READINESS OF THE BACHELOR OF SECONDARY EDUCATION MAJOR IN MATHEMATICS STUDENTS FOR COLLEGE AND ADVANCED ALGEBRA: A BASIS FOR MODULE DESIGN AND ENHANCEMENT PROGRAM

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ABSTRACT: *This research investigates the readiness of Bachelor of Secondary Education Major in Mathematics students at Negros Oriental State University, focusing on their preparedness for College and Advanced Algebra. A researcher-made test, developed, validated, and tested for reliability, assessed students' proficiency in algebra topics foundational to basic education. Results revealed varying degrees of readiness, with notable deficiencies in areas such as Exponents and Radicals, Domain and Range of a Function, Graph of Functions and their Inverses, Solution of quadratic, fractional, and radical inequalities, Linear inequalities involving absolute value, Systems of Linear Equations and Inequalities, Exponential and Logarithmic Functions, Real Roots of Polynomial Functions, and Complex Zeros of Polynomial Functions. Performance varied across strands, with STEM students outperforming their peers, and a moderate relationship was observed between strands and scores, while sex showed a negligible relationship with performance. These findings emphasize the need for differentiated teaching strategies and equitable interventions to address the diverse needs of students from different strands. To address these gaps, the instructional module should focus on critical areas such as finding the domain of functions; solving quadratic, fractional, radical, and linear inequalities; solving systems of linear equations in two and three variables; determining the solution set of systems of inequalities; sketching graphs of exponential and logarithmic functions; solving exponential and logarithmic functions; evaluating, expanding, and simplifying logarithmic expressions; and finding the roots and complex zeros of polynomial functions. The study concludes with the recommendation to implement these targeted instructional modules in the curriculum to enhance students' comprehension of advanced algebraic concepts, ensuring readiness for higher education and supporting the development of competent and confident future mathematics educators.*

Keywords: College and Advanced Algebra, Algebra, College Algebra, Advanced Algebra, BSED Mathematics

1. INTRODUCTION

Mathematics is a cornerstone of education, fostering logical reasoning, analytical thinking, and problem-solving skills essential for various fields of study and professional domains. For Bachelor of Secondary Education (BSED) students majoring in Mathematics, a robust understanding of foundational mathematical concepts, particularly algebra, is indispensable for academic success and effective teaching in secondary schools [1]. Advanced algebra is a critical bridge between basic education and higher-level mathematical thinking, yet many students face significant challenges in transitioning to its more complex concepts [2].

The diverse academic backgrounds of students, shaped by their senior high school strands, create a range of readiness levels for college-level mathematics. Research indicates that students from STEM strands typically demonstrate stronger mathematical competencies than their peers from other tracks, revealing a gap that often hinders the uniform development of algebraic proficiency [3].

The readiness of aspiring mathematics educators to teach advanced algebra is directly linked to their mastery of the subject. While student teachers demonstrated relatively higher competency in algebra than other mathematics domains, significant gaps existed, particularly in applying algebraic concepts in real-world contexts [1].

This study investigates the readiness of BSED Mathematics students at Negros Oriental State University for college and advanced algebra. Using a validated researcher-made assessment tool, it evaluates students' proficiency in critical algebra topics, including exponents, functions, inequalities, and polynomial functions. The findings aim to inform the design of instructional modules and enhancement programs that address identified gaps and support the development of competent, confident mathematics educators. Specifically, it purports to shed light on the following questions:

1. What is the teaching interns' profile according to:
   1.1 sex; and
   1.2 senior high strand.
2. What is the respondents' performance in College and Advanced Algebra across all strands?
3. What is the difference between the respondents' performance when Grouped According to strand?
4. What is the relationship between the respondents' profile and their scores?
5. What competencies in the College and Advanced Algebra need emphasis in designing the module?

2. REVIEW OF RELATED LITERATURE

The study of students' readiness for advanced mathematical concepts, particularly algebra, has been a critical focus in education research. This review synthesizes studies that contribute to understanding the preparedness of students, particularly those in mathematics education programs, to transition to college-level and advanced algebra. The emphasis is placed on identifying the key factors influencing students' competencies in algebra and suggesting strategies for addressing gaps in knowledge.

Readiness for College and Advanced Algebra Several studies highlight the challenges that incoming students face in mastering algebraic concepts, which are fundamental for higher education mathematics. Difficulties that freshmen experience in understanding College Algebra, stressing the need for effective teaching materials and remedial instruction to prepare students better [4]. Many students, particularly in Ghana, struggle with algebraic concepts like exponential binomial expansions, order of operations, and simplification errors, highlighting the need for stronger algebra foundations before entering higher education [5].

Freshmen students encounter College Algebra, finding that many struggle with word problems, special products, factoring, equations, and radicals. They attribute these difficulties to deficiencies in prior knowledge, the absence of adequate instructional materials, and a lack of student persistence [6].

Difficulties in Learning Algebra

A significant theme across multiple studies is the identification of common algebraic difficulties. The research by Pramesti and Retnawati [7] analyzes errors students make in learning algebra, noting three primary difficulties: understanding the problem, interpreting variables, and manipulating algebraic expressions. The study emphasizes the need for strategies that enhance students' procedural and conceptual understanding of algebra.

Similarly, the study by Stemele and Asvat [8] highlights errors and misconceptions in algebraic expressions among Grade 9 learners in South Africa. They categorize these errors into slips, sign errors, misconceptions, and substitution errors.

Instructional Strategies for Addressing Algebraic Difficulties

Effective teaching strategies are critical for addressing the difficulties students face in algebra. Karjanto and Acelajado [9] explore the impact of flipped classrooms on students' performance in College Algebra, noting that this approach leads to improvements in both cognitive and non-cognitive outcomes. This teaching strategy could help students actively engage with the material, thus fostering a deeper understanding of algebraic concepts.

Gender

The studies by Sebastian [10] examined the impact of gender and learning style on students' success in College Algebra. Sebastian's study found that female students often struggle more with algebraic concepts than male students, possibly due to higher levels of math anxiety. Additionally, Ndum [11] explored how psychosocial factors, including gender differences in self-efficacy and learning styles, mediate the performance gaps in subjects like College Algebra. These studies highlight the importance of tailored instructional strategies that consider gender-specific learning challenges and psychological factors influencing students' performance in mathematics.

Curriculum and Teaching Approaches

Research by Karjanto & Acelajado [9] on flipped classrooms in College Algebra emphasized how innovative teaching methods could positively affect cognitive and non-cognitive outcomes. The flipped classroom model was shown to enhance students' understanding by providing more opportunities for active learning and peer interactions. Remedial instruction and the development of supplementary learning materials to bridge the knowledge gap for incoming freshmen struggling with algebra [4]. These approaches align with the findings of Sabonsolin [12], which indicated the need for curriculum adjustments based on student performance. Sabonsolin's study showed that students from different colleges had varying levels of understanding of algebraic concepts, with some performing better in specific areas like linear equations and quadratic equations. This further underscores the importance of adaptive teaching strategies.

Student Performance and Algebraic Concepts

The study by Sabonsolin [12] also found that students' performance in algebraic topics like sets, real numbers, algebraic expressions, and fractions varied widely across colleges. Colleges with higher-performing students (such as CIICT and CoE) demonstrated a better understanding of algebraic principles, while others, such as CoME and CAS, exhibited moderate to low performance. This variation could be due to differences in student backgrounds, preparedness, and the quality of instruction received. Additionally, students' deficiencies in key areas like factoring, solving equations, and working with radicals were noted. This study complements the findings of Felix [4] and Unay *et al.* [6], emphasizing the importance of reinforcing foundational concepts in College Algebra.

3. SIGNIFICANCE OF THE STUDY

This research holds significant value in the field of mathematics education, particularly for teacher preparation programs and secondary education. Its findings contribute to various stakeholders as follows:

For Bachelor of Secondary Education (BSED) Mathematics Students

The study identifies specific gaps in students' readiness for college and advanced algebra, enabling the development of tailored instructional modules and enhancement programs. These interventions aim to strengthen their algebraic proficiency, preparing them not only for academic success but also for their future roles as competent mathematics educators.

For Teacher Educators and Program Designers

The insights gained from this study can guide educators in revising and improving the curriculum of teacher education programs. By addressing the specific deficiencies in advanced algebra readiness, teacher educators can implement differentiated strategies to ensure a solid foundation for their students. This aligns with the findings of Denbel [1], who highlighted the importance of subject matter competency in mathematics teacher preparation.

For Senior High School Curriculum Developers

The research emphasizes the varying performance levels among students from different strands, such as STEM and non-STEM tracks. This information can inform senior high school curriculum developers in designing preparatory programs that enhance algebra readiness across all tracks [2].

For Educational Policymakers

Policymakers can use the study's results to develop policies that support the equitable preparation of students for college-level mathematics, regardless of their academic background. This includes funding and promoting interventions like performance-based assessments and the integration of technology in mathematics instruction [2, 13].

For Future Researchers

The study provides a foundation for future research on addressing gaps in algebra readiness and developing effective instructional strategies. It encourages further exploration of how teaching approaches and curriculum designs can impact students' proficiency and confidence in teaching advanced mathematics concepts.

In sum, the findings of this study have far-reaching implications for the enhancement of mathematics education, particularly in preparing aspiring mathematics teachers to meet the demands of their profession with confidence and competence.

4. METHODOLOGY

The research followed a structured procedure to ensure the validity, reliability, and accuracy of the findings. Initially, a 100-item test was developed based on the competencies specified in CMO No. 15 s. 2017 and the Teacher Education Council and Research Center for Teacher Quality Compendium of 2020. The test covered key algebra topics such as exponents, radicals, functions, inequalities, and polynomial roots. It underwent validation through a panel of mathematics education experts, who reviewed the content for clarity, relevance, and alignment with the prescribed competencies. Revisions were made based on their feedback to improve the instrument's quality.

Following the validation, the test was pilot-tested at Negros Oriental State University-Siaton Campus using the parallel forms method to evaluate its consistency and applicability in assessing students' algebra readiness. Reliability testing was conducted using the Pearson Product-Moment Correlation Coefficient, yielding a high-reliability score of 0.945, indicating that the test was a dependable measure of the intended competencies.

The validated and reliable test was then administered to Bachelor of Secondary Education major in Mathematics students across multiple campuses, including NORSU-Main Campus, NORSU-Bayawan Campus, and NORSU-Guihulngan Campus. Data were systematically gathered during the test administration phase to ensure completeness and accuracy. Finally, statistical analysis was performed, including the computation of the mean, standard deviation, and correlation, to analyze the students' performance and identify trends and gaps in their algebra readiness.

RESULTS AND DISCUSSION

Table 1.1: Respondents' Profile in Terms of Sex

Sex	Frequency	Percentage (%)
Male	20	28.6%
Female	50	71.4%
Total	**70**	**100%**

Table 1.1 shows that out of the 70 students in the study, 20 (28.6%) are male and 50 (71.4%) are female. This indicates that there are more female students in the group. However, despite the higher number of female students, gender did not significantly affect their performance in algebra. This finding aligns with the research of Owolabi and Adejoke [14], who found that gender, along with factors like mathematics anxiety, did not significantly influence students' algebra achievement. Similarly, Sebastian [10] highlighted that gender differences in learning outcomes are less important than individual learning styles and academic preparedness. Therefore, the results suggest that both male and female students should receive similar support to enhance their algebra skills, focusing more on their learning needs than on gender.

Table 1.2: Respondents' Profile in Terms of Strand

STRAND	Frequency	Percentage
STEM	10	14.3%
ABM	10	14.3%
HUMMS	30	42.9%
GA	12	17.1%
TVL	8	11.4%
Total	**70**	**100%**

Table 1.2 presents the student distribution across strands and shows that HUMMS has the largest representation at 42.9% (30 students), followed by STEM and ABM at 14.3% each (10 students), GA at 17.1% (12 students), and TVL at 11.4% (8 students). The dominance of HUMMS reflects its focus on humanities and social sciences, while STEM and ABM represent balanced interests in business and science, key areas in algebraic learning [15]. The smaller TVL group aligns with vocational education's emphasis on practical skills over advanced mathematics [4]. This distribution allows for an analysis of how students from different strands perform in algebra, helping to identify strand-based differences in algebraic proficiency [6].

Table 2.1: Performance of the Respondents in College and Advanced Algebra Across All Strands

Topics	Objectives	Cognitive Domain Level	No. of Items	Mean Score	Transmutation	Verbal	SD
1. ALGEBRAIC EXPRESSION 1.1 Constants, variables, terms, monomial, multinomial (binomial, trinomial…), polynomials, coefficients, factors, degree of a term	Identifying algebraic expression as monomial, binomial, trinomial or polynomial	Remembering	3	2.971	99	Excellent	0.168
	Identifying the degree of polynomial	Understanding	3	1.814	72	Did Not Meet Expectations	1.026
1.2 The fundamental operations of algebraic expressions	Performing fundamental operations of algebraic expressions	Application	3	1.129	56	Did Not Meet Expectations	1.128
1.3 Factoring and Algebraic Fractions	Using special products to expand and simplify expressions	Application	2	0.457	46	Did Not Meet Expectations	0.652
	Factoring algebraic expressions	Analyzing	3	2.129	80	Did Not Meet Expectations	1.179
	Simplifying algebraic fractions.	Applying	3	0.357	38	Did Not Meet Expectations	0.781
	Simplifying complex fractions	Applying	2	0.300	41	Did Not Meet Expectations	0.622
OVERALL				**1.308**	**62**	**Did Not Meet Expectations**	

Table 2.1 reveals significant gaps in students' understanding and application of key algebraic concepts. While students excelled in identifying algebraic expressions like monomials and polynomials (mean score 2.971), they struggled with more complex tasks, such as identifying the degree of a polynomial (mean score 1.814). Students also faced difficulties with fundamental operations on algebraic expressions, scoring poorly in tasks like addition, subtraction, and division of polynomials (mean score 1.129), consistent with Unay *et al*. [6]. Factoring and simplifying algebraic expressions, especially special products and algebraic fractions, were also challenging, with mean scores of 0.457 and 0.300, respectively, mirroring findings by Owolabi and Adejoke [14] and Karjanto and Acelajado [9]. The overall mean score of 1.308 highlights the inadequate mastery of the topics, which aligns with Stemele and Asvat [8] and Williams and Agyei [5].

Table 2.2: Performance of the Respondents in College and Advanced Algebra Across All Strands

2. EXPONENTS AND RADICALS	Objective	Cognitive Domain Level	No. of	Mean Score	Transmutat.	Verbal	SD
2.1 Simplifying exponential expressions	Simplifying exponential expressions	Applying	3	0.343	38	Did Not Meet Expectations	0.720
2.2 Fundamental operations on exponential expressions	Performing fundamental operations on exponential expressions	Applying	6	0.143	32	Did Not Meet Expectations	0.427
2.3 Transforming exponential expressions to radicals and versa	Transforming exponential expressions to radicals and versa	Understanding	5	0.057	31	Did Not Meet Expectations	0.234
OVERALL				0.181	34	Did Not Meet Expectations	

who noted freshmen's lack of procedural knowledge. Transforming between exponential and radical forms yielded an even lower mean score of 0.057, pointing to a fundamental misunderstanding of their relationship. Learners' difficulties with such transformations are due to inadequate foundational knowledge [8, 5]. The overall mean score of 0.181 places students in the "Did Not Meet Expectations" category, reflecting a widespread lack of mastery in these areas.

Table 2.3 presents the data on students' performance in Relations and Functions and shows significant challenges, with widespread struggles across all areas. In identifying functions, students scored a mean of 1.729, which, although higher than other sections, still falls within the "Did Not Meet Expectations" range. This reflects difficulties in distinguishing functions from general relations, as noted by Smith [15].

Table 2.3; Performance of the Respondents in College and Advanced Algebra Across All Strands

3. RELATIONS AND FUNCTIONS AND THEIR GRAPHS	Objectives	Cognitive Domain Level	No. of Items	Mean Score	Transmutation	Verbal	SD
3.1 Definition of a Relation and Function	Identifying functions	Remembering	4	1.729	60	Did Not Meet Expectations	1.102
3.2 Domain & Range of a Function	Finding the domain of a function	Analyzing	3	0.000	30	Did Not Meet Expectations	0.000
3.3 Algebra of Functions	Evaluating functions	Applying	4	0.314	35	Did Not Meet Expectations	0.843
	Evaluating composite functions	Applying	4	0.029	31	Did Not Meet Expectations	0.239
3.4 Graph of Functions and their Inverses	Graphing Functions and their Inverses		2	0.029	31	Did Not Meet Expectations	0.168
	OVERALL			**0.420**	**37**	**Did Not Meet Expectations**	

Performance in understanding the domain and range of functions was particularly poor, with a mean of 0.000, indicating that students could not identify or calculate the domain, a crucial algebraic skill. Pramesti and Retnawati [7] found similar issues, with students failing to recognize the limitations of functions. Evaluation of functions and composite functions also showed low scores (0.314 and 0.029, respectively), reflecting gaps in both conceptual understanding and procedural knowledge, as highlighted by Unay *et al*. [6] and Edo and Tasik [16].

Table 2.4: Performance of the Respondents in College and Advanced Algebra Across All Strands

4. EQUATIONS AND INEQUALITIES	Objective	Cognitive Domain Level	No. of	Mean Score	Transmutation	Verbal	SD
4.1 Equality Properties and Basic Concepts of Equations	Solving Linear and Quadratic Equations in One Unknown	Analyzing	5	1.186	47	Did Not Meet Expectations	0.906
4.2 Inequalities in general	Solutions of Linear Inequalities	Analyzing	3	0.157	34	Did Not Meet Expectations	0.367
4.3 Solutions of Linear Inequalities	Solutions of Linear Inequalities	Analyzing	3	0.157	34	Did Not Meet Expectations	0.367
4.4 Solution of quadratic, fractional and radical inequalities	Solution of quadratic, fractional and radical inequalities	Analyzing	5	0.000	30	Did Not Meet Expectations	0.000
4.5 Linear inequalities involving absolute value	Solving linear inequalities involving absolute value		2	0.000	30	Did Not Meet Expectations	0.000
OVERALL				**0.448**	**37**	**Did Not Meet Expectations**	

Graphing functions and their inverses yielded a mean score of 0.029, pointing to difficulties in visualizing and representing functions graphically, consistent with Williams and Agyei [5].

In Table 2.4, the performance data for Equations and Inequalities reveals significant challenges for students in mastering essential algebraic skills. The mean score for solving linear and quadratic equations was 1.186, indicating struggles with basic concepts. Difficulties stem from a lack of foundational knowledge necessary for solving equations [4, 15].

Students also struggled with inequalities, scoring 0.157 for linear inequalities and 0.000 for fractional, quadratic, and radical inequalities. The lack of correct solutions for more complex inequalities suggests deeper conceptual issues. Additionally, students scored 0.000 in solving absolute value inequalities, indicating a fundamental misunderstanding of the concept [14].

Table 2.5 presents the data on Systems of Linear Equations and Inequalities that highlight significant difficulties for students in applying algebraic concepts. The mean scores for solving systems of linear equations in two and three variables were both 0.000, indicating a severe lack of proficiency in these foundational skills. Students often struggle with systems of equations, especially those involving multiple variables [4, 6].

Table 2.5: Performance of the Respondents in College and Advanced Algebra Across All Strands

5. SYSTEMS OF LINEAR EQUATIONS AND INEQUALITIES	Objective	Cognitive Domain Level	No. of Items	Mean Score	Transmutation	Verbal	SD
5.1 Methods in Solving System of Linear Equations in Two Variables	Solving System of Linear Equations in Two Variables	Analyzing	2	0.000	30	Did Not Meet Expectations	0.000
5.2 System of Linear Equations in Three Variables;	Solving System of Linear Equations in Three Variables	Analyzing	2	0.000	30	Did Not Meet Expectations	0.000
5.3 Word Problems involving one, two, or three Variables	**Solving word Problems involving one, two, or three Variables**	**Analyzing**	**2**	**0.243**	**39**	**Did Not Meet Expectations**	**0.000**
5.4 Solution linear in two variables	Finding/determining the solution set of system of inequalities two variables	Analyzing	2	0.000	30	Did Not Meet Expectations	0.000
5.5 Solution of a system of inequalities in two unknowns	Finding/determining the solution set of the system of inequalities in two unknowns	Analyzing	2	0.000	30	Did Not Meet Expectations	0.000
OVERALL				**0.049**	**32**	**Did Not Meet Expectations**	

This difficulty extends to solving word problems involving systems of equations, where the mean score was 0.243, showing that students face challenges in translating real-world situations into algebraic expressions, a struggle noted by Owolabi and Adejoke [14].

The results for systems of inequalities were equally concerning, with mean scores of 0.000, suggesting significant gaps in understanding how to solve systems of linear inequalities. This aligns with Smith [15] and Unay [6], who identified conceptual misunderstandings in inequalities.

Table 2.6 shows the results for Exponential and Logarithmic Functions revealing significant gaps in students' understanding. For example, the mean score for sketching graphs of exponential and logarithmic functions was 0.000, indicating a complete lack of proficiency. Students also struggled with solving exponential functions using the One-to-One Property, scoring 0.000. In logarithmic functions, they performed poorly on tasks such as converting between exponential and logarithmic forms, with a mean score of 0.429, reflecting insufficient understanding.

The data also showed difficulties in solving and graphing natural logarithmic functions, with students scoring 0.000 on multiple items.

Table 2.6: Performance of the Respondents in College and Advanced Algebra Across All Strands

6. EXPONENTIAL AND LOGARITHMIC	Objective	Cognitive Domain Level	No. of Items	Mean Score	Transmutation	Verbal	SD
6.1 Exponents and the Number *e*	Sketching the graph of exponential and logarithmic functions	Applying	2	0.000	30	Did Not Meet Expectations	0.000
6.2 Exponential Function	Solving exponential functions using the One-to-One Property.	Applying	2	0.000	30	Did Not Meet Expectations	0.000
6.3 Logarithmic Function	Writing exponential form to logarithmic form	Understanding	3	0.429	40	Did Not Meet Expectations	0.356
	Writing logarithmic form to exponential form	Understanding	3	0.429	40	Did Not Meet Expectations	0.356
6.4 Natural Logarithmic Function	Solving logarithmic Functions	Analyzing	3	0.000	30	Did Not Meet Expectations	0.000
	Graphing natural logarithmic functions	Analyzing	1	0.000	30	Did Not Meet Expectations	0.000
	Evaluating Natural Logarithmic Functions	Applying	3	0.029	30	Did Not Meet Expectations	0.239
	Expanding logarithm	Applying	2	0.000	30	Did Not Meet Expectations	0.000
	Simplifying logarithmic functions.		3	0.000	30	Did Not Meet Expectations	0.000
OVERALL				**0.099**	**61**	**Did Not Meet Expectations**	

Low performance in evaluating natural logarithmic functions and expanding logarithms further underscores a lack of skill in applying logarithmic properties.

Students often struggle with exponential and logarithmic functions due to conceptual challenges [7]. Similar gaps were observed in research by Unay et al. [6] and Felix [4], which highlighted deficiencies in algebraic understanding, particularly in handling complex functions

Table 2.7: Performance of the Respondents in College and Advanced Algebra Across All Strands

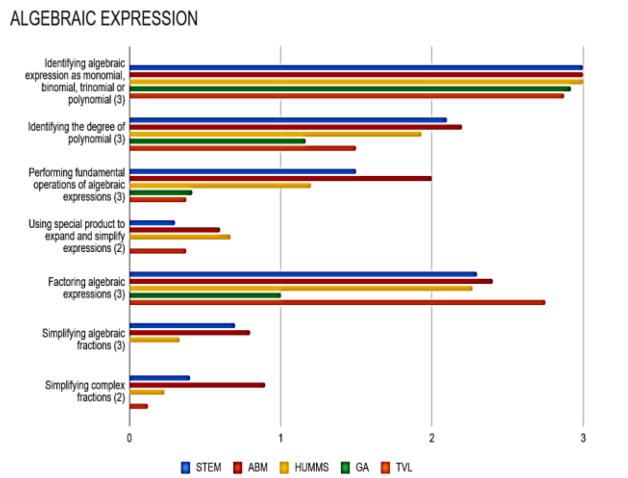
7. POLYNOMIAL FUNCTIONS AND POLYNOMIAL EQUATIONS	Objective	Cognitive Domain Level	No. of Items	Mean Score	Transmutation	Verbal	SD
7.1 The Remainder Theorem, The Factor Theorem, and Synthetic Division	finding the remainder using the long method	Applying	2	0.014	31	Did Not Meet Expectations	0.119
	Using the synthetic division in finding the quotient and the remainder.	Applying	2	0.014	31	Did Not Meet Expectations	0.119
7.2 Real Roots of Polynomial Functions	Finding the roots of the following polynomials	Applying	2	0.000	30	Did Not Meet Expectations	0.000
7.3 Complex Zeros of Polynomial Functions	Finding the complex Zeros of the given polynomial function	Applying	1	0.000	30	Did Not Meet Expectations	0.000
OVERALL				**0.007**	**31**	**Did Not Meet Expectations**	

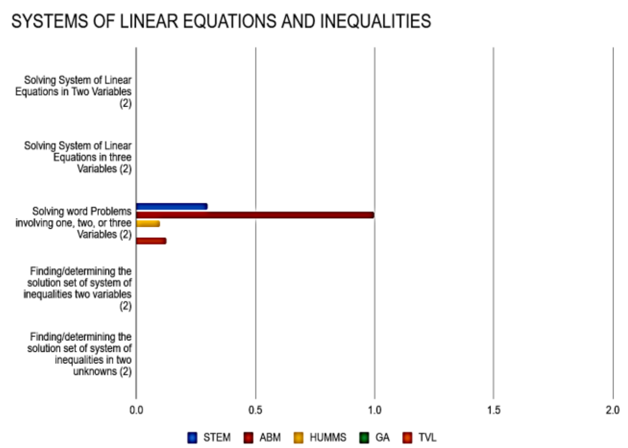
Table 2.7 presents the performance in Polynomial Functions and Polynomial Equations which highlights significant challenges in mastering key algebraic concepts. Students scored poorly when tasked with finding the remainder using long division (mean score of 0.014) and using synthetic division to find the quotient and remainder (mean score of 0.014), reflecting struggles with procedural application.

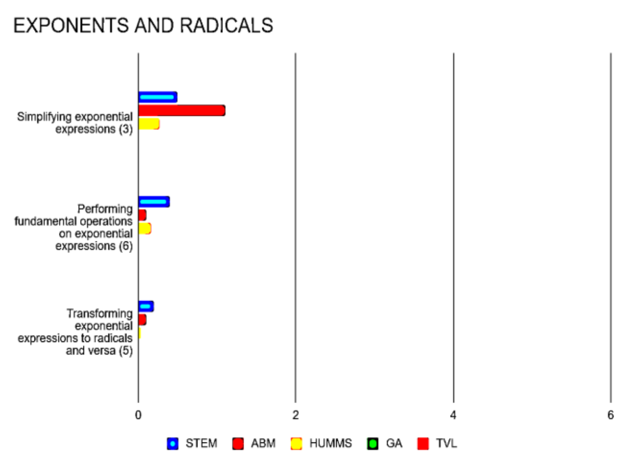
Additionally, students showed no proficiency in finding the real roots of polynomial functions, scoring 0.000, and also struggled with finding complex zeros, which is concerning given the importance of these skills in algebra.

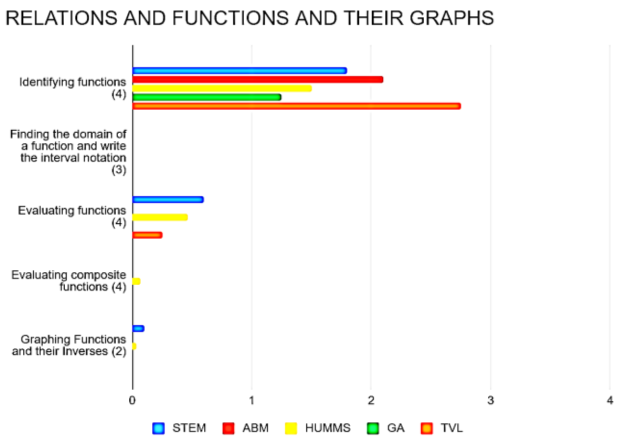
The respondents' performance in various algebraic topics was analyzed based on their academic strands, which included STEM, ABM, HUMMS, GA, and TVL. In the topic of Algebraic Expressions, the students from the STEM and ABM strands performed equally well, with perfect scores in tasks related to identifying algebraic expressions and understanding polynomials. However, students from the HUMMS, GA, and TVL strands showed slightly lower scores in some tasks, particularly in identifying the degree of polynomials and performing fundamental operations on algebraic expressions.

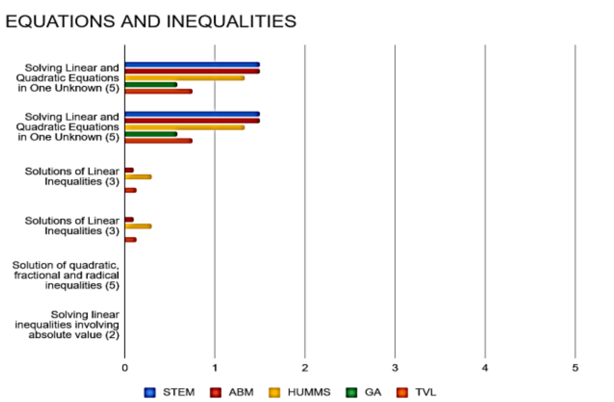
Table 3.1; Difference Between the Respondents' Performance when Grouped According to STRAND

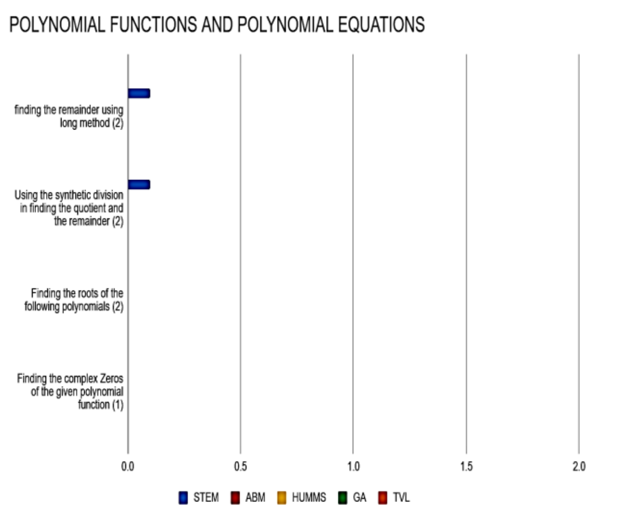












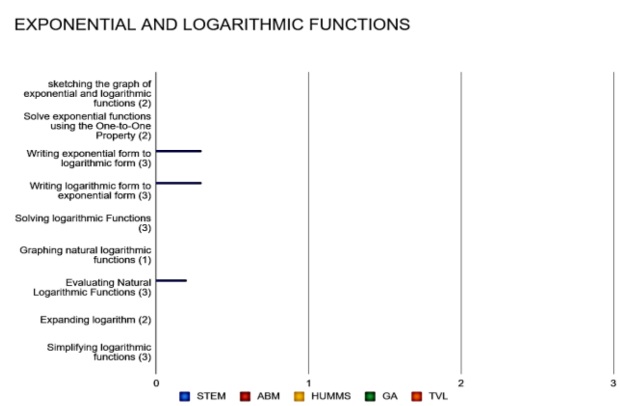
The overall performance in factoring and simplifying algebraic fractions showed a notable disparity, with STEM and ABM students scoring higher compared to HUMMS, GA, and TVL students. This highlights the need for more focused teaching strategies tailored to the specific needs of each group [6; 14].

In the Exponents and Radicals section, STEM and ABM students outperformed their counterparts in simplifying exponential expressions and performing fundamental operations, with GA and TVL students scoring significantly lower. The ability to transform exponential expressions into radical form was especially challenging for students from the GA and TVL strands, who scored the lowest across all groups. Students' academic background and strand may significantly influence their understanding of complex mathematical concepts [10].

For Relations, Functions, and Their Graphs, students from the STEM strand showed strong performance, particularly in identifying functions and graphing their inverses. The ABM students performed moderately well, while HUMMS, GA, and TVL students exhibited lower scores, especially in tasks related to finding the domain and range of functions. Differences in mathematical competencies among students from varying educational strands [4].

In the Equations and Inequalities section, STEM and ABM students showed consistent performance in solving linear and quadratic equations, as well as in understanding inequalities. However, students from the GA and TVL strands struggled more, particularly with solving inequalities and quadratic equations. The overall performance in systems of linear equations and inequalities was low across all strands, with most students failing to score well on word problems and inequalities involving absolute values. This mirrors the results of studies such as that by Ndum [11], which highlight gender and strand-based performance differences in mathematics.

In the area of Exponential and Logarithmic Functions, most students from the STEM and ABM strands demonstrated difficulty in solving exponential and logarithmic functions,



with scores close to zero for all strands in tasks related to graphing and solving exponential functions. The TVL strand showed the weakest performance overall in this section, confirming the findings of Anoling et al. [17] regarding the challenges faced by students in grasping higher-order algebraic functions.

For Polynomial Functions and Polynomial Equations, the performance was similar across strands, with most students failing to perform well on tasks such as finding remainders using long division or synthetic division. The scores for finding the real roots and complex zeros of polynomials were also low across all groups. Students often struggle with polynomial concepts due to insufficient foundational knowledge [9].

In conclusion, the performance of students was generally better in the STEM and ABM strands, especially in fundamental algebraic concepts, while students in the GA and TVL strands faced challenges, particularly in more complex algebraic topics such as logarithmic functions and polynomial equations. These results suggest that there is a need for targeted interventions and more focused support, especially for students in the GA and TVL strands, to help improve their algebraic proficiency [4, 14].

Table 4.1: Relationship Between the Respondents' Profile and Their Scores

Profile vs Scores	Rho-Value	Degree of Relationship
Sex	-0.023	Very Low or Negligible Relationship
Strand	0.448	Moderate Relationship

*Adapted from Calmorin

Table 4.1 presents the analysis of the relationship between student profiles (sex and strand) and their algebraic performance and reveals notable findings based on the correlation (Rho-value). The relationship between **sex** and scores was found to be very low or negligible, with a Rho-value of **-0.023**. This suggests that there is little to no significant difference in performance based on sex, implying that male and female students performed similarly across the algebra topics. This aligns with findings from Owolabi and Adejoke [14], who reported that gender did not significantly influence students' mathematical performance in algebra.

On the other hand, the relationship between strand and algebra scores was found to be moderate, with a Rho-value of **0.**448. This indicates a moderate correlation, suggesting that students' performance in algebra is influenced to a greater extent by the academic strand they belong to. STEM and ABM students generally performed better compared to students from the GA and TVL strands. The academic background and specialization of students influence their mathematical capabilities and problem-solving skills [4, [10].

CONCLUSIONS

The findings of this study revealed that the academic strand significantly influenced students' performance in College Algebra, with STEM students generally performing better than those from the other strands. The results suggest that students from the STEM strand exhibit stronger algebraic skills, particularly in topics like algebraic expressions, factoring, and solving equations. On the other hand, students from the GA and TVL strands faced greater challenges in these areas, as reflected in their lower scores. Furthermore, the study found no significant relationship between students' sex and their algebraic performance, indicating that gender did not play a substantial role in determining students' mathematical abilities in the context of this study.

The moderate relationship between academic strands and performance underscores the potential influence of specialized curricula and teaching methods tailored to different strands. Variations in academic preparation and focus can lead to differential performance in mathematics [10]; [6]. However, the negligible relationship between sex and performance aligns with findings suggesting that other factors, such as teaching approaches or learning styles, may have a more significant impact on student outcomes in mathematics [14].

To address the gaps identified in the study, the instructional module should focus on key areas that were challenging for students, particularly those from the GA and TVL strands. These areas include:

- Finding the domain of functions
- Solution of quadratic, fractional, and radical inequalities
- Solving linear inequalities involving absolute value
- Solving systems of linear equations in two and three variables
- Finding/determining the solution set of systems of inequalities in two variables
- Sketching the graph of exponential and logarithmic functions
- Solving exponential functions using the One-to-One Property
- Solving logarithmic functions
- Graphing natural logarithmic functions
- Evaluating natural logarithmic functions
- Expanding and simplifying logarithmic functions
- Finding the roots of polynomials
- Finding the complex zeros of polynomial functions

By focusing on these key areas, the instructional module can better support students in mastering the foundational concepts necessary for success in College Algebra.

RECOMMENDATIONS

1. **Curriculum Adjustments and Targeted Support**
2. Given the performance differences between strands, it is recommended that the curriculum for College Algebra be tailored to address the varying needs of students from different academic strands. This could involve providing additional support and resources for GA and TVL students, who may benefit from remedial courses or targeted instruction in foundational algebraic skills. STEM students may also benefit from more advanced algebraic challenges to further enhance their skills.
3. **Further Investigation of Gender and Other Factors**
4. Although gender did not show a significant impact in this study, future research could explore additional demographic and psychological factors that may influence algebraic performance, such as motivation, anxiety, and learning preferences. This would provide a more comprehensive understanding of student performance and help in designing more inclusive and effective teaching strategies.
5. **Professional Development for Educators**
6. Teachers should receive ongoing professional development to better address the diverse needs of students across strands. Training in differentiated instruction, formative assessments, and the use of technology in teaching mathematics can enhance the learning experience for students, particularly those from strands with lower performance in algebra.
7. **Introduction of Peer Tutoring and Collaborative Learning**
8. To address the disparities in performance, it may be beneficial to implement peer tutoring or collaborative learning approaches where higher-performing students (especially from STEM) can help their peers from other strands. This fosters a collaborative learning environment that not only reinforces the skills of advanced students but also supports those who are struggling.
9. Use of Technological Tools for Practice and Reinforcement

10. Integrating educational technologies, such as online algebra tutorials, interactive problem-solving platforms, and virtual simulations, could provide students with more opportunities to practice and reinforce their skills outside of the classroom. These tools may be particularly helpful for TVL and GA students, providing additional support for independent learning and problem-solving.

By addressing these areas, future studies and instructional practices can work towards improving the algebraic skills of all students, regardless of their academic strand or background.

REFERENCES

[1] Denbel, D.G. (2023). Competency level of teachers' subject matter knowledge as a compulsory for teaching secondary school mathematics: A case study on postgraduate diploma trainees. *Education Research International, 2023*, Article ID 8287791

[2] Tejeda, S., & Gallardo, K. (2017). Performance assessment on high school advanced algebra. IEJME – Mathematics Education, 12(9), 777-798.

[3] Tio, R. A. (2023). Learning competency and styles of senior high school students in general mathematics. *Psychology and Education: A Multidisciplinary Journal, 13*, 199-212.

[4] Felix, C. S. (2023). Analyzing the impact of declining math skills on college readiness for incoming freshmen. IRE Journals, 7(1), 24-30.

[5] Williams, O., & Agyei, D. D. (2024). Analyses of algebra knowledge and difficulties among Ghanaian Junior High School learners: Insights from standard-based mathematics curriculum implementation. Social Sciences & Humanities Open.

[6] Unay, P. R., Esquierdo, A. M., Calpa, J. V., Basista, F. A., Pinca, R. D., & Muncada, N. D. (2014). Difficulties in college algebra of freshmen students at the University of Eastern Philippines: Basis for modular construction. Journal of Educational Research and Practice, 4(2), 119-127.

[7] Pramesti, T. I., & Retnawati, H. (2019). Difficulties in learning algebra: An analysis of students' errors. Journal of Physics: Conference Series, 1320, 012061.

[8] Stemele, B. P., & Asvat, Z. J. (2024). Exploring Learner Errors and Misconceptions in Algebraic Expressions with Grade 9 Learners Through the Use of Algebra Tiles. African Journal of Research in Mathematics, Science, and Technology Education, 28(1), 153-170.

[9] Karjanto, N., & Acelajado, M. J. (2022). Sustainable learning, cognitive gains, and improved attitudes in college algebra flipped classrooms. Sustainability, 14(19), 12500.

[10] Sebastian, M. A. (2017). Students' gender, learning style, and difficulties in solving problems in college algebra. International Journal of Multidisciplinary Research and Modern Education, 3(2), 87-95.

[11] Ndum, E., Allen, J., Way, J., & Casillas, A. (2018). Explaining gender gaps in English composition and college algebra in college: The mediating role of psychosocial factors. Journal of Advanced Academics, 29(1), 56-88.

[12] Sabonsolin, R. T. (2016). Performance of students in algebra across colleges at the Naval State University. *International Journal of Engineering Sciences & Research Technology*, *5*(8), 46.

[13] Porter, R. C., Ofodile, C., & Carthon, J. (2015). Redesigning college algebra for success: An analysis of student performance. *Georgia Journal of Science*, *73*(2), Article 5.

[14] Owolabi, J., & Adejoke, E. O. (2014). Effect of gender, age, and mathematics anxiety on college students' achievement in algebra. American Journal of Educational Research, 2(7), 474-476.

[15] Smith, A. D. (2019). Relationship between required corequisite learning and success in college algebra. Georgia Journal of College Student Affairs, 35(1), Article 3.

[16] Edo, S. I., & Tasik, W. F. (2022). Investigation of Students' Algebraic Conceptual Understanding and the Ability to Solve PISA-Like Mathematics Problems in a Modeling Task. Mathematics Teaching Research Journal, 14(2), Summer 2022.

[17] Anoling Jr., O. C., Dagdag, J. D., Pascual, J. F., & Salviejo, R. P. (2018). Factor structure of problem-solving efficacy among college algebra students. Journal of Research, Policy & Practice of Teachers & Teacher Education, 8(2), 85-96