcuban@gmail.com

| ABSTRACT
Strategic Intervention Material (SIM) served as instructional support to help students review key ideas and techniques to help them master a competency-based ability they could not achieve during routine class discussions. This study aimed to determine the attitudes and the performance of Grade 11 students in Pre-Calculus using SIM at the three-identified public national high schools in Cebu, Philippines. It employed the descriptive-correlational method to collect data from 97 samples using two questionnaires (A standardized Attitudinal Test by Fennema-Sherman and researchers-made Performance Test in Equations of Circles). The Chi-square test, t-test, frequency, simple percentage, mean, standard deviation, and attitude toward success were used to analyze the respondents' attitudes about pre-calculus regarding confidence in learning, attitude toward success, mathematics as a male domain, and usefulness. The findings demonstrated that SIMs were appropriate for the respondents' needs, with more excellent knowledge gained from the SIM leading to a better understanding of Pre-Calculus, specifically Equations of Circles, which is beneficial when SIM is used as a teaching tool. The study concluded that using SIM in Pre-Calculus as instructional support significantly affected the student's performance in Pre-Calculus, which is effective in learning the subject. The proposed intervention plan was recommended to be implemented, monitored, and evaluated to boost the math performance of the Grade 11 senior high schools.

| KEYWORDS

Teaching Mathematics, SIM, descriptive correlational method, Philippines

| ARTICLE INFORMATION

ACCEPTED: 15 April 2024 **PUBLISHED:** 18 May 2024 **DOI:** 10.32996/jmss.2024.5.2.1

1. Introduction

Our forefathers have always stressed the need for knowledge in life, no matter how horrible one's circumstances may be. An adage goes, "Education is the only inheritance nobody can take away from you." This adage has never been more accurate than during the COVID-19 outbreak that hit the nation. Students continued their studies despite the financial and physical repercussions of the epidemic. Everything has changed since the COVID-19 pandemic broke out, and new protective measures have been implemented. The educational system also must deal with these limitations. However, the system has discovered numerous approaches to the challenge in multiple learning modalities. Teachers now need to develop pandemic teaching tactics as their duties have increased.

Moreover, the education sector faces a serious issue because of students' poor performance. Despite technological advances, this technology's success depends on a basic understanding. Learning the fundamentals begins in school. Conceptual comprehension is generally required for the arithmetic study.
Based on the researchers' observations, students can read mathematical concepts but need to absorb and understand them. As a result, one of the fundamental issues in education is the caliber of math abilities taught in schools. Mathematics was frequently considered challenging, and some students avoided tackling mathematical issues.

According to the Mean Percentage Scores (MPS) results for Grades 6, 10, and 12 from the 2018 National Achievement Test (NAT) Department of Education (DepEd), no Grade 12 student achieved the proficient level in mathematics.

According to the TIMSS 2019 results, the Philippines improved its achievements in mathematics and science in the TIMSS 2015 assessment. The average score for fourth-grade mathematics increased from 297 in 2015 to 341 in 2019, while the average score for eighth-grade mathematics increased from 324 in 2015 to 357 in 2019. The average science score for fourth-grade students remained relatively unchanged, with a score of 297 in 2015 and 296 in 2019, while the average science score for eighth-grade students increased from 330 in 2015 to 367 in 2019.

The TIMSS 2019 results suggest that the Philippines has improved students' mathematics and science achievement over the past four years. However, there is still room for improvement, particularly in addressing the gender gap in mathematics achievement and the association between socioeconomic status and achievement. Most exam takers fall into the low and not proficient categories.

Regarding NAT Grade 12, all subject areas had varying mean % scores, with Media and Information Literacy recording the most excellent mean, followed by Language and Communication, and Mathematics and Science recording the lowest mean percentage scores of the examined study areas. One of the most significant difficulties that math teachers presently confront is the students' need for fundamental algebra and number theory skills, severely hindering the growth and explanation of mathematical ideas.

The researchers in their respective schools observed that Grade 11 students must perform better in their mathematics subjects, particularly in the Equations of Circles. These students need to have a deep understanding of mathematics, which is crucial in learning higher mathematics when enrolling in tertiary education.

The primary objective is to broaden and develop existing knowledge, skills, and understanding from the concrete to the abstract. Furthermore, SIM served as instructional support to help students review key ideas and techniques to help them master a competency-based ability they could not achieve during routine class discussions. Additionally, SIM is a teaching tool that DepEd recommends to enhance students' performance in mathematics classes. DepEd encourages all teachers to promote students' learning through modular to express and improve their mathematical skills, particularly in the competencies in Pre-Calculus, as part of its campaign to encourage the widespread usage of the module.

The researchers had shown in previous academic years that remediation had beneficial results when used to correct learning gaps and other learning impairments. Slow learners need more time than the classroom's allotted one hour of teaching and learning to understand the lesson fully. This raises serious questions about how to help students learn the most. The study's objective is to ascertain the efficiency of SIM as a strengthening tool for those students who need help calculating the standard form of a circle's equation as one of the least-mastered skills in Grade 11 Pre-Calculus.

2. Literature Review

This study is anchored on the following theories: Self-Determination Theory (SDT) by Ryan and Deci (2017), Expectancy-Value Theory by Wigfield et al. (2009), and Achievement Motivation Theory by Atkinson (1964). Also, this is supported by the following legal bases: DepEd Division Memorandum No. 155A, series 2020 entitled, "Quarantrain on Designing Electronic SIMs," DepEd Order 08, series 2015 entitled, "Classroom Assessment Policy Guidelines," and DepEd Order No. 39, series of 2012 entitled, "Policy Guidelines on Addressing Learning Gaps and Implementing a Reading and Writing Program in Secondary Schools."

The Self-Determination Theory (SDT) by Ryan and Deci (2017) is a comprehensive framework that encompasses motivation, personal goals, and well-being, making it highly relevant for addressing motivation and engagement in modern workplaces (Gagné et al., 2017). SDT focuses on the individual as the central reference point and examines how factors like management style and work environment can either support or hinder an individual's motivation and overall well-being. This aspect of SDT aligns well with the contemporary societal emphasis on individual empowerment, providing a research-backed approach to understanding and fostering motivation and engagement with the potential for positive outcomes. According to theoretical methods and

empirical studies, the levels of motivating factors and self-esteem among students appear to drop throughout their academic careers. However, exact estimates of the size of the change continue to be tricky (Scherrer & Preckel, 2019).

Several motivational styles, derived from external rewards, ego involvement, self-worth, and intrinsic interest, impact student achievements. SDT states that the various motivational kinds co-occur to varying degrees and ought to have multiple effects. Due to each individual's distinctive qualities and the level of liberty it entails, links exist between these factors and outcomes (Howard et al., 2021).

The Expectancy-Value Theory (EVT) does not address complex cognitive processes like how someone interprets an arousal cue or if their expectations of success may spur them to action (Beckmann & Heckhausen, 2018). Although studies have demonstrated that students' expectations and values generally diminish, more recent research reveals a wide range of trajectories in the overall trend. As a result, the significance of drives as an organizing principle has diminished.

Additionally, the idea that organisms are constantly active gained traction, and the study of motivation changed from focusing on what makes an organism "on" or "off" to concentrating on the direction of behavior, including persistence and choice (Reeve, 2018). The interest in cognition resulted in EVT in motivation (Feather, 2021; Choi et al., 2010). Self-discipline is frequently necessary in pursuing important long-term objectives, such as diet adherence, regular exercise, or saving money (Tsukayama et al., 2013). The perceived behavioral control and self-efficacy significantly impacted the likelihood of individuals following through with the students' intentions (Kurata et al., 2023).

According to Atkinson's Theory of Achievement Motivation, high achievers are more driven to succeed (Brunstein & Heckhausen, 2018**;** Hasan & Khalid, 2012). While numerous research has examined the relationship between need attainment and characteristics, including ability, tenacity, risk-taking, retention, and gender, relatively few have examined the relationship between need accomplishment and programmed teaching. Teachers agree that motivation significantly affects classroom performance (Nyakundi, 2012). However, as crucial as motivational variables may be in the understanding, predicting, and controlling classroom behavior, there needs to be more information and theory associated with them (Pelletier et al., 2002).

DepEd Division Memorandum No. 155A, series 2020, entitled "Quarantrain on Designing Electronic SIMs." This activity aims explicitly to a] discuss the rationale and design of SIM; b] share strategies for developing and locating instructional materials that encourage active learning and support module-level learning objectives to be incorporated in the online or blended class; c] produce a well-designed SIM; d] assess the effectivity of the SIM produced; e] show optimism in creating SIMs to address the diverse needs of the learners.

In addition, DepEd Order 08, series 2015 entitled, Classroom Assessment Policy Guidelines, states that there must be adequate and relevant instructional measures to make sure that students are prepared for summative tests and that a student who gets a grade of less than 75 in any area of study or subject in any quarter must be intervened by remedial work and extra tutoring from the students' subject teacher (Sadsad, 2022). This policy guideline underlines the need to intervene to prevent gaps in student academic achievement. It also places a high value on inclusive learning.

Teachers must employ a teaching strategy that will enable students' active participation and performance, resulting in an excellent academic outcome and allowing them to develop, improve, and promote a healthy lifestyle (Capuyan et al., 2019; Etcuban, 2013). SIM is a remedial tool that aims to reteach concepts and skills to students to help them master competency-based skills that they could not develop during regular classroom teaching. With the release of DepEd Order No. 39 series of 2012, teachers in the country are encouraged to use SIMs, tutorials, and summer camps or classes to address learning gaps that vary across students and subject areas. This intervention requires a posttest, pretest, and fun learning activities. This stimulates the learners' acquisition of factual knowledge and mastery competence on specific topics. Instructional tools such as SIMs were proven effective educational involvement practices when applied to low-achieving learners. The good results were evident through countless research done both locally and abroad.

The most common motivations for participation were to contribute to scientific knowledge and learn new things. If someone were to inquire about why some students persevere in finishing tasks despite their extreme difficulty while others give up at the slightest provocation or why some students set themselves such unreasonably high goals that failure is inevitable, in an achievement setting, that person would be concerned with motivation (Serin, 2018).

Mathematics is essential for developing and testing scientific theories, making predictions, and designing experiments. A comprehensive approach to mathematics instruction is required to boost student performance and prepare them for future success. To achieve a school's educational goals, each teacher must grasp and comprehend the complexities of behavioral changes (Capuno et al., 2019). Teaching materials are commonly used to describe the teacher's resources to deliver instruction. This can support the students' learning and increase students' success. Ideally, the teaching materials were designed to fit the content in which such content is to be used in consonance with the student's level and needs. Though they vary widely in size and form, instructional resources may all contribute to students' learning. Instructional material plays a vital role in the teaching-learning process. It enhances the students' memory level and makes the teaching-learning process enjoyable. SIM, instructional material for remediation purposes, is one of the solutions employed by DepEd to enhance the academic achievements of students performing poorly in science, technology, and mathematics. During this pandemic, when some students have difficulty understanding the lessons in the module, this material is beneficial to help improve their performance while learning at home (Sison, 2021).

Many students struggled with math anxiety during their time in school. According to Kim et al. (2022), many students struggle more with math today. This could be because standards are becoming more challenging, and more demands are placed on the students. For whatever reason, students with problems succeeding in math need and need intervention measures. The 2019 study by Abuda et al. concentrated on the most minor learned abilities in solving exponential equations and examined how SIM affected eleventh-grade students' general mathematics proficiency level. The study's conclusions emphasize the use of cutting-edge SIM-based education and its counterpart in teaching general mathematics, one of the subject's commonly least-mastered abilities, which opens the door for students in the eleventh grade to advance their mathematical proficiency. The study by Cerujano (2019) concluded that the developed SIMs could address the learning gaps in mathematics. It is recommended that the teacher consider every individual learner's learning styles, needs, strengths, and weaknesses. However, the developed SIM should be utilized to address the least mastered competencies in mathematics.

These theories, legal bases, related literature, and studies are essential in formulating the variables concerning the attitudes and performance of the Grade 11 students in Pre-Calculus using SIM during the reopening of face-to-face classes.

3. Methodology

This section presents the study's design, research site, respondents, instruments to gather the quantitative data, research procedures, and data analysis.

3.1 Design

This study employed the descriptive-correlational method in gathering data relating to the attitudes and performance of the Grade 11 students in Pre-Calculus using SIM during the reopening of classes. The main reason for employing the descriptive method is to describe the attitudes and performance of the Grade 11 students in Pre-Calculus. Descriptive-correlational research provides the current situation regarding using SIM to determine the attitudes and performance of Grade 11 students in Pre-Calculus. The identified variables were designed to discover their relationships and allow predictions.

3.2 Environment and Respondents

Ninety-seven Grade 11 students from the three identified senior high schools of DepEd Cebu Province enrolled in Pre-Calculus during the school year 2022-2023. There were 33 respondents [34.02%] from School A, 28 respondents [28.87%] from School B and 36 respondents [37.11%] from School C. These Grade 11 student respondents were chosen using the probability random sampling technique through a sample generator. Once the generator identified the target respondent, the researchers labeled the generated number in the survey questionnaires. These questionnaires with filled-generated numbers were then used for survey administrations.

3.3 Instrument

This study utilized two sets of questionnaires. The first set of questionnaires is a standardized Attitudinal Test by Fennema-Sherman. The second set of questionnaires is a researchers-made Performance Test in Equations of Circles.

The standardized Attitudinal Test by Fennema-Sherman has two parts. Part 1 gathers the respondents' profiles, including the age, gender, type of junior high school the respondents graduated from, and the final math grade in Grade 10. Part 2 gathers the respondents' attitudes toward Pre-Calculus. The students' attitudes toward Pre-Calculus are categorized into a) Confidence in Learning, b) Attitude Towards Success, c) Mathematics as a Male Domain, and d) Usefulness. Each category has 12 items each, a total of 48 items wherein the respondents answered these items using the 4-Likert scale: 4 points for Strongly Agree [Very Positive Attitude], 3 points for Agree [Positive Attitude], 2 points for Disagree [Negative Attitude], and 1 point for Strongly Disagree [Very Negative Attitude].

The second instrument is a researchers-made performance test in equations of circles, which consists of two parts. Part 1 is the 15 multiple-choice test items, a researchers-made performance test in Equations of Circles during the pretest and posttest while using SIM. Part 2 gathers data using the ten items wherein the respondents answered these items using the 4-Likert scale: 4 points for Strongly Agree, 3 points for Agree, 2 points for Disagree, and 1 point for Strongly Disagree.

3.4 Data Analysis

The researchers wrote transmittal letters asking for approval to conduct the study on the identified respondents. Once approved, they administered the survey questionnaires to Grade 11 students in the identified public national senior high schools in DepEd Cebu Province. Since physical classes have resumed in the country, administration and data collection were done face-to-face. Once the data had been returned to the researchers, they checked individual questionnaires for completeness of data entries. With the help of a Data Matrix file, they encoded each data using the said file. After that, data hygiene is conducted to ensure all entries are consistent and complete. The researchers then used statistical software to tabulate and analyze. Based on the results, statistical interpretation was supported with professional recognition when representing significant results, conclusions, and actions. The gathered data were statistically treated using frequency, mean, simple percentage, standard deviation, weighted mean, Chi-square test of independence, and t-test.

3.5 Credibility and Reliability

Formal consent was obtained from the Office of the School Principal and the Grade 11 student respondents to ensure the confidentiality of the data collected from the respondents. The respondents are guaranteed the confidentiality of the information gathered regarding the Grade 11 students' attitudes and performances in Pre-Calculus. In this manner, the students' responses were used only for research purposes. Also, **t**he researchers ensure the respondents' confidentiality is respected and maintained during the study. They advised the respondents to fill out the consent form before they began answering the survey questionnaires. The consent form's concept is that the researchers provided the respondents with enough information regarding the study to inform them about their benefits when participating in the study. Also, this assures the respondents that only authorized personnel have access to all the information acquired and retrieved from the respondents.

3.6 Ethical Considerations

This research has ethical implications for addressing and promoting the search for knowledge and truth by preventing data fabrication or falsification. To avoid such hazards, the respondents in this study were informed of everything they needed to know about the study's purpose, duration, and process. It is entirely up to the respondents whether or not they choose to participate in this study. The respondents were not forced to participate in the study if they did not want to. If, for any reason, the respondents may withdraw from the investigation. There was no pressure on the respondents to continue. There were no negative consequences if respondents declined or removed from the study. Throughout the survey procedures, the researchers complied with the ethical research considerations. The researchers kept all respondents' sensitive information and identities protected.

4. Results and Discussion

This section presents the gathered data regarding the respondents' attitudes and performance in Pre-Calculus using SIM. Apprehension of Grade 11 students' attitudes and performances in Pre-Calculus is crucial for several reasons. This provides insights into their grasp of fundamental mathematical concepts, laying the foundation for advanced studies and future careers in their future careers.

4.1 Profile of the Respondents

Table 1 presents the profile of the respondents.

Table 1
Profile of the Respondents

		Frequency	Percentage
A. Age [in years]			
16 - 17		60	61.86
18 - 19		31	31.96
20 and above			6.19
	Mean : 17.34		
	StDev : 1.35		
B. Gender			
Female		47	48.45

Male	50	5 .55
C. Type of Junior High School Graduated		
Private	8	8.25
Public	89	91.75
D. Final Math Grade in Grade 10		
90 - 100 [Outstanding]	53	54.64
85 - 89 [Very Satisfactory]	27	27.84
80 - 84 [S tisfactory]	11	11.34
75 - 79 [Fairly Satisfactory]	6	6.19
Below 75 [Did Not Meet E pectations]	-	--.--
Mean : 89.07		
StDev : 4.94		
E. Strand Enrolled		
GAS	33	34.02
STEM	64	65.98

Most respondents are 16 to 17 years old (61.86%), with a mean age of 17.34 and a standard deviation of 1.35. Also, it shows that there are slightly more male respondents (51.55%) than females (48.45%). Most graduated from a public junior high school (91.75%) compared to a private (8.25%). Regarding the final math grade in Grade 10, most respondents received an outstanding grade (54.64%) with a mean grade of 89.07 and a standard deviation of 4.94 and are enrolled in the STEM strand (65. 8%).

According to the statistics, Grade 11 students offer essential insights about this cohort's demographics. The age distribution is noteworthy, showing that the majority are between 16 and 17. With a standard deviation of 1.35 and a mean age of 17.34, Grade 11 students' ages are uniformly distributed, suggesting a somewhat tight age grouping.

The statistics also reveal a modest gender imbalance, with slightly more male respondents than female respondents. This gender distribution raises concerns concerning possible effects on social dynamics, educational needs, and academic achievement within the Grade 11 cohort.

Regarding the educational background, the information suggests an intriguing trend in the kind of junior high school attended. Compared to private junior high schools, more students graduated from public ones. This discovery provides opportunities for investigating the possible influence of school type on socioeconomic characteristics, academic preparation, and resource accessibility.

The information on the final math results for Grade 10 shows an interesting pattern, with most respondents receiving excellent marks. A low standard deviation of 4.94 and an average grade of 89.07 indicate that the cohort's academic performance is above average. The table also reveals that early academic achievement shapes students' later educational paths.

4.2 Students Attitudes Toward Pre-Calculus

Table 2 presents the confidence level of the respondents in learning Pre-Calculus, with a total of 97 respondents.

Table 2
Confidence in Learning

#	Indicators	Mean	StDev	Interpretation
1.	I have felt secure about attempting Pre-Calculus.	2.87	0.61	Positive attitude
2.	I can do advanced work in Pre-Calculus.	2.78	0.60	Positive attitude
3.	I can learn Pre-Calculus.	3.10	0.74	Positive attitude
4.	I could handle more difficult Pre-Calculus.	2.75	0.75	Positive attitude
5.	I can get good grades in Pre-Calculus.	3.09	0.71	Positive attitude
6.	I have much self-confidence when it comes to pre-calculus.	2.86	0.74	Positive attitude
7.	I could improve at Pre-Calculus.	2.66	0.87	Positive attitude
8.	I could not do advanced Pre-Calculus.	2.69	0.77	Positive attitude
9.	I could do better in Pre-Calculus.	2.54	0.77	Positive attitude

10.	Even though I am studying pre-calculus, it seems unusually hard for me.	2.91	0.72	Positive attitude
11.	I can handle most subjects, but I must keep up.	2.84	0.72	Positive attitude
12.	Pre-Calculus has been my worst subject.	2.36	0.94	Negative attitude
	Aggregate Mean :	**2.79**	**0.75**	**Positive attitude**

Legend: 1.00-1.74 Very Negative Attitude; 1.75-2.49 Negative Attitude; 2.50-3.24 Positive Attitude; 3.25-4.00 Very Positive Attitude

The respondents generally had a positive attitude towards learning Pre-Calculus, with an aggregate mean of 2.79 and a standard deviation of 0.75. The "I can learn Pre-Calculus" indicator got the highest mean of 3.10 (Positive attitude) with a standard deviation of 0.74. The indicator, “Pre-Calculus has been my worst subject,” got the lowest mean of 2.36 (Negative attitude) with a standard deviation of 0.94. The data imply that respondents generally had a positive attitude toward learning Pre-Calculus, with only one indicator indicating a negative attitude. This result suggests that the respondents are confident in understanding and handling Pre-Calculus.

An important finding is that Grade 11 students had the chance to study Pre-Calculus. Pre-Calculus's inclusion in the curriculum denotes a shift in academic focus toward more complex mathematical ideas. This finding raises questions about how ready Grade 11 students are for the difficulties of Pre-Calculus courses. This implies that instructional techniques are meant to provide students entering this advanced mathematical realm with sufficient background knowledge and support systems. Comprehending the ramifications of including Pre-Calculus in the eleventh-grade curriculum enables customized methods that foster mathematical competence and establish the foundation for further academic achievements.

Table 3 presents the respondents' attitudes toward success.

Table 3
Attitude Towards Success

#	Indicators	Mean	StDev	Interpretation
1.	To be acknowledged as an exceptional Pre-Calculus student would bring me joy.	2.97	0.73	Positive attitude
2.	I would be proud to be an outstanding student in Pre-Calculus.	2.93	0.73	Positive attitude
3.	I would be happy to get top grades in Pre-Calculus.	3.06	0.80	Positive attitude
4.	It would be great to win a prize in Pre-Calculus.	3.08	0.70	Positive attitude
5.	Being first in a pre-calculus competition would please me.	3.00	0.69	Positive attitude
6.	Being regarded as competent in Pre-Calculus would be a great thing.	3.09	0.72	Positive attitude
7.	Gaining an award in mathematics would make me feel uncomfortable and noticeable.	2.56	0.75	Positive attitude
8.	People would think I was some creep if I got A's in Pre-Calculus.	2.57	0.79	Positive attitude
9.	If I got the highest grade in Pre-Calculus, I would try to hide it.	2.60	0.84	Positive attitude
10.	If I got the highest grade in math, I would prefer no one to know.	2.46	0.84	Negative attitude
11.	It would make people like me less if I were an excellent Pre-Calculus student.	2.45	0.83	Negative attitude
12.	I prefer people to think I need to be more competent in Pre-Calculus.	2.96	0.78	Positive attitude
	Aggregate Mean :	**2.81**	**0.77**	**Positive attitude**

Legend: 1.00-1.74 Very Negative Attitude; 1.75-2.49 Negative Attitude; 2.50-3.24 Positive Attitude; 3.25-4.00 Very Positive Attitude

The table shows that the indicator, “It would be great to win a prize in Pre-Calculus," got the highest mean of 3.08 (Positive attitude) with a standard deviation of 0.70. Also, it shows that the indicator, "It would make people like me less if I were an excellent Pre-Calculus student," got the lowest mean of 2.45 (Negative attitude) with a standard deviation of 0.83. The data imply that the data offer a strong chance for Grade 11 senior high school students who want to do well in Pre-Calculus and win awards. The significance is that trends among strong performers from earlier math courses may be found, enabling teachers to customize resources and assistance for best results. Targeted treatments may be developed by examining the traits of Pre-Calculus success students, such as their study habits and levels of engagement.

Table 4 presents the results on the perception of mathematics as a male domain.

Table 4
Mathematics as a Male Domain

#	Indicators	Mean	StDev	Interpretation
1.	Females are as good as males in Pre-Calculus.	2.74	0.92	Positive attitude
2.	Studying pre-calculus is just as appropriate for women as it is for men.	2.76	0.89	Positive attitude
3.	I would trust a woman just as much as a man to figure out essential calculations.	2.95	0.80	Positive attitude
4.	In Pre-Calculus, females can perform on par with males.	2.88	0.94	Positive attitude
5.	Pre-Calculus men are not inherently superior to women.	2.57	0.88	Positive attitude
6.	Women certainly are logical enough to do well in Pre-Calculus.	2.71	0.80	Positive attitude
7.	It is hard to believe a female could be a genius in Pre-Calculus.	2.46	0.89	Negative attitude
8.	When a woman has to solve a Pre-Calculus problem, asking a man for help is feminine.	2.61	0.77	Positive attitude
9.	I would have more faith in the answer to a Pre-Calculus problem solved by a man than a woman.	2.55	0.84	Positive attitude
10.	Girls who enjoy studying Pre-Calculus are peculiar.	2.66	0.80	Positive attitude
11.	Pre-Calculus is for men. Arithmetic is for women.	2.44	0.94	Negative attitude
12.	A female mathematician should be a manly individual.	2.53	0.86	Positive attitude
	Aggregate Mean :	**2.66**	**0.86**	**Positive attitude**

Legend: 1.00-1.74 Very Negative Attitude; 1.75-2.49 Negative Attitude; 2.50-3.24 Positive Attitude; 3.25-4.00 Very Positive Attitude

The table shows that the indicator, "I would trust a woman just as much as a man to figure out essential calculations," got the highest mean of 2.95 (Positive attitude) with a standard deviation of 0.80. Also, it shows that the indicator, "Pre-Calculus is for men. Arithmetic is for women," got the lowest mean of 2.44 (Negative attitude) with a standard deviation of 0.94. The results show that respondents generally believe that females are as good as males in pre-calculus and that studying Pre-Calculus is just as appropriate for women as for men. They also trust women to figure out essential calculations and believe that girls can do just as well as boys in pre-calculus. However, some negative attitudes are also present, such as the belief that it is hard to believe a female could be a genius in Pre-Calculus or that pre-calculus is only for men while arithmetic is for women. The results suggest that while some negative attitudes persist, most participants hold a positive attitude toward women's ability to succeed in Pre-Calculus.

Table 5 presents the survey results on the usefulness of Pre-Calculus among 97 respondents.

Table 5
Usefulness

#	Indicators	Mean	StDev	Interpretation
1.	I will need Pre-Calculus for my future work.	3.24	0.76	Positive attitude
2.	I studied pre-calculus because I knew how useful it was.	3.06	0.83	Positive attitude
3.	Knowing Pre-Calculus will help me earn a living.	3.11	0.73	Positive attitude
4.	Pre-Calculus is a worthwhile and necessary subject.	3.16	0.66	Positive attitude
5.	I will need a firm mastery of Pre-Calculus for my future work.	2.98	0.74	Positive attitude
6.	I will use Pre-Calculus in many ways as an adult.	3.00	0.79	Positive attitude
7.	Pre-Calculus is of no relevance to my life.	2.40	0.84	Negative attitude
8.	Pre-Calculus will be optional for me in my life's work.	2.28	0.89	Negative attitude
9.	Pre-Calculus is a subject I will rarely use daily as an adult.	2.67	0.86	Positive attitude
10.	Taking Pre-Calculus is a good use of time.	2.18	0.96	Negative attitude
11.	Regarding my adult life, I do not have to do well in Pre-Calculus in high school.	2.27	0.88	Negative attitude
12.	I expect to have little use for Pre-Calculus when I leave school.	2.75	1.22	Positive attitude
	Aggregate Mean :	**2.76**	**0.85**	**Positive attitude**

Legend: 1.00-1.74 Very Negative Attitude; 1.75-2.49 Negative Attitude; 2.50-3.24 Positive Attitude; 3.25-4.00 Very Positive Attitude

The table shows that the indicator, "I will need Pre-Calculus for my future work," got the highest mean of 3.24 (Positive attitude) with a standard deviation of 0.76. The indicator, "Taking Pre-Calculus is a good use of time," got the lowest mean of 2.18 (Negative attitude) with a standard deviation of 0.96. These imply that a crucial point for Grade 11 students' proficiency in Pre-Calculus is required for future career aspirations. Analyzing patterns in academic accomplishment and career paths may show a rising need for sophisticated mathematical abilities across various sectors. Pre-calculus proficiency gives students a solid basis for taking on complex analytical and problem-solving tasks, essential in various professional routes, including technology, economics, and STEM

fields. Thus, the research highlights Pre-Calculus's practical relevance and calls on teachers and students to acknowledge its critical role in developing a competitive skill set for the ever-changing demands of the workforce.

Table 6 summarizes students' attitudes toward Pre-Calculus based on four indicators: Confidence in Learning, Attitude Towards Success, Mathematics as a Male Domain, and Usefulness.

Table 6
Summary Table on Students' Attitudes Toward Pre-Calculus

	Indicators	Mean	StDev	Interpretation
A.	Confidence in Learning	2.79	0.75	Positive attitude
B.	Attitude Towards Success	2.81	0.77	Positive attitude
C.	Mathematics as a Male Domain	2.66	0.86	Positive attitude
D.	Usefulness	2.76	0.85	Positive attitude
	Aggregate Mean :	**2.76**	**0.81**	**Positive attitude**

Legend: 1.00-1.74 Very Negative Attitude; 1.75-2.49 Negative Attitude; 2.50-3.24 Positive Attitude; 3.25-4.00 Very Positive Attitude

The results indicate that students have a generally positive attitude toward Pre-Calculus across all four indicators, with an aggregate mean of 2.76, which falls within the positive attitude range. Specifically, students feel confident in their ability to learn Pre-Calculus (mean = 2.79), have a positive attitude toward success in the subject (mean = 2.81), do not view mathematics as a male domain (mean = 2.66), and perceive Pre-Calculus as beneficial for their future (mean = 2.76). The standard deviations for each indicator range from 0.75 to 0.86, indicating relatively low variability in students' attitudes.

4.3 Performance Test in Equations of Circles

Table 7 presents the results of the respondents' performances in Equations of Circles.

Table 7
Respondents' Performance Test in Equations of Circles

Raw Scores	Verbal Description	Frequency	Percentage
13 - 15	Very Good	-	--.--
9 - 12	Good	41	42.27
5 - 8	Fair	54	55.67
0 - 4	Poor	2	2.06
	Mean : 8.21		
	StDev : 2.02		

The mean score for the performance test in equations of circles is 8.21, with a standard deviation of 2.02. This means that, on average, the respondents performed at a "Fair" level in the test. The data show that Grade 11 students performed poorly in the Equations of Circles section. The data suggest a fair and consistent proficiency across the cohort, balancing challenge and success. This well-rounded performance indicates that everyone is aware of the relevant mathematical ideas. It motivates teachers to keep creating a safe and nurturing learning atmosphere so students can successfully understand the complexities of Equations of Circles. In Equations of Circles, the students' fair performance indicates a chance for focused interventions and cooperative learning techniques that would eventually help them receive a comprehensive mathematical education.

4.4 Students' Response to the Use of SIM

Table 8 presents the responses to the usefulness of SIM.

Table 8
Respondent's Response to the Usefulness of SIM

#	Indicators	Mean	StDev	Interpretation
1.	Thanks to the SIM, I can better comprehend how to solve the circle's standard equation.	3.18	0.56	Agree
2.	The SIM's concept designs are simple and appropriate for my needs.	3.22	0.50	Agree
3.	After using the material in the regular class, I picked up some helpful knowledge that needed to be covered.	3.15	0.51	Agree
4.	The SIM's tasks and activities were relatively simple.	3.08	0.59	Agree

5.	I liked reading and engaging in all of SIM's activities.	3.06	0.56	Agree
6.	SIM employs language that is appropriate for my reading comprehension.	3.18	0.58	Agree
7.	I could read and comprehend the SIM's explanation.	3.13	0.51	Agree
8.	I want to employ SIM in a conventional classroom the next time.	3.10	0.64	Agree
9.	I was motivated and inspired by SIM to learn additional mathematics concepts.	3.21	0.52	Agree
10.	Using SIM will help me perform well in mathematics.	3.25	0.56	Strongly agree
	Aggregate Mean :	**3.16**	**0.55**	**Agree**

Legend: 1.00-1.74 Strongly Disagree; 1.75-2.49 Disagree; 2.50-3.24 Agree; 3.25-4.00 Strongly Agree

The table shows that the indicator "Using SIM will help me perform well in mathematics" has the highest mean of 3.25 (Strongly agree) with a standard deviation of 0.56. The indicator, "I liked reading and engaging in all of SIM's activities," got the lowest mean of 3.06 (Agree) with a standard deviation of 0.56. The data imply that the use of SIMs significantly improves mathematics ability. The findings indicate that applying tactical intervention resources correlates with enhanced academic performance. These resources provide focused help to students by addressing specific issues and knowledge gaps. Also, it implies that a well-thought-out intervention strategy can support a better understanding of mathematical ideas by catering to various learning demands. This inference encourages future development and use of such resources, giving teachers a road map for creating a nurturing atmosphere supporting students' increased mathematics achievement in Grade 11.

4.5 Test of Significance of the Relationship

The study hypothesized that students' attitudes toward Pre-Calculus have significant relationships with the profile of the respondents. Table 9 shows the results.

Table 9
Relationship Between the Profile of the Respondents and the Students' Attitudes Toward Pre-Calculus

Variables	Chi-Square	df	Critical Value	Significance	Result
Students' Attitudes Toward Pre-Calculus and					
Age	12.298	4	9.488	Significant	Ho Rejected
Gender	2.290	2	5.991	Not Significant	Ho Accepted
Type of JHS Graduated	1.349	2	5.991	Not Significant	Ho Accepted
Final Math Grade in Grade 10	11.965	6	12.592	Not Significant	Ho Accepted
Strand Enrolled	15.166	2	5.991	Significant	Ho Rejected
Performance Test	1.702	4	9.488	Not Significant	Ho Accepted

The study revealed that the ages and strands of the respondents are correlated with their attitudes toward Pre-Calculus. The computed Chi-square values are significantly higher than their respective critical values. This leads to the rejection of the null hypothesis. These indicate a significant relationship between students' attitudes toward pre-calculus and their age and enrollment. Age and strand enrollment are essential factors in shaping students' attitudes toward Pre-Calculus. These imply that Grade 11 students' perceptions toward Pre-Calculus showed interesting relationships with enrolled strand and age. According to the findings, Pre-Calculus perceptions among students may change as they age due to growing academic maturity or cognitive growth. Also, differences in views were seen between academic strands, suggesting that curricular choices correspond with needs for a particular strand or innate topic affinities. These implications highlight critical issues about adjusting Pre-Calculus instruction to students' developmental stages and academic interests to provide a more effective and engaging learning environment for the varied Grade 11 students.

Table 10 shows the relationship between the respondents' profile and SIM's usefulness.

Table 10
Relationship Between the Profile of the Respondents and the Usefulness of SIM

Variables	Chi-Square	df	Critical Value	Significance	Result
The Usefulness of SIM and					
Age	8. 50	4	9.488	Not Significant	Ho Accepted
Gender	0.228	2	5.991	Not Significant	Ho Accepted
Type of JHS Graduated	11.909	2	5.991	Significant	Ho Rejected
Final Math Grade in Grade 10	14.506	6	12.592	Significant	Ho Rejected
Strand Enrolled	18.631	2	5.991	Significant	Ho Rejected
Performance Test	5.971	4	9.488	No Significant	Ho Accepted

The study shows that the type of JHS the respondents graduated, their final math grade in Grade 10, and the strand they enrolled in were correlated with their perceived usefulness of SIM. The computed Chi-square values are significantly higher than their respective critical values. This leads to the rejection of the null hypothesis. This means that the identified variables (type of JHS graduated, final math grade in Grade 10, and strand enrolled) were significantly correlated with their perception of the utility of the SIM, according to an examination of student data in Grade 11. The results imply that students' evaluations of the effectiveness of SIM are significantly shaped by their educational backgrounds, past academic achievement, and academic routes of choice. This information emphasizes how crucial it is to modify intervention tactics to meet the various demands of students according to their learning paths to provide more focused and efficient educational support.

4.6 Test of Significance of the Difference

Furthermore, it was hypothesized that the respondents' attitudes toward Pre-Calculus and their perceived usefulness of SIM significantly differ from their level of performance in the Equations of Circles. Table 11 shows the results.

Table 11
Difference Between Respondents' Attitudes Toward Pre-Calculus and the Students' Attitudes Toward Pre-Calculus (alpha = 0.05)

Variables	t-value	p-value	Significance	Result
Attitudes Toward Pre-Calculus and Level of Performance	-26.90	0.000	Significant	Ho Rejected
SIM's Level of Use and Level of Performance	-25.52	0.000	Significant	Ho Rejected

The table shows that these variables significantly differ from each other. The computed p-values are lesser than the alpha level of 0.05, which led to the rejection of their null hypothesis. Based on their performance in the Equations of Circles, the Grade 11 students exhibit striking differences in their views regarding Pre-Calculus and the perceived value of SIM. The information suggests a clear relationship between students' impressions of the topic and its resources and their understanding of specific mathematical ideas. Increased awareness of the value of intervention tools and more optimistic attitudes correlate with higher competency with the Equations of Circles. These revelations call for a more thoughtful approach to curriculum development and support systems, focusing on treatments that align with particular academic difficulties.

5. Conclusion

The study concluded that using the SIM in Pre-Calculus as instructional support significantly affected the student's performance in Pre-Calculus. The study found that the attitude of the students towards Pre-Calculus, specifically in Equation of Circles, and the use of SIM affect their performance in the subject. The study's results established that using SIM as an instructional support is effective in studying Pre-Calculus. As a result of using SIM to support learning, understanding the vital components that help students improve their Pre-Calculus performance has become essential. Giving students access to additional instructional materials, such as textbooks, teachers' manuals, supplemental materials, multimedia, and digital resources, is also advantageous for teaching and learning. SIMs are created to address the unique requirements and challenges students face when learning the principles and techniques of the subject matter. However, the researchers encourage teachers to keep track of their student's development and offer them the right interventions based on their unique needs and learning preferences.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
ORCID ID (if any): https://orcid.org/0000-0001-8930-6476

References

[1] Abuda, B. F., Oraller-Balazo, G. F., Orque, J. C., Cabili, M. C. D., & Maestre, M. (2019). Struggling learners' mathematics achievement level using quick response embedded strategic intervention material. https://tinyurl.com/4hyfxwjn
[2] Beckmann, J., & Heckhausen, H. (2018). Motivation as a function of expectancy and incentive. *Motivation and action*, 163-220. https://doi.org/10.1007/978-3-319-65094-4_5
[3] Brunstein, J. C., & Heckhausen, H. (2018). Achievement motivation. Motivation and action, 221-304. https://doi.org/10.1007/978-3-319-65094-4_6
[4] Capuno, R., Necesario, R., Etcuban, J. O., Espina, R., Padillo, G., & Manguilimotan, R. (2019). Attitudes, study habits, and academic performance of junior high school students in mathematics. *International Electronic Journal of Mathematics Education*, *14*(3), 547-561. https://doi.org/10.29333/iejme/5768
[5] Capuyan, D., Etcuban, J. O., Manguilimotan, R., Padillo, G., Raynera, W., & Onrejas, E. (2019). Mathematics remedial program for elementary learners in Cebu City, Philippines. *American Research Journal of Humanities Social Sciences*, *2*(5), 16-23. https://tinyurl.com/mr4bw6vd
[6] Cerujano, J. (2019). Effectiveness of the developed strategic intervention materials in Mathematics 9 as perceived by select junior high school teachers and students in Nasugbu East District. *Ascendens Asia Journal of Multidisciplinary Research Abstracts*, *3*(2B). https://tinyurl.com/ynb4e9wj
[7] Choi, J., Fiszdon, J. M., & Medalia, A. (2010). Expectancy-value theory in persistence of learning effects in schizophrenia: Role of task value and perceived competency. Schizophrenia Bulletin, 36(5), 957-965. https://doi.org/10.1093/schbul/sbq078
[8] Etcuban, J. O. (2013). Professional and ICT efficacy plan of instructors based on their training needs at the University of Cebu campuses, Philippines. *IAMURE International Journal of Multidisciplinary Research*, *5*(1), 1-1. https://www.ejournals.ph/article.php?id=2526
[9] Feather, N. T. (Ed.). (2021). Expectations and actions: Expectancy-value models in psychology. Routledge. https://tinyurl.com/38e3apt3
[10] Gagné, M., Deci, E. L., & Ryan, R. M. (2018). Self-determination theory applied to work motivation and organizational behavior. *The SAGE handbook of industrial, work & organizational psychology: Organizational psychology*, *2*, 97-121. https://tinyurl.com/2jcpstfy
[11] Hasan, S. S., & Khalid, R. (2012). Differences in achievement motivation and its salient components among high and low achieving students. *Pakistan Journal of Psychology*, *43*(1). http://tinyurl.com/5xpxxyth
[12] Howard, J. L., Bureau, J. S., Guay, F., Chong, J. X., & Ryan, R. M. (2021). Student motivation and associated outcomes: A meta-analysis from self-determination theory. *Perspectives on Psychological Science*, *16*(6), 1300-1323. https://doi.org/10.1177/1745691620966789
[13] Kim, S. J., Kastberg, S. E., Xin, Y. P., Lei, Q., Liu, B., Wei, S., & Chen, Y. (2022). Counting strategies of students struggling in mathematics in a computer-based learning environment. *The Journal of Mathematical Behavior, 68,* 101007. https://doi.org/10.1016/j.jmathb.2022.101007
[14] Kurata, Y. B., Ong, A. K. S., Prasetyo, Y. T., Dizon, R. M., Persada, S. F., & Nadlifatin, R. (2023). Determining factors affecting perceived effectiveness among Filipinos for fire prevention preparedness in the National Capital Region, Philippines: Integrating protection motivation theory and extended theory of planned behavior. *International Journal of Disaster Risk Reduction*, *85*, 103497. https://doi.org/10.1016/j.ijdrr.2022.103497
[15] Nyakundi, T. K. (2012). Factors affecting teacher motivation in public secondary schools in Thika West District, Kiambu County. Kiambau: Education of Kenyatta University. http://tinyurl.com/34nsnsrb
[16] Pelletier, L. G., Séguin-Lévesque, C., & Legault, L. (2002). Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *Journal of Educational Psychology, 94*(1), 186. https://psycnet.apa.org/doi/10.1037/0022-0663.94.1.186
[17] Reeve, J. (2018). Understanding motivation and emotion. John Wiley & Sons. https://tinyurl.com/3rv9ec9z
[18] Ryan, R. M., & Deci, E. L. (2017). Self-determination theory: Basic psychological needs in motivation, development, and wellness. The Guilford Press. https://tinyurl.com/365w7b73
[19] Sadsad, M. P. (2022). Utilizing the competency-based strategic intervention materials as tool to assess performance of students in Grade 9 Physical Education. http://tinyurl.com/2hhwb7m9
[20] Scherrer, V., & Preckel, F. (2019). Development of motivational variables and self-esteem during the school career: A meta-analysis of longitudinal studies. *Review of Educational Research*, *89*(2), 211-258. https://doi.org/10.3102/0034654318819127
[21] Serin, H. (2018). The use of extrinsic and intrinsic motivations to enhance student achievement in educational settings. *International Journal of Social Sciences & Educational Studies*, *5*(1), 191-194. https://doi.org/10.23918/ijsses.v5i1p191
[22] Tsukayama, E., Duckworth, A. L., & Kim, B. (2012). Resisting everything except temptation: Evidence and an explanation for domain–specific impulsivity. *European Journal of Personality*, *26*(3), 318-334. https://doi.org/10.1002/per.841