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Students' Competence in College and Advanced Algebra: Basis for an Intervention Plan

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Abstract

This study explored the competence in college and advanced algebra of teacher education students in the school year 2025-2026. Quantitative data for this study were collected from 126 teacher education student respondents using a researcher-developed questionnaire that underwent rigorous validity and reliability testing. The questionnaire focused on six areas: algebraic expressions, exponents and radicals, equations and inequalities, systems of linear equations and inequalities, relations and functions and their graphs, and exponential and logarithmic functions. The respondents were classified according to key profile variables: age, sex, year level, and average monthly family income. The ensuing analysis showed that most respondents were aged 21 years and above, male, third-year students, and in the lower-income category, with exponential and logarithmic functions identified as the area with the lowest mean. This study found a significant difference in year level across all the aforementioned areas. In contrast, no significant differences were found when grouped by age, sex, and average monthly family income across four areas: algebraic expressions, exponents and radicals, equations and inequalities, and relations and functions. Furthermore, in the area of systems of linear equations and inequalities and exponential and logarithmic functions, it was found that there is a significant difference in age, sex, and year level, but no significant difference in average monthly family income. These findings suggest the need for targeted, year-level–specific instructional interventions, particularly in exponential and logarithmic functions, to strengthen algebraic competence among teacher education students.

Keywords: *Algebraic Competence, Teacher Education Students, Exponential and Logarithmic Functions, Year Level Differences, Intervention Plan*

Introduction

Nature of the Problem

The competence in College and Advanced Algebra is very important in higher education. In every respect, algebra is the fundamental structure of advanced mathematics, problem-solving, and success in STEM areas. Research has demonstrated that student success in algebra is important and has a significant impact on academic progression and success in more advanced mathematics courses. Lesser successes in foundational algebra predicted lesser achievements in subsequent academic pursuits, and the reverse holds: successful mastery of algebra exposes certain obstacles that may limit academic success (Bland, 2024). Thus, prying open the student's grip on conceptual understanding, procedural fluency, and analytical reasoning in algebra provides powerful support for their academic and professional growth.

College algebra, as well as a few other advanced mathematical fields, is often considered a difficult subject for undergraduate students. Many studies have found that students are generally quite poor at problem-solving, equations, and other important topics, mainly due to insufficient prerequisite knowledge and mathematical skills. The evidence substantiates the idea that first-year students perform poorly in college algebra classes. In particular, the study by Unay et al. (2016) found that students perform well in meeting subject concepts and requisite components. Likewise, limiting students at higher levels of the problem-solving process somewhat contributes to weak procedural fluency, thereby undermining understanding, strategy formation, and evaluation. This definitely implies limited transition and poor knowledge, as learning losses are common. The outcomes of these challenges are used to select related and effective diagnostic and intervention programs designed to address the specific areas where learners demonstrate challenges.

In addition, educational research underscores the importance of tailored intervention plans aligned with defined competencies and learning needs. Algebra learning is anything but simple calculations; it also involves problem-solving, higher-order thinking, and motivation. In the student's performance, cognitive, affective, and instructional factors play a role, such as math anxiety, motivation, and teaching strategies (Grira et al., 2025). The study aligns with United Nations Sustainable Development Goal 4 on Quality Education to support Higher Learning Outcomes and competencies (UN, 2015). Over several years as a mathematics teacher, I have directly observed students encountering many difficulties with abstract concepts and their everyday applications, and their consistently low performance in assessments, classroom activities, and problem-solving tasks indicates the need to examine their competence in algebra closely. These observed difficulties and unsatisfactory academic outcomes underscore the importance of identifying specific learning gaps that may hinder student achievement as the strongest stimulus for conducting this study and devising an effective intervention plan to increase learners' proficiency in algebra.

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Current State of Knowledge

Research reveals that many students attain average performance in algebra, thereby denting their apprehension and application capacity of higher-order concepts (Asia Pacific Journal of Educational Perspectives, 2021). Moreover, it is notably difficult for students to solve problems and decipher algebraic relationships (Gloria, 2025) due to the lack of well-grounded prior training during the secondary education years (Lyubov et al., 2024). Evidence of this is quite glaring in the lack of students' ability to transfer knowledge to other unfamiliar problem settings (Garcia, 2023) with good performance in basic operations but finding complex operations problematic, such as systems of equations, functions, and exponential notation, to mention a few (Cadorna et al., 2021). Consequently, any foundational gaps must be filled at an early stage to accommodate more advanced mathematic skill acquisition.

Likewise, studies specifically in Negros Occidental have affirmed the existence of issues in learning algebra that burden students with average to near-proficient levels (Rodrigo and Alave, 2021; Garinganao and Bearneza, 2021). College students have been frequently practicing topics related to Algebra 1 since acquiring learning skills specific to algebraic fractions (Bagundol, 2025), contradicting the idea that conceptual understanding and procedural skills must be understood separately from one another. This clearly indicates that learning difficulties are a consistent concern for skills at all these stages of teaching and are not exclusive to any given stage (Parcon and Bearneza, 2024). In response to these problems, educational models advocate the promotion of conceptual understanding, the nurturing of problem-solving skills, and the use of differentiated instruction to cater to the diverse needs of learners (National Council for Teachers of Mathematics, 2020; Tomlinson, 2019). Such findings have strengthened the call for contextualized and adaptive teaching methodologies.

Moreover, mathematical competency is established through the union of conceptual understanding and procedural fluency (Rittle-Johnson, et al., 2020; Siegler, et al., 2019). Consequently, poor mastery of the fundamental conceptual and procedural foundations significantly incapacitates learners' ability to grasp higher-level topics such as exponential and logarithmic functions (Silla et al., 2026). Beyond the development of higher-order cognitive skills and socio-emotional learning and attendant mathematical anxiety (Ogena et al., 2019; Bernardo, 2020), among others, Filipinos encounter issues. A synthesis of skill deficits and emotional grain will set up two layers worth questioning, creating dual barriers to learning. This situation calls for consideration of cognitive and affective factors in mathematical education.

In general, the results indicate the urgent need for instructional interventions that are appropriately matched to instruction, providing scaffolded activities geared heavily toward students' establishing a growing foundation in algebra regardless of their difficulty or experience. These interventions must be created carefully to address the right level of readiness and the context of learning shown by learners. Such interventions thus serve to close the learning gap and enhance learners' readiness for more complex mathematical tasks (Salazar & Salazar, 2023).

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Theoretical Underpinnings

The study is anchored in Bloom's taxonomy, first introduced by Benjamin Bloom in 1956 and later revised by Lorin Anderson and David Krathwohl in 2001. The theory provides a structured range of learning objectives in the cognitive domain and stipulates a progression of thinking skills by level of difficulty. It has been widely adopted in education research and curriculum development to facilitate instruction and assess students' competencies.

Based on Bloom's Taxonomy, there are different levels of cognitive processing, with remembering, understanding, applying, analyzing, evaluating, and creating as the basic constituents. As this scale addresses progressive strategies for thinking, one moves from indiscriminate recall of information to learning more advanced mental skills, such as critical analysis and generative ideas. Mathematics teaching and, by implication, algebra ask learners not to concern themselves heavily with details and stimulating facts, and call this mastery. Know why a theorem must work, and graph; on the other hand, argue that it cannot work when some variables are defined. Perspicuous creation is also a bare necessity when competing with algebraic or other mathematical things that build rigor. The newer taxonomy drives for more assertive learning processes and reinforces the need for inquiry-based learning, which positions the taxonomist on a specific path toward achieving or bringing to life measurable learning objectives that address students' competencies in the long run.

This is relevant to the present study because it provides the foundation, knitted together by the strands of College and Advanced Algebra, for determining a student's level of competence, with a divide in high-level cognitive demand between students. By classifying whether a student faces difficulty comprehending, applying, or analyzing algebraic concepts, the research may be able to design interventions to address the issues identified through detailed questioning of the evaluative data in the given scenario. For Bloom's Taxonomy, the revised values clarify what the intervention will be about, from one student differing from another to one whose strengths lie in a different area. This means it provides solid support for developing instructional strategies that further improve students' performance and overall competence in algebra.

Objectives of the Study

This study aimed to determine the level of students’ competence in College and Advanced Algebra at a private tertiary school in Southern Negros during the school year 2025-2026, as a basis for an intervention plan. Specifically, it aimed to determine 1) the profile of respondents according to the variables of age, sex, year level, and average family monthly income; 2) the level of students’ competence in College and Advanced Algebra in terms of the areas algebraic expressions, exponents and radicals, equations and inequalities, relations and functions and their graphs, and exponential and logarithmic functions; 3) whether a significant difference exists between the levels of students’ competence in College and Advanced Algebra when grouped and compared according to the variables; and 4) the formulation of an intervention plan based on the findings of the study.

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Research Methodology:

This portion presents a discussion of the research methodology used, the study's subject-respondents of the study, the research instrument used, the validity and reliability of the instrument, the procedure for data gathering, the conduct of the study, and the statistical tools and procedures for data analysis.

Research Design

A descriptive design was employed in this study. According to McCombes (2023), a descriptive research design aims to precisely and fully describe a population, situation, or phenomenon. It answers what, where, when, and how questions, but not the why question. It utilizes a wide variety of research designs to examine a single or multiple variables. Unlike in an experimental study, the researcher does not control or manipulate any of the variables but only observes and measures them.

In this study, the focus was on the education students' competence in College and Advanced Albegra. Therefore, the descriptive design is appropriate for answering this inquiry because it helped describe the level of difficulties these learners experience in mathematics.

Study-Respondents

The study involved 126 teacher-education students who had completed College and Advanced Algebra during their first academic year. The researcher used stratified random sampling to select study participants while maintaining their year-level distribution throughout the research process. The Raosoft sample size calculator was used to validate the study sample size, ensuring that the total number of participants met the research requirements. The final sample included all student subgroups, enabling researchers to make accurate comparisons across year levels. Research demonstrates that stratified random sampling improves sample representativeness by enabling researchers to obtain samples from different groups within a population. According to Taherdoost (2016), stratified sampling enables accurate population estimation by ensuring complete subgroup representation, thereby reducing sampling error. Etikan and Bala (2017) state that this method benefits educational research because it enables scientists to compare respondents across different category groups while obtaining more precise research results. Furthermore, Table 1 shows the distribution of respondents by year level.

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Table 1

Distribution of Respondents

Year level	Population	Sample (*n*)	Percentage (%)
Second year	68	46	36.51
Third year	72	48	38.09
Fourth year	46	32	25.40
Total	186	126	100.00

Instrument

The instrument used in this study is a self-made questionnaire to determine the level of students' competence in College and Advanced Algebra. The questionnaire was divided into two parts. The first part collected respondents' personal profiles, including age, sex, year level, and average monthly family income. The second part consisted of the main test, which contained 42 items covering College and Advanced Algebra. The test was distributed across six key areas, namely: algebraic expressions; exponents and radicals; equations and inequalities; systems of linear equations and inequalities; relations and functions and their graphs; and exponential and logarithmic functions. Each key area was allocated seven (7) items to ensure equal representation of all topics. A Table of Specifications (TOS) was prepared to guarantee the proper distribution and alignment of the test items with the identified competencies. The questionnaire was administered to the respondents, who were given one (1) hour to complete all 42 items.

The validity of the instrument was established with three expert validators who are recognized as mathematics education professionals, including a PhD graduate and the program chair in mathematics in a public school. Validation followed the criteria of Good and Scates, with interpretation ranges from Poor to Excellent. The instrument obtained a validation mean of 4.66, interpreted as excellent, indicating high validity.

Reliability was determined using Cronbach's alpha to assess internal consistency. A pilot test was conducted among 30 education students at a private college who were not part of the actual respondents. Furthermore, the result taken from pilot testing of the said self-made questionnaire is 0.824, which is interpreted as good making the questionaire reliable.

Data Gathering and Procedure

After administering the validity and reliability tests, and upon approval of the schools division superintendent and the school head, the questionnaires were administered to the target respondents. The questionnaires were gathered, recorded, and analyzed. The data

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gathered from the responses of the respondents were tallied and tabulated using the appropriate statistical tools. The encoded data were processed using SPSS.

Data Analysis and Statistical Treatment

Objectives 1 and 2 employed a descriptive analytical scheme, using frequency counts and percentages as statistical tools to assess the profile of respondents, mean to assess the level of students' competence across the three areas. Objective 3 utilized a comparative analytical scheme, applying the independent samples t-test and ANOVA to determine significant differences in the level of students' competence in College and Advanced Algebra when grouped and compared according to the aforementioned variables.

Ethical Consideration

The respondents' participation was voluntary. The learners were given the option to participate or not, depending on their own volition and free will. Additionally, all respondents were informed in advance of the study's purpose and procedures, and the researcher ensured that they were fully informed. The researcher ensured that all participants were not harmed or put in a precarious situation by maintaining the confidentiality of their responses and information. The anonymity protocol for respondents' identities was strictly followed, and the raw data, after appropriate treatment, were destroyed. The data and the results were for the sole purpose of this study, and nothing else.

Results and Discussion:

This section presents, analyzes, and interprets the data gathered to carry out the predetermined objectives of this study.

Profile of Respondents

Table 2

Profile of the Respondents

Variables	Categories	Frequency	Percentage
Age	Lower (below 21 years old)	43	34.10
	Higher (21 and above)	83	65.90
Sex	Male	64	50.80
	Female	62	49.20

Year Level	2nd Year	46	36.50
	3rd Year	48	38.10
	4th Year	32	25.40
Average Family Monthly Income	Lower (below 7,600)	85	67.50
	Higher (P7,600 and above)	41	32.50
	Total	**126**	**100**

Table 2 shows the demographic profile of the respondents according to the variables age, sex, year level, and monthly family income. It can be gleaned from the table that, in terms of age, there are two categories: lower (below 21 years old) and higher (21 and above). It shows that the lower category has 43 respondents, equivalent to 34.10%, while the higher category has 83 respondents, equivalent to 65.90%.

Regarding sex, the table shows two categories: male and female. The male category has 64 respondents, which is equivalent to 50.80% of the total respondents, while the female category has 62 respondents, which is equivalent to 49.20% of the total respondents.

In terms of year level, the table shows three categories: mainly the second, third, and fourth years. The second year has 46 respondents, equivalent to 36.50% of the total; the third year has 48 respondents, equivalent to 38.10% of the total; and the fourth year has 32 respondents, equivalent to 25.10% of the total.

In terms of monthly family income, the table shows two categories: lower (below Php. 7,000) and higher (Php. 7,000 and above). The lower category has 85 respondents, equivalent to 67.50% of the total respondents, while the higher category has 41 respondents, equivalent to 32.50% of the total respondents.

Descriptive Analysis of the Level of Mathematical Competence in College and Advanced Algebra of Education Students

Table 3

Levels of Students' Competence in College and Advanced Algebra Among Education Students in the Areas

Area	Mean	Interpretation
a. Algebraic Expression	4.83	High Level
b. Exponents and Radicals	4.09	Average Level

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c. Equations and Inequalities	3.77	Average Level
d. Systems of Linear Equations and Inequalities	3.42	Average Level
e. Relation and Functions and their Graphs	3.41	Average Level
f. Exponential and Logarithmic Functions	2.71	Low Level
Overall Mean	22.22	Average Level

Table 3 shows the students' competence in College and Advanced Algebra across six areas, with an overall mean of 22.22, interpreted as an average level. This indicates that education students generally demonstrated moderate competence in the subject areas covered. Among the six areas, Algebraic Expression had the highest mean of 4.83, indicating a High Level. Exponents and Radicals had a mean score of 4.09, Equations and Inequalities with 3.77, Systems of Linear Equations and Inequalities with 3.42, and Relations and Functions and their Graphs with 3.41, all interpreted as Average Level. Meanwhile, Exponential and Logarithmic Functions obtained the lowest mean of 2.71, interpreted as Low Level.

The students face challenges when they need to learn advanced abstract algebra, which requires them to use advanced analytical skills and deep thinking. The area needs better teaching methods, more learning resources, and additional practice materials to help students learn. The teacher needs to provide better explanations and show students how to perform tasks through real-world situations, which will help them better understand the material. The results show that students need to develop their basic knowledge of exponents, functions, and algebraic manipulation, as these concepts become crucial for studying exponential and logarithmic functions. The low performance of students in this topic may also be influenced by the fact that exponential and logarithmic functions are usually discussed later in the subject. The lessons at the end of the course are subject to disruptions from school activities and extracurricular programs, as well as class schedule changes and reduced teaching time, leading to incomplete topic coverage. Students with weak skills in this area will struggle to succeed in future math studies because these concepts are required.

Rodrigo and Alave (2021) reported that students' achievement in Algebra was generally low, with many learners experiencing difficulty in higher-level topics such as quadratic functions and other abstract concepts, indicating weaknesses in analytical and problem-solving skills. This supports the finding that students struggle more as mathematical topics become more complex.

Likewise, the Asia Pacific Journal of Educational Perspectives (2021) study on students' competence in College and Advanced Algebra revealed that students demonstrated lower competence in more difficult and advanced areas than in basic algebraic topics, suggesting that mastery decreases as lessons demand greater reasoning and conceptual application.

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Comparative Analysis of the Level of Students' Competence in College and Advanced Algebra When Grouped and Compared According to the Variables

Table 8

Significant Difference in the Level of Students' Competence in College and Advanced Algebra Among Education Students in Algebraic Expression When Grouped and Compared According to the Aforementioned Variables

Variable	Category	N	Mean Rank	One-way ANOVA	t-test	p-value	*Sig. level*	Interpretation
Age	Younger	43	4.56		-1.620	0.110		Not Significant
	Older	83	4.96					
Sex	Male	64	4.64		-1.741	0.084		Not Significant
	Female	62	5.02					
Year Level	Between Groups	12.267	6.13	4.34		0.015	0.05	Significant
	Within Groups	173.89	1.41					
Average Family Monthly Income	Lower	85	4.86		0.441	0.660		Not Significant
	Higher	41	4.76					

Table 8 shows a significant difference in students' competence in College and advanced algebra among Education Students in Algebraic Expression, when grouped and compared according to the aforementioned variables. At the 0.05 level of significance, the computed results from the t-tests for age, sex, and Average Family Income were p=0.110, p=0.084, and p=0.660, respectively. The null hypothesis that there is no significant difference in Students' Competence in College and Advanced Algebra among Education Students in Algebraic Expression when grouped and compared according to age, sex, and average family income, was accepted, since the computed values were greater than the level of significance. However, for Year Level, p = 0.015 is significant; therefore, the null hypothesis is rejected. The significant difference, according to Bagundol (2025), indicates that students who receive consistent teaching assistance also have greater learning opportunities.

The testing results for Algebraic Expression proficiency across different year levels show that students perform better in this subject as they progress through their academic studies. The research shows that students who progress through their academic studies acquire better

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mathematical skills, which help them understand algebraic expressions. Students who progress to higher educational levels will achieve better learning outcomes because their educational journey includes both mathematical instruction and their prior learning experiences. Students who advance to higher educational levels will achieve better learning outcomes because advanced mathematics courses provide ongoing practice of essential algebra skills. The results indicate that students acquire better mathematical skills through their academic advancement because higher educational levels provide students with more complex math instruction, which helps them develop their algebra abilitiesW1 The research identifies a need for educational institutions to establish instructional methods that teach algebraic expression skills to students during their initial academic years, so that students can learn advanced material in college and advanced algebra classes.

Research evidence demonstrates that progressive educational advancement from one year to the next establishes a direct link between academic achievement and student performance in Algebraic Expression. Ismail and Khoo (2020) demonstrated that students acquire better mathematical skills through ongoing lesson practice because their understanding of algebraic concepts develops through repeated practice during their school years. The OECD (2022) PISA results confirmed that students at advanced educational levels achieve higher mathematics scores because they have learned multiple mathematical concepts and worked with more difficult materials throughout their academic journey. The National Council of Teachers of Mathematics (NCTM, 2020) established that students develop their algebraic conceptual understanding through a progression of learning activities that first establish basic skills and then build on those abilities to advance to advanced algebraic expression studies.

Table 9

Significant Difference in the Level of Students' Competence in College and Advanced Algebra Among Education Students in Exponents and Radicals When Grouped and Compared According to the Aforementioned Variables

Variable	Category	N	Mean Rank	One-way ANOVA	t-test	p-value	Sig. level	Interpretation
Age	Younger	43	3.88		-0.990	0.324		Not Significant
	Older	83	4.19					
Sex	Male	64	3.91		-1.187	0.238	0.05	Not Significant
	Female	62	4.27					
Year Level	Within Groups	64.853	32.43	12.57		0.000		Significant
	Between	317.19	2.58					

	Groups					
Average Family Monthly Income	Lower	85	4.12	0.280	0.780	Not Significant
	Higher	41	4.02			

Table 9 shows a significant difference in students' competence in College and advanced algebra of education students in Exponents and Radicals when grouped and compared by age, sex, year level, and Monthly Family Income. At the 0.05 level of significance, the computed results from the t-tests for Age, Sex, and Average Family Income were p=0.990, p=1.187, and p=0.280, respectively. The null hypothesis that there is no significant difference in Students' Competence in College and Advanced Algebra of Education Students in Exponents and Radicals when grouped and compared according to age, sex, and Average Family Income was accepted, since the computed value was greater than the level of significance. However, in terms of year level, the difference is significant (p = 0.000) and lower than the significant value. Therefore, the null hypothesis was rejected.

The character of Exponents and Radicals shows a distinct difference across academic levels, as students demonstrate varying levels of proficiency as they develop academically. The research indicates that students improve their understanding of exponents and radicals as they progress through higher grade levels, as they receive more instruction and complete additional practice while learning related algebra concepts throughout their future mathematics courses. The research demonstrates that students acquire knowledge through successive educational stages, allowing them to build on their prior achievements to advance to advanced academic work. The findings show that students' success in exponents and radicals depends on how teachers deliver instruction through their lesson plans and educational programs. The research indicates that students need to establish a strong foundation in their early years, which will assist them in mastering advanced mathematical content later.

Rodrigo and Alave (2021) found that students' performance in Algebra improves as they advance in year level, as they practice fundamental mathematical concepts through continuous exposure and repeated practice. The study showed that higher-level learners demonstrate better skills because their prior lessons are used to teach advanced material. The OECD (2022) PISA report showed that students in higher educational levels achieve better mathematics results because they build on their previous knowledge through planned curriculum development. The report found that students who study exponents and basic algebra skills will develop a better understanding of these concepts through their application in advanced math, which helps them perform better in upcoming academic years.

Table 10

Significant Difference in the Level of Students' Competence in College and Advanced Algebra Among Education Students in Equations and Inequalities When Grouped and Compared According to the Aforementioned Variables

Variable	Category	N	Mean Rank	One-way ANOVA	t-test	p-value	*Sig. level*	Interpretation
Age	Younger	43	3.56		-1.135	0.259	0.05	Not Significant
	Older	83	3.88					
Sex	Male	64	3.67		-0.729	0.467		Not Significant
	Female	62	3.87					
Year Level	Within Groups	24.941	12.47	5.737		0.004		Significant
	Between Groups	267.38	2.17					
Average Family Monthly Income	Lower	85	3.72		-0.550	0.584		Not Significant
	Higher	41	3.88					

Table 10 shows a significant difference in students' Competence in College and advanced algebra among education students in Equations and Inequalities, when grouped and compared by age, sex, year level, and Monthly Family Income. At the 0.05 level of significance, the computed results from the t-tests for age, sex, and Average Family Income were p=0.259, p=0.467, and p=0.584, respectively. The null hypothesis that there is no significant difference in Students' Competence in College and Advanced Algebra among Education students in Equations and Inequalities when grouped and compared according to age, sex, and average family income was accepted, since the computed value was greater than the level of significance. However, in terms of year level, the difference is significant (p = 0.004), with a lower significance level. Therefore, the null hypothesis was rejected.

The students demonstrate different levels of competence in this mathematical area, and there is a statistical difference in their performance on Equations and Inequalities across academic years. The research indicates that students who progress to higher academic levels will demonstrate improved skills in solving equations and inequalities because their education includes more challenging mathematical content. They undergo repeated practice as they build their basic algebra foundation through advanced courses. The learning process in this area requires students to achieve mastery through a sequence of lessons that build their mathematical

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skills from basic to advanced. The development of students' abilities to solve equations and inequalities depends on how schools sequence their curriculum and how teachers present their lessons. The research requires educational institutions to establish more effective teaching methods for elementary students, as their initial foundation will determine their ability to solve problems, which are vital for succeeding in advanced mathematics courses.

The research by Rodrigo and Alave (2021) found that students who study Algebra over consecutive academic years perform better because they learn more difficult mathematical material through their ongoing educational experience. The research demonstrated that students who practice basic algebra skills multiple times with their exercises will achieve better results when solving equations and inequalities because their skills will develop over time. The OECD ()2022 PISA report demonstrated that students who reach advanced educational levels achieve superior mathematics results because they acquire knowledge through their educational progression and systematic curriculum development. The report explained how students build their understanding of basic concepts, including equations and inequalities, through multiple exercises before they reach advanced grade-level studies.

Table 11

Significant *Difference in the Level of Students' Competence in College and Advanced Algebra of Education Students in Systems of Linear Equations and Inequalities When Grouped and Compared According to the Aforementioned Variables*

Variable	Category	N	Mean Rank	One-way ANOVA	t-test	p-value	*Sig. level*	Interpretation
Age	Younger	43	2.86		-2.516	0.014		Significant
	Older	83	3.71					
Sex	Male	64	2.95		-2.848	0.005		Significant
	Female	62	3.90					
Year Level	Within Groups	77.791	38.90	12.43		0.000	0.05	Significant
	Between Groups	384.92	3.13					
Average Family Monthly Income	Lower	85	3.42		0.024	0.981		Not Significant
	Higher	41	3.41					

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Table 11 shows the significance of students' competence in College and advanced algebra of Education Students in Systems of linear equations and Inequalities when grouped and compared by age, sex, year level, and monthly family income. At the 0.05 level of significance, the computed results for age, sex, and year level were p=0.014, p=0.005, and p=0.000, respectively. The null hypothesis that there is no significant difference in students' competence in College and Advanced Algebra of Education students in Systems of Linear Equations and Inequalities when grouped and compared according to age, sex, and year level was rejected, since the computed value was less than the level of significance. However, the Average Monthly Family Income is not significant (p = 0.981), which is greater than the significance level. Therefore, the null hypothesis was accepted.

Students from families with different monthly incomes show no differences in mathematical competence, indicating that economic status has little impact on their academic performance in this subject. Academic and personal factors both affect student achievement in this subject more strongly than financial status. The study results provide essential information that helps explain which factors determine how education students develop their mathematical skills in College and Advanced Algebra when they study systems of linear equations and inequalities. Demographic factors, including age, sex, and year level, have a statistically significant effect on how students perform. The characteristics of the class require teachers to develop teaching methods, learning resources, and curricular changes to help students achieve better academic results. Year-level differences show how students progress through mathematical concepts, while age and sex differences reveal diverse learning needs that teachers must address during classroom instruction.

El Refae et al. (2019) study demonstrated that age and gender, along with academic level, have distinct effects on students' mathematical performance due to differences in cognitive abilities and learning patterns. Reardon (2019) presented evidence that family income shapes academic performance, as higher-income students have access to superior educational resources.

Table 12

Significant *Difference in the Level of Students' Competence in College and Advanced Algebra Among Education Students in Relation and Functions and Their Graphs When Grouped and Compared According to the Aforementioned Variables*

Variable	Category	N	Mean Rank	One-way ANOVA	t-test	p-value	Sig. level	Interpretation
Age	Younger	43	3.16		-1.178	0.242	0.05	Not Significant
	Older	83	3.54					
Sex	Male	64	3.19		-1.528	0.129		Not Significant
	Female	62	3.65					

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Year Level	Within Groups	27.915	13.96	5.22		0.007	Significant
	Between Groups	328.63	2.67				
Average Family Monthly Income	Lower	85	3.45		0.322	0.749	Not Significant
	Higher	41	3.34				

Table 12 shows a significant difference in students' competence in College and advanced algebra among education students in relation to functions and their Graphs, when grouped and compared by age, sex, year level, and Monthly Family Income. At the 0.05 level of significance, the computed results from the t-tests for age, sex, year level, and Average Family Income were p= 0.242, p= 0.129, and p= 0.749, respectively. The null hypothesis that there is no significant difference in students' competence in College and Advanced Algebra of Education students in Relation and Functions when grouped and compared according to age, sex, and Average Family Income was accepted, since the computed value was greater than the level of significance. However, in terms of year level, the difference is significant (p = 0.007), with a lower p-value. Therefore, the null hypothesis was rejected.

The mathematical skills of education students in College and Advanced Algebra are influenced by their year level in the academic program. The Commission on Higher Education, through CMO No. 75, s. 2017 sets the framework for the Bachelor of Secondary Education major in Mathematics, ensuring progressive learning across year levels. Results show that competence in functions and their graphs is not significantly affected by age, sex, or family income, indicating relatively equal learning outcomes across these variables. However, students in higher year levels demonstrate better mathematical skills due to increased exposure to advanced concepts and continuous learning. This highlights the importance of a structured curriculum, strong foundational instruction in the early years, and continuous academic support to enhance students' mathematical development throughout their studies.

Current research in mathematics education shows that teaching methods and learning environments have a greater impact on students' math skills than demographic factors such as age, gender, and socio-economic status. The National Council of Teachers of Mathematics (2020) demonstrated that effective curriculum implementation, combined with research-based teaching methods, enables students to succeed across diverse demographic groups. The OECD (2023) demonstrated that students develop superior critical thinking and problem-solving abilities through extended periods of organized mathematics training.

Conclusion:

The research showed that most participants in the study were men who belonged to the lower-income group and who were third-year students at the age of 21 or older. The study found that most respondents possess basic and intermediate algebra knowledge, which enables evaluators to test their skills in College and Advanced Algebra. The respondents exhibit common academic backgrounds that exist because their demographic traits differ from one another.

The study found that teacher education students achieved an average performance level in both College and Advanced Algebra. Students demonstrated advanced proficiency in algebraic expressions, yet their skills in other areas reached only average performance. Students achieved the lowest mean score in exponential and logarithmic functions, which indicates a weak skill level. The pattern shows that students perform better in basic and procedural tasks, yet they struggle with advanced abstract algebraic concepts.

The study found that year level created significant differences in all areas because students demonstrated better skills as they progressed through their academic programs. The study found that students' age and sex and family income level did not affect their ability to solve algebraic expressions and exponents and radicals, as equations and inequalities,relations, and functions. The research showed that age,sex, and year level created significant differences in systems of linear equations and inequalities and in exponential and logarithmic functions, while income level had no impact.

Intervention Plan

Introduction

The field of mathematics serves as a basic academic area that fosters essential skills by training students to think logically, solve problems, and analyze situations that future teachers need to acquire. The mastery of algebra is a crucial requirement for teacher education programs because it provides the fundamental knowledge future educators need to teach mathematics at various educational levels. The process of learning mathematics presents challenges for students who find it difficult to master advanced concepts after completing their basic studies, especially in systems of equations and functions, as well as in exponential and logarithmic relationships. Students demonstrate ongoing challenges in their mathematical performance, as documented through various assessment methods. Local research has found that pre-service teachers exhibit the same behavioral patterns as the local population. The research results indicate that students who learned mathematical concepts through educational content still lack sufficient knowledge to comprehend advanced subjects. The existing difficulties require the development of organized educational programs that need to focus specifically on improving students' advanced algebra skills while preparing them to become proficient mathematics teachers.

Rationale

Teacher Education students demonstrate intermediate basic algebra skills while lacking the advanced mathematical knowledge necessary to understand systems of linear equations and inequalities, relations and functions, and exponential and logarithmic functions. The results show a gap in understanding fundamental concepts, which will negatively impact both academic achievement and future teaching performance. The situation represents an established national educational problem in the Philippines.

The local evidence supports all of these assertions. The OECD on the Program for International Student Assessment (2018) study demonstrated that students achieve better academic results when they study through problem-solving and real-world applications rather than memorizing information through traditional learning techniques. The research showed that students' mathematical skills depend on their academic year because learning progress and access to content are necessary for developing their abilities. The students will need proper support, as their advanced topic comprehension issues will prevent them from teaching mathematics effectively. The one-semester intervention plan will help students overcome learning gaps, build foundational knowledge, and develop advanced algebraic competencies. The intervention program satisfies CHED requirements, which require educational institutions to improve teacher training programs through outcomes-based methods and student-centered teaching approaches that produce competent graduates who can work professionally.

Objectives

The intervention plan for education students who study College and Advanced Algebra aims to enhance their mathematical abilities in accordance with the standards established in the Republic Act No. 10533, which mandate that education institutions teach advanced cognitive skills and lifelong learning competencies.

The intervention plan has the following specific objectives:

1. The program will assist students in developing advanced mathematical abilities because they will progress from their current low level to achieve at least the moderately competent standard in advanced algebra topics, which include systems of linear equations and inequalities, relations and functions, and exponential and logarithmic functions.
2. The program will assist students in acquiring basic algebra skills, which will enable their advancement to the higher-level skills that the CHED teacher education program quality standards require for curriculum development and teaching.
3. The program will teach students higher-order thinking skills (HOTS), which include critical thinking, problem-solving, and analytical reasoning for learner-centered and competency-based education.

4. The program will use student-centered instructional methods, which provide different learning approaches that match CHED's goal to create graduates who can compete globally through innovative teaching methods that focus on achieving learning outcomes.
5. The program needs to develop pre-service teachers' teaching skills in algebra through content knowledge instruction and practical teaching methods to meet CHED's goal of creating skilled and self-assessing educators.
6. The institution needs to implement ongoing assessment systems along with feedback methods that track student progress and verify that students achieve predefined learning goals while adhering to OBE standards, which require the connection between teaching methods,evaluation processes, and educational objectives.
7. The program needs to provide equal educational access to all students regardless of their demographic characteristics in accordance with national educational standards, which mandate inclusive educational practices and provide quality education to every student

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INTERVENTION PLAN MATRIX

Phase	Timeline	Objectives (CHED-Aligned Outcomes)	Content Focus	Strategies / Activities (College-Level, Contextualized)	Assessment Tools	Persons Involved	Success Indicators
Phase 1: Diagnostic & Preparation	Week 1	Determine prior algebra competency of BSED Math students	All Algebra Areas	- College-level diagnostic test problem-solving and analysis questions - Error analysis worksheet (identify misconceptions) - Self-assessment reflection on algebra mastery - Oral diagnostic questioning (concept explanation, not recall)	Diagnostic test, rubric checklist	Instructor, Students	- 100% assessed - Proper competency grouping
Phase 2: Algebraic Expressions (College Reinforcement)	Week 2	Strengthen symbolic manipulation and algebraic reasoning	Algebraic Expressions	- Simplifying complex expressions using multi-step problems - “Explain your solution” based on board problems - Peer critique of solutions (college-level justification)	Quiz, problem set	Instructor, Students	- 70% demonstrate improved reasoning
Phase 3: Exponents & Radicals (Applied	Week 3	Develop conceptual and procedur	Exponents & Radicals	- Law derivation exercises (why rules work, not memorization)	Written quiz, oral recitatio	Instructor, Studen	- 70% improve conceptual

Reasoning)		al fluency		- Multi-step radical simplification problems - Group justification of answers using algebraic laws - Real-world application (engineering/science contexts simplified) - Peer explanation sessions	n	ts	accuracy
Phase 4: Equations & Inequalities (Analytical Thinking)	Week 4	Solve and interpret algebraic equations	Equations & Inequalities	- Multi-step equation modeling problems - Word problems requiring interpretation (budgeting, teaching scenarios, etc.) - Inequality interpretation using real constraints - Board solving with reasoning defense	Quiz, written explanation	Instructor, Students	- 60% improved analytical responses
Phase 5: Systems of Linear Equations (Problem-Solving Focus)	Week 5	Apply systems in real decision-making contexts	Systems of Linear Equations	- Case-based problems (classroom planning, resource allocation) - Solve using substitution/elimination with justification	Performance task	Instructor, Students	- 60% improved problem-solving

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				- Group problem defense presentations - Error detection in incorrect solutions - Teacher simulation: students act as instructors, solving systems			
Phase 6: Relations & Functions (Conceptual Modeling)	Week 6	Interpret and analyze functiona l relations hips	Relation s & Function s	- Function modeling using real data scenarios (attendance vs performance) - Graph interpretation with explanation writing - Identify function properties (injective, mapping logic simplified) - Peer teaching: explain graph behavior - Construct own function examples	Written task, graph analysis	Instruc tor, Studen ts	- 65% correct interpreta tion
Phase 7–12 (EXTENDE D CORE INTERVEN TION PHASE)	Week s 7–18	Master exponent ial and logarith mic functions through deep conceptu al and	Exponen tial and Logarith mic Function s	- Derivation of exponent and log laws (guided reasoning) - Multi-step algebraic transformation problems - College-level word problems:	Weekly mastery tests, performa nce tasks, and oral defense	Instruc tor, Peer Tutors, Studen ts	- 75% reach competen cy level - Significa nt improve ment in post-test

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		applied learning		• Compound interest (financial literacy) • Population modeling (community-based) • Scientific decay processes (health/science context) - Graph interpretation and transformation analysis - Problem-solving seminars (students defend solutions verbally) - Micro-teaching sessions (students teach lesson segments to peers) - Error analysis of incorrect reasoning cases - Weekly mastery tests with justification required - Remediation conferences (1-on-1 teacher feedback) - Reflective journal: "How I solved it and why it works."			reasoning
Phase 8: Integration	Weeks 19–	Apply algebra	All	- Micro-teaching demonstration	Rubric, project	Instructor,	- 70% demonstr

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& Application (Teaching Readiness)	20	in a teaching context	Topics	(lesson delivery simulation) - Creation of lesson plans (BSED format) - Development of instructional materials (Manila paper, worksheets) - Real-world problem-solving project (community-based) - Peer evaluation using a rubric - Reflective teaching journal	output	Panel, Students	ate teaching competence
Phase 9: Evaluation & Feedback	Weeks 21–22	Assess learning outcomes and effectiveness	All Topics	- Comprehensive post-test (analysis + problem solving) - Pre-test vs post-test statistical comparison - Oral interview (concept explanation) - Focus group discussion - Program reflection report	Post-test, interview	Instructor, Program Head	- 75% improvement rate - 80% positive feedback

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