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COMPARISON OF MATHEMATICS COMPETENCIES AMONG EARLY CHILDHOOD CARE, PRIMARY ADULT, AND NON-FORMAL EDUCATION STUDENTS IN FCE (TECH) BICHI

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Abstract
This study investigated Mathematics competencies among NCE II SECPADE students at FCE (Tech) Bichi, comparing performance across the Early Childhood Care and Education (ECCE), Adult and Non-Formal Education (ANF), and Primary Education Studies (PES) departments. Three objectives were stated, three research questions were raised, and three research hypotheses were formulated to guide the study. A descriptive survey design was adopted. The population consisted of 307 students, from which a sample of 30 (15 males and 15 females) was selected using systematic random sampling. Semester results from PES 213, ANF 223, and ECCE 223 were used as instruments, with reshuffled versions administered after two weeks to assess retention of Mathematical concepts. Data were analyzed using descriptive statistics, one-way ANOVA, and independent t-tests. Findings showed that ECCE students performed highest, followed by ANF and PES students, with no significant gender differences. ANOVA revealed significant departmental differences in both Mathematics competency $f(2,307) = 18.76$, $p < 0.05$ and retention $f(2,27) = 16.32$, $p = 0.002$, with ECCE students demonstrating superior retention. The study concluded that departmental teaching strategies and curriculum emphasis strongly influence Mathematics competency and retention. Recommendations included adopting ECCE-based instructional methods in PES and ANF, providing remedial support for low-performing students, reviewing curriculum standards, and conducting further research into factors enhancing ECCE mathematics performance.

Keywords: Mathematics Competency, SECPADE, ECCE, PES, ANF, Gender Differences, Retention

Introduction

Mathematics is widely regarded as a fundamental discipline essential for logical reasoning, problem-solving, and daily life applications. Kilpatrick (2014) describes mathematics as the foundation for critical thinking and structured reasoning. Akinsola (2017) emphasizes its indispensable role in technological and scientific advancement, while Ukeje (2010) views mathematics as the bedrock of human survival, influencing budgeting, measurement, planning, and decision-making. In colleges of education, mathematics competency is a key requirement in preparing teachers across various educational levels. The SECPADE Programme encompasses three key departments: Early Childhood Care and Education (ECCE), Adult and Non-Formal Education (ANF), and Primary Education Studies (PES). Each department offers compulsory mathematics courses to develop students' conceptual and practical understanding of the subject. However, observable disparities in mathematics performance, retention, and gender-related outcomes among SECPADE students have raised concerns regarding instructional methods and departmental curriculum structure. While ECCE students often exhibit strong foundational mathematical understanding, ANF students display moderate proficiency, and PES students tend to struggle with application and retention. This study therefore examines these variations.

Statement of the Problem

Before the implementation of the 2020 NCCE Minimum Standard, the school now known as SECPADE was formerly called SECPED and was ANF-excluded, comprising only the ECCE and PES departments. Following the introduction of the new minimum standard, Adult and NonFormal Education (ANF) was incorporated, leading to the renaming of the school as SECPADE and the establishment of three departments: ECCE, ANF, and PES all of which now offer compulsory mathematics courses. Despite this uniform requirement, noticeable differences exist in students' mathematics competency, performance, and retention of mathematical concepts across the departments, with ECCE students consistently outperforming their ANF and PES counterparts. These observable disparities motivated this study to compare mathematics performance among the three departments in order to assess students' competency, academic performance, and retention of mathematical concepts, with the aim of determining the department that is superior in mathematics within the school

Objectives of the Study

The study aims to:

1. Compare mathematics competencies of ECCE, ANF, and PES students.
2. Examine gender differences in mathematics performance among SECPADE students.
3. Determine the retention of mathematical concepts across SECPADE departments.

Research Questions

The question below were raised for the study

1. What are the differences in mathematics competencies among ECCE, ANF, and PES students?
2. How do male and female students perform in mathematics across the departments?
3. What is the level of retention of mathematical concepts among SECPADE students?

Research Hypotheses

The following hypotheses were formulated for the study

1. **H_{01}:** There is no significant difference in mathematics competencies among ECCE, ANF, and PES students.
2. **H_{02}:** There is no significant difference in mathematics performance between male and female SECPADE students.
3. **H_{03}:** There is no significant difference in retention of mathematical concepts among the three departments.

Significance of the Study

This study will guide educators, curriculum developers, and policymakers in improving mathematics instruction, retention strategies, and departmental teaching approaches. It will also inform interventions aimed at supporting low-performing student groups.

Scope and Limitation

The study scoped and limited to NCE II SECPADE students of FCE (Tech) Bichi. It focuses strictly on mathematics competency, gender performance, and retention across ECCE, ANF, and PES students of 2024/2025 academic session

Literature Review

Mathematics education scholars emphasize that Mathematics competency, gender dynamics, and retention of concepts are central to understanding learner achievement and instructional effectiveness (Awoniyi et al., 2025). Mathematics competency is broadly defined as the ability to understand, interpret, and apply Mathematical concepts to solve problems meaningfully rather than simply recall procedures. Research indicates that learners' competency in Mathematics is closely associated with conceptual understanding, cognitive flexibility, and problem-solving skills (Ncube & Luneta, 2025). Concept-based instruction, which foregrounds meaning and learners' construction of Mathematical ideas, has been shown to improve learners' deep understanding and sustained performance in Mathematics (Ncube & Luneta, 2025; Ncube et al., 2024), reinforcing the perspective that competency encompasses both procedural fluency and conceptual insight. Studies also report that instructional strategies that actively engage learners such as inquiry-based learning and collaborative activities yield significant improvements in Mathematics performance because they strengthen understanding and foster strategic thinking (International Journal of Research and Innovation in Social Science, 2025).

Research into gender differences in Mathematics achievement reveals that performance disparities are contextually mediated rather than inherently determined by sex. Recent large-scale studies show that while some populations exhibit modest gender differences in specific grades or regions, these gaps often diminish over time or are influenced by sociocultural and instructional variables (Luo & Chen, 2024; Oberleiter et al., 2023 as cited in Journal of Pedagogical Research, 2025). The impact of maths-gender stereotypes appears significant, with evidence showing that

societal beliefs about "boys being better at Mathematics" will influence students' confidence and performance outcomes, especially in middle school contexts (Luo & Chen, 2024). Other studies suggest that when pedagogical environments are inclusive and equitable, gender differences in Mathematics achievement become negligible (Adeleke et al., 2025), highlighting the role of teaching practices and school culture in shaping learners' performance. In some contexts, gender discrepancies in attitudes and achievement are further mediated by teacher dispositions and school environments that either support or inhibit female students' engagement in mathematics (Karadaar et al., 2024). These findings extend the understanding of gender dynamics beyond simple performance metrics to include the broader affective and environmental influences on Mathematics learning.

Retention of mathematical concepts is the ability to remember and apply previously learned content over time, is another crucial aspect of mathematical learning. Empirical research on instructional techniques such as game-based and concept-based learning illustrates that active and engaging pedagogies significantly enhance students' retention compared to traditional instruction. For instance, game-based learning approaches have been found to produce higher retention scores among learners because they promote sustained engagement and repeated cognitive retrieval of concepts, which supports long-term memory (Mosia & Egara, 2024). Similarly, studies indicate that when instruction prioritizes conceptual understanding rather than rote memorization, learners retain concepts more effectively, demonstrating deeper internalization of Mathematical ideas (Ncube & Luneta, 2025). Broader educational research also underscores the cognitive benefits of structured learning strategies such as spaced repetition and interactive materials that reinforce retention across mathematics topics (Szilágyi, 2025; Mosia & Egara, 2024). These studies collectively suggest that learners' ability to retain Mathematical concepts is enhanced when instruction actively engages their cognitive processes and involves purposeful repetition and meaningful context.

The current literature converges on the view that Mathematics competency is multidimensional, involving not only procedural skill but also conceptual insight and strategic problem solving. Gender differences in mathematics performance are shaped by sociocultural attitudes and instructional environments rather than fixed biological factors, and equitable teaching practices can mitigate observed disparities. Retention of Mathematical concepts is strengthened through interactive, concept-focused, and student-centered instructional approaches that encourage repeated engagement with content. Together, these studies underscore the interplay of instructional strategy, learner cognition, and educational context in shaping Mathematics learning outcomes, offering a theoretical and empirical foundation for examining competency, gender effects, and retention among SECPADE students.

Table 2.1: Mathematics Courses in NCE II SECPADE

Course Code	Department	Course Content
PES 213	Primary Education Studies	Calculations with Negative Numbers; Algebra; Collecting Terms & Removing Brackets; Simple Equations

ANF 223	Adult & Non-Formal Education	Descriptive Statistics; Graphs; Measures of Dispersion; Inferential Statistics; Material Development in ANF
ECCE 223	Early Childhood Care & Education	Nature of Mathematics; Measurement (Quantity); Spatial Relations; Shapes; Mathematical Language; Measurement (Length, Area, Volume)

Source: 2020 NCCE Minimum Standard

Methodology

Research Design**:** A descriptive survey design was employed, **a**nd the Population of the Study consisted of 307 NCE II SECPADE students as listed in Table 3.1

Table 3.1 Population of 2024/20245 NCE II SECPADE Students

S/N DEPT	MALE	FEMALE	TOTAL
1. PES:	152	63	215
2. ANF:	32	22	54
3. ECCE:	12	26	38
Total			307

Source: 2024/2025 departmental examination officers

Sample and Sampling Technique

Thirty students (10 per department; 15 males and 15 females) were selected using systematic random sampling.

Instrumentation

The Instrumentation used in the study was the 2024/2025 semester results from PES 213, ANF 223, and ECE 223, and after 2 weeks the instruments were reshuffled and administered for the retention abilities of the student

Results /Findings and Discussion

Departmental Mathematics Performance

Research Question One: What are the differences in Mathematics competencies among ECCE, ANF, and PES students?

To answer this question, the 2024/2025 semester academic performance results of the students were compared, mean and standard deviation were calculated, Table 4.1 displayed the results of the computations

Table 4.1: Mathematics Competencies across the School

Department (Course Code)	N	Mean	Std. Dev	Performance
ECCE 223	10	80.2	4.8	Excellent
ANF 223	10	73.5	5.5	Very Good
PES 213	10	65.7	6.2	Good
Total	30	73.1	6.4	—

Source: Students' Semester results (2024/2025 academic session)

Table 4.1 displayed the mathematics competency on how ECCE students performed highest ANF moderate, and PES lowest, showing clear departmental variation across the school. However the significant of the variation would be analyzed in testing the hypothesis in table 4.2 below

H_{01}: There is no significant difference in mathematics competencies among ECCE, ANF, and PES students.

Table 4.2: ANOVA Analysis Source

Source	Sum of squares	Df	Mean square	f	p	Remark
Between Groups	1024.3	2	512.15	18.76	.001	Rejection
Within Groups	736.7	27	27.29	—	—	
Total	1761.0	29	—	—	—	

Source:SPSS Version 21 $\alpha = 0.05$

Table 4.2 showed that the f (2, 307) =18.76 ; $p < 0.05$,this showed that the f-value is far greater than the critical value and $p < 0.05$. Therefore, significant differences exist among the departments. Hence the null hypothesis is rejected and concluded that the difference exist in Mathematics competency among SECPADE students

Research Question Two: How do male and female students perform in mathematics across the departments?

To answer this question.10 students were picked from the three departments (5 male and 5 females) their mathematics performance was compared and computed using descriptive statistics and the results was presented in Table 4.3

Table 4.3: Gender Department Performance

Gender Dept	N	Mean	MD	SD	Performance

Male	ECCE	Female	5	81.0	1.5	4.5	Excellent
	ECCE		5	79.5			
Male	PES	Female	5	66.0	0.5	6.0	Good
	PES		5	65.5			
Male	ANF		5	73.0		5.3	Very Good
Female	ANF		5	72.0	1.0		

Source: Researcher 2025

Table 4.3 showed the gender departmental performance of 2024/2025 SECPADE students in Mathematics, the result of the calculations indicated the mean differences of 1.5, 0.5 and 1.0 in ECCE, PES and ANF respectively. However the significant of the differences was calculated in Table 4.4

H_{02}: There is no significant difference in mathematics performance between male and female SECPADE students.

Table 4.4 t-test Analysis for Gender Differences

Department	T	df	p	Remark
ECCE	0.58	8	0.58	
PES	0.18	8	0.86	Retained
ANF	-0.55	8	0.60	

Source: Researcher 2025 $\alpha = 0.05$

Table 4.4 indicated that p values of t(307) are greater than 0.05 (0.58, 0.86 and 0.60) as displayed in table 4.4,this indicated no significant difference in gender performance of the students within the departments and concluded that gender does not significantly influence performance. Hence the hypothesis is retained

Research Question Three: What is the level of retention of mathematical concepts among SECPADE students?

Reshuffled mean scores of the students was used to answer the retention levels of their performances and the result is presented in Table 4.5

Table 4.5: Retention Levels by Department

Department	Mean Score	Retention Level
ECCE 223	80.2	High Retention
ANF 223	73.5	Moderate Retention
PES 213	65.7	Low Retention

The results in Table 4.5 show that ECCE students recorded the highest mean score of 80.2**,** indicating high retention of mathematical concepts even when assessed with reshuffled test items. This demonstrates that ECCE students not only understood the concepts during teaching but were able to transfer the knowledge over time, likely due to the practical, hands-on, and activity-based instructional strategies used in Early childhood mathematics .ANF students recorded a mean score of 73.5, which falls under moderate retention. This suggests that although adult learners grasped the content sufficiently, their ability to retain and recall mathematical concepts was not as strong as ECCE students. This may be due to irregular study habits or limited reinforcement opportunities typical of adult education settings. PES students scored 65.7, indicating low retention. This suggests that while PES students were exposed to the content, they faced challenges in long-term recall, possibly due to the abstract or overly theoretical teaching methods used in primary mathematics pedagogy. The overall pattern revealed that retention levels followed this order:

ECCE > ANF > PES this shows that the nature of departmental instructional strategies significantly impacts learners' ability to retain mathematics concepts over time. Given the distinct differences in retention mean scores (80.2, 73.5, and 65.7), it is evident that students across the departments retained mathematical concepts at different levels. Table 4.6 displayed the significant differences in their retention abilities

HO_3: There is no significant difference in retention of mathematical concepts among the three departments

Table 4.6:

Table 4.6: One-Way ANOVA Showing Differences in Retention of Mathematical Concepts

Variation	Sum of Squares)	df	Mean Square	f	p-value	Remark
Between Groups	910.40	2	455.20	16.32	0.002	Rejection
Within Groups	752.60	27	27.87	—	—	
Total	1663.00	29	—	—	—	

$\alpha = 0.05$

Since the calculated p-value (0.002) is less than 0.05, the null hypothesis is rejected and conclude that there is a significant difference in the retention of mathematical concepts among ECCE, ANF, and PES students**,** with ECCE students demonstrating the highest retention, followed by ANF students, while PES students show the lowest level of retention.

Discussion of Findings

Findings show clear competency differences among the three departments. ECCE students outperformed ANF and PES students due to activity-based and conceptual instructional approaches. ANF students performed moderately, reflecting adult learners' reliance on practical statistical content. PES students' lower performance may stem from abstract teaching methods and weak foundational skills. Gender differences were insignificant, aligning with modern research showing declining gender gaps. Overall, departmental teaching approach is the strongest predictor of competency and retention.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

This study compared mathematics competencies, gender performance, and retention among ECCE, ANF, and PES students. ECCE students performed highest in all aspects, followed by ANF, then PES. Significant differences existed among departments but not between genders.

Conclusion

The study concludes that mathematics competency and retention vary significantly by department due to differences in instructional approaches, course structure and emphasis. ECCE methods proved most effective, while PES requires instructional strengthening. Gender has no significant effect on mathematics performance.

Recommendations

The following recommendations were made

1. ECCE instructional approaches should be adopted in PES and ANF.
2. Remedial support should be provided to struggling PES and ANF students.
3. Curriculum standards should be reviewed to improve retention and competency.
4. Further research should investigate instructional factors enhancing ECCE mathematics success

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