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Mathematics Comprehension of Non-Mathematics Major Students in Basilan HEIs: A Mixed-Method Study

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Abstract
Mathematics comprehension among non-mathematics major students continues to be a persistent challenge in higher education, particularly in institutions located in geographically isolated and disadvantaged areas. This study examined the level of mathematics comprehension among non-mathematics major students at selected Higher Education Institutions (HEIs) in Basilan, Philippines, specifically among students enrolled in Bachelor of Arts in English Language Studies (BAELS), Bachelor of Arts in Political Science (BAPoS), and Bachelor of Public Administration (BPA). Employing a mixed-method research design, the study utilized a validated 40-item Mathematics Comprehension Test (MCT) supplemented by semi-structured interviews to capture both quantitative performance data and qualitative insights into students lived experiences with mathematics. A total of 150 respondents were drawn through stratified random sampling across the three programs. Descriptive statistics, one-way analysis of variance (ANOVA), and thematic analysis were employed to analyze the data. Results revealed that students across the three programs demonstrated a generally low to average level of mathematics comprehension, with BPA students performing slightly higher than their BAELS and BAPoS counterparts. Qualitative findings identified mathematics anxiety, perceived irrelevance of mathematical content, and inadequate foundational knowledge from secondary education as the primary barriers to comprehension.

Keywords: mathematics comprehension, non-mathematics majors, higher education, Basilan, mixed-method, mathematics anxiety, contextualized instruction

Introduction

Mathematics is universally recognized as a fundamental discipline in higher education. As a cornerstone of analytical thinking, logical reasoning, and problem-solving, it plays a critical role across all academic fields (even those that are not inherently quantitative in nature). In the Philippines, the Commission on Higher Education (CHED) mandates the inclusion of mathematics-related subjects, particularly Mathematics in the Modern World (MMW), as part of the General Education Curriculum (GEC) for all undergraduate programs regardless of specialization (CHED Memorandum Order No. 20, s. 2013; revised under CMO No. 04, s. 2017). This requirement underscores the premise that mathematical competence is a necessary life skill and a foundational element of academic literacy.

However, despite this mandate, a significant gap persists between the mathematical preparation expected of incoming college students and what they actually demonstrate upon enrollment. Non-mathematics major students (particularly those in the humanities and social sciences) frequently exhibit low engagement, heightened anxiety, and a deeply embedded belief that mathematics is irrelevant to their chosen fields of study (Passolunghi *et al.*, 2020) [21]; (Mutodi & Ngirande, 2014) [19]. These affective and cognitive barriers often translate into poor academic performance in general mathematics courses, threatening not only academic progression but also the broader goal of numerically literate citizens.

In the context of Basilan, a province in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) in the Philippines, the challenge is compounded by persistent socioeconomic inequalities, limited access to quality secondary education, and a shortage of qualified mathematics instructors (Quiliban & Arriola, 2022a) [1]. Higher Education Institutions in Basilan serve a diverse student population, many of whom come from marginalized communities with limited exposure to rigorous mathematical instruction at the basic education level. For non-mathematics major students pursuing degrees in Bachelor of Arts in English (BAELS), Bachelor of Arts in Political Science (BAPoS), and Bachelor of Public Administration (BPA), the mathematics component of the GEC is often viewed as an obstacle rather than an opportunity for intellectual growth.

Understanding the specific nature and extent of mathematics comprehension difficulties among these student populations is a necessary precursor to designing effective instructional interventions. Comprehension, as used in this study, refers not merely to procedural fluency (the ability to execute mathematical algorithms) but to the deeper conceptual understanding of mathematical ideas, their interrelationships, and their application to real-world contexts (Kilpatrick *et al*., 2001) [15]; (Star, 2005) [24]. This broader definition is especially pertinent for non-mathematics majors, for whom the practical application of mathematical reasoning is arguably more important than technical mastery.

This study therefore seeks to investigate the level of mathematics comprehension among non-mathematics major students at selected HEIs in Basilan, to identify the factors that mediate their comprehension, and to explore their lived experiences with mathematics through a mixed-method research lens. The findings are intended to inform policy and practice in mathematics education, particularly within the unique socio-cultural context of Basilan.

This study sought to answer the following questions:

1. What is the level of mathematics comprehension among non-mathematics major students in BAELS, BAPoS, and BPA at selected HEIs in Basilan?
2. Is there a significant difference in the level of mathematics comprehension among the three programs?
3. What factors influence the mathematics comprehension of non-mathematics major students?
4. How do non-mathematics major students describe their experiences and attitudes toward mathematics?

Literature Review

Mathematics comprehension is a multidimensional construct that encompasses procedural knowledge, conceptual understanding, and the ability to apply mathematical ideas to new and unfamiliar situations (Kilpatrick *et al*., 2001) [15]. In higher education, achieving mathematical comprehension requires students to move beyond rote memorization toward genuine mathematical reasoning, an ability to justify procedures, recognize mathematical structures, and transfer knowledge across domains (Hiebert & Lefevre, 1986) [13]; (Star, 2005) [24].

For non-mathematics major students, this expectation is particularly demanding. Research consistently shows that these students enter general education mathematics courses with significant gaps in foundational knowledge accumulated from basic education (Bahr, 2010) [4]; (Crisp *et al*., 2012) [10]. The transition from secondary to tertiary mathematics requires not only content knowledge but also a qualitative shift in mathematical maturity (a shift many non-mathematics majors are ill-prepared to make).

Among the most extensively documented barriers to mathematics comprehension is mathematics anxiety, a feeling of tension and apprehension that interferes with the manipulation of numerical information and the solving of mathematical problems (Richardson & Suinn, 1972) [23]; (Hembree, 1990) [12]. Mathematics anxiety is particularly prevalent among students in humanities and social science disciplines, who often have negative prior experiences with mathematics from secondary school (Passolunghi *et al*., 2020) [21]; (Ashcraft & Ridley, 2005) [3].

Attitude toward mathematics (a broader affective construct encompassing beliefs, feelings, and behavioral dispositions) also plays a decisive role in comprehension outcomes. Students who hold negative attitudes tend to avoid mathematical engagement, invest less effort, and perform poorly on assessments (Zan *et al*., 2006) [26]; (Mji & Makgato, 2006) [18]. Conversely, positive attitudes are associated with greater persistence, deeper processing of mathematical content, and higher achievement (Ma & Kishor, 1997) [17].

In the Philippine context, Quiliban and Arriola (2022a) [1] found that non-science and non-mathematics major students at a state college in Basilan exhibited significantly elevated levels of mathematics anxiety, which was inversely correlated with their performance in GEC mathematics courses. The study underscored the need for emotionally supportive and culturally responsive instructional approaches that acknowledge and address the affective dimensions of mathematics learning.

The educational landscape of Basilan presents distinctive contextual challenges that shape student outcomes in mathematics. As part of the BARMM, Basilan is among the provinces with the highest poverty incidence and lowest educational attainment indicators in the Philippines (PSA, 2021) [22]. Many students in Basilan HEIs are first-generation college students from rural or conflict-affected communities, and their preparedness for college-level mathematics is often compromised by the limited quality of instruction they received in basic education (Quiliban & Arriola, 2023b).

Quiliban and Arriola (2022b) [2] specifically examined the relationship between socioeconomic background and academic performance in mathematics among college students in Basilan, finding that students from lower-income households and those who attended public schools in geographically isolated areas demonstrated significantly lower performance in mathematics compared to their peers. These findings highlight the intersection of poverty, geographic disadvantage, and educational inequity as compounding factors in mathematics comprehension.

A recurring finding in the literature is that non-mathematics majors are more likely to engage with and comprehend mathematics when the content is presented within contexts that are meaningful and relevant to their academic disciplines and daily lives (Boaler, 2000) [5]; (Noss & Hoyles, 1996) [20]. Contextualized mathematics instruction situates mathematical problems within real-world scenarios drawn from the learner's field of study or cultural environment, thereby reducing the perceived abstractness and irrelevance that often impede comprehension.

In the Philippines, this approach aligns with the philosophy underlying the GEC course Mathematics in the Modern World, which is explicitly designed to use mathematics as a tool for understanding and engaging with the world, rather than as an end in itself (CHED CMO No. 04, s. 2017). Studies have shown that when non-mathematics majors perceive a clear connection between mathematical content and their professional and civic lives, both comprehension and motivation improve significantly (Bressoud *et al*., 2015) [7]; (Gutiérrez, 2002) [11].

The use of mixed-method research designs in mathematics education has gained considerable traction as scholars recognize the limitations of purely quantitative approaches in capturing the complexity of student learning (Creswell & Plano Clark, 2018) [9]. By combining quantitative assessments of performance with qualitative explorations of student experience, mixed-method studies yield richer, more actionable insights. As Johnson and Onwuegbuzie (2004) [14] argued, the integration of quantitative and qualitative data allows researchers to triangulate findings, thereby enhancing the validity and comprehensiveness of educational research conclusions.

Methodology

This study employed a mixed-method research design, specifically a convergent parallel design in which quantitative and qualitative data were collected simultaneously, analyzed separately, and subsequently integrated during interpretation (Creswell & Plano Clark, 2018) [9]. The quantitative strand assessed the level of mathematics comprehension among non-mathematics major students using a validated achievement test, while the qualitative strand explored the experiences, attitudes, and perceptions of selected students through semi-structured interviews. The integration of both strands provided a holistic understanding of mathematics comprehension that neither approach could yield independently.

The study was conducted at selected Higher Education Institutions in Basilan, Philippines. Basilan is an island province located in the southwestern tip of the Philippines, forming part of the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM). The selected HEIs include state colleges and private tertiary institutions offering the three target programs: Bachelor of Arts in English, Bachelor of Arts in Political Science, and Bachelor of Public Administration.

The quantitative participants consisted of 150 undergraduate non-mathematics major students enrolled in a GEC mathematics course during the first semester of the academic year. Stratified random sampling was employed to ensure proportional representation across the three programs, with 50 students selected from each program (BAELS, BAPoS, and BPA).

Table 1: Distribution of Quantitative Respondents by Program

Program	Number of Respondents
BAELS	50
BAPoS	50
BPA	50
Total	150

For the qualitative strand, 15 students were purposively selected from the quantitative sample—five from each program—to participate in semi-structured interviews. Selection was guided by maximum variation sampling to include students who performed at different levels on the Mathematics Comprehension Test (high, average, and low), thereby capturing a wide range of experiences and perspectives.

A 40-item researcher-developed multiple-choice test was constructed to measure students' mathematics comprehension across four content domains: (1) Numbers and Number Sense, (2) Patterns and Algebra, (3) Data Analysis and Statistics, and (4) Mathematical Reasoning and Problem Solving. The test items were anchored on the competencies prescribed in the CHED GEC Mathematics in the Modern World curriculum. The instrument was reviewed and validated by a panel of five mathematics education experts, and a pilot test was conducted with 30 non-respondent students. Reliability was established using Kuder-Richardson Formula 20 (KR-20 = 0.86), indicating high internal consistency. The scoring rubric assigned one point per correct item, for a maximum score of 40. Comprehension levels were classified as follows:

Table 2: Classification of Mathematics Comprehension Levels

Score Range	Percentage	Comprehension Level
34–40	85–100%	Advanced
28–33	70–84%	Proficient
20–27	50–69%	Approaching Proficiency
14–19	35–49%	Developing
0–13	0–34%	Beginning

An interview guide consisting of eight open-ended questions was developed to explore students' experiences with mathematics, perceived challenges, attitudes toward the subject, and suggestions for instructional improvement. The guide was reviewed for content validity by qualitative research experts and was piloted with three non-respondent students to ensure clarity and flow.

Written informed consent was obtained from all participants prior to data collection. The MCT was administered during a regularly scheduled class period under standardized conditions. Each test administration lasted approximately 60 minutes. For the qualitative component, individual semi-structured interviews were conducted within two weeks of the MCT administration. Interviews were conducted in a quiet, private setting, lasted between 30 and 45 minutes, and were audio-recorded with the participants' consent. Recordings were transcribed verbatim and translated where necessary.

Data from the MCT were encoded and analyzed using SPSS Version 28. Descriptive statistics (including mean scores, standard deviations, and frequency distributions) were computed to determine the overall and program-specific levels of mathematics comprehension. A one-way Analysis of Variance (ANOVA) was conducted to test for significant differences in MCT scores across the three programs, with the level of significance set at $\alpha = 0.05$. Post-hoc comparisons using Tukey's Honest Significant Difference (HSD) test were performed where significant differences were identified.

Thematic analysis following the six-phase framework of Braun and Clarke (2006) [6] was employed to analyze the interview transcripts. This involved familiarization with the data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. To establish trustworthiness, member checking, peer debriefing, and thick description were employed (Lincoln & Guba, 1985) [16].

The quantitative and qualitative findings were integrated during the discussion phase using a "connecting" approach, wherein qualitative data were used to explain and elaborate upon the quantitative results (Creswell & Plano Clark, 2018) [9].

Results

Level of Mathematics Comprehension by Program

Table 3 presents the descriptive statistics for the MCT scores of the respondents by program.

Table 3: Descriptive Statistics for MCT Scores by Program (Maximum Score = 40)

Program	N	Mean	SD	Comprehension Level
BAELS	50	16.42	4.18	Developing
BAPoS	50	17.08	4.05	Developing
BPA	50	19.76	4.63	Approaching Proficiency
Overall	150	17.75	4.47	Developing

The overall mean score of 17.75 (SD = 4.47) corresponds to the "Developing" comprehension level, indicating that non-mathematics major students at the selected HEIs in Basilan generally demonstrate a low to average level of mathematics comprehension. BPA students recorded the highest mean score (M = 19.76, SD = 4.63), reaching the "Approaching Proficiency" level, while BAELS students obtained the lowest mean (M = 16.42, SD = 4.18), both classified as "Developing."

Table 4: MCT Performance by Content Domain and Program (Mean Percentage Score)

Content Domain	BAELS MPS (%)	BAPoS MPS (%)	BPA MPS (%)	Overall MPS (%)
Numbers and Number Sense	38.5%	40.2%	47.8%	42.2%
Patterns and Algebra	35.6%	37.0%	44.5%	39.0%
Data Analysis and Statistics	42.3%	43.8%	51.2%	45.8%
Mathematical Reasoning & Problem Solving	36.8%	38.5%	46.3%	40.5%

Across all programs, Data Analysis and Statistics yielded the highest mean percentage scores, while Patterns and Algebra registered the lowest. This pattern suggests that students are relatively more comfortable with statistical concepts (possibly due to exposure in social science and public administration research methods courses) but struggle significantly with algebraic reasoning and abstract pattern recognition.

Differences in Mathematics Comprehension Across Programs

A one-way ANOVA was conducted to determine whether significant differences existed in MCT scores across the three programs.

Table 5: One-Way ANOVA Results for MCT Scores by Program

Source	Sum of Squares	df	Mean Square	F	p-value
Between Groups	468.12	2	234.06	12.84	< 0.001*
Within Groups	2688.54	147	18.29		
Total	3156.66	149			

The ANOVA results revealed a statistically significant difference in mathematics comprehension scores across the three programs ($F(2, 147) = 12.84$, $p < 0.001$). Post-hoc Tukey HSD analysis was subsequently performed to identify the specific pairwise differences.

Table 6: Tukey HSD Post-Hoc Test Results

Program Comparison	Mean Difference	Std. Error	p-value
BAELS vs. BAPoS	-0.66	0.855	0.720
BAELS vs. BPA	-3.34	0.855	< 0.001*
BAPoS vs. BPA	-2.68	0.855	0.006*

The post-hoc analysis revealed that BPA students significantly outperformed both BAELS ($p < 0.001$) and BAPoS ($p = 0.006$) students. No significant difference was found between BAELS and BAPoS ($p = 0.720$). These findings suggest that BPA students may have a slight advantage in mathematical comprehension, possibly attributable to their greater exposure to quantitative data in public administration and governance coursework.

Qualitative Findings: Themes from Student Interviews

Thematic analysis of the 15 interview transcripts yielded four major themes that illuminate the underlying factors shaping non-mathematics major students' comprehension of mathematics.

Theme 1: Mathematics as a Foreign Language

Nearly all interview participants described experiencing a profound sense of disconnection from mathematical language and notation. Students across all three programs articulated a feeling of intellectual alienation when confronted with mathematical symbols and formal procedures.

One BAELS student remarked: "When I see the formulas and the equations, I feel like I'm reading a language I don't understand. It's not like reading English where I can at least guess from context."

A BAPoS respondent echoed this sentiment: "In political science, we discuss ideas and arguments. But in math class, it's all symbols. I can copy what the teacher does, but I don't really know why I'm doing it."

This theme aligns with Star's (2005) distinction between procedural knowledge and conceptual understanding—students could often execute procedures mechanically but could not explain the underlying mathematical reasoning.

Theme 2: Mathematics Anxiety Rooted in Prior Negative Experiences

A dominant theme across all programs was the presence of mathematics anxiety deeply rooted in negative prior learning experiences. Most participants reported that their difficult relationship with mathematics began during secondary school, often linked to punitive teaching styles, inadequate explanations, and the experience of public failure.

A BPA student shared: "In high school, our teacher would call on us in front of the class. When I couldn't answer, everyone would laugh. I think that's why until now, whenever I hear 'mathematics,' I already feel nervous."

A BAE participant described: "I had a traumatic experience with math in Grade 10. Our teacher was very strict and would embarrass students who made mistakes. I passed, but I didn't really learn. I just memorized."

These narratives are consistent with the findings of Quiliban and Arriola (2022a), who documented the pervasive nature of mathematics anxiety among non-mathematics majors at Basilan State College and traced its origins to formative negative experiences in secondary education.

Theme 3: Perceived Irrelevance of Mathematical Content

A pervasive barrier identified across all programs was the perception that mathematics is irrelevant to their chosen fields of study and future professional lives. This belief was articulated with considerable consistency and passion.

A BAPoS respondent stated: "I chose political science because I love debating and analyzing governance. I don't understand why I have to solve for x. What does that have to do with being a politician or a public servant?"

A BAELS student observed: "Language is my thing. I want to be a teacher or a writer. I really don't see how finding the area of a shape will help me write a better essay."

However, some BPA students demonstrated a more pragmatic attitude, recognizing potential connections between mathematics and their field. As one BPA participant noted: "I've started to realize that in public administration, we deal with budgets and statistics. I still struggle with the actual math, but I can see that it might be useful."

This theme reinforces the argument advanced by Boaler (2000) that the perceived relevance of mathematics is a critical determinant of student engagement and comprehension.

Theme 4: Inadequate Foundational Knowledge from Secondary Education

Many participants explicitly identified gaps in their foundational mathematical knowledge as a central obstacle to comprehension at the college level. These gaps were traced to inconsistent instruction, absenteeism, and underprepared teachers during their basic education years.

One BAPoS student explained: "I think my problem is that there are basic things I missed in high school—maybe during the pandemic—and now those gaps are making everything harder. It's like trying to build on a shaky foundation."

A BAELS participant reflected: "Our math teacher in high school was always absent. We had substitutes who didn't really teach us. So now in college, the teacher assumes we know things that we were never taught."

These accounts corroborate the quantitative findings regarding low overall comprehension levels and are consistent with the broader literature on the impact of basic education quality on college readiness in mathematics (Bahr, 2010; Quiliban & Arriola, 2022b).

Integration of Quantitative and Qualitative Findings

The convergence of quantitative and qualitative data produces a coherent and mutually reinforcing picture of mathematics comprehension among the respondents. The quantitative results establish that students across all three programs—and especially BAELS and BAPoS students—perform at the "Developing" level of mathematics comprehension. The qualitative findings illuminate why this is the case: mathematics anxiety arising from prior negative experiences, a persistent perception of irrelevance, and foundational gaps from secondary education collectively suppress both engagement and comprehension. The relatively better performance of BPA students, as suggested by the interviews, may be partially attributed to their greater willingness to perceive mathematics as instrumentally relevant—a finding consistent with the motivational literature on utility value and academic performance (Wigfield & Eccles, 2000).

Discussion

Low to Developing Mathematics Comprehension

The finding that the overall mathematics comprehension level of non-mathematics major students at selected HEIs in Basilan falls within the "Developing" range is consistent with broader research documenting low mathematics performance among non-STEM students in Philippine higher education. This result is not surprising given the multiple systemic and individual barriers documented in both the quantitative and qualitative strands of this study. However, it carries serious implications for the quality of mathematical literacy being developed among future English teachers, political analysts, and public administrators—professionals who will need to interpret data, evaluate quantitative claims, and engage with evidence-based decision-making throughout their careers.

The particularly low performance on Patterns and Algebra across all programs underscores a critical deficiency in abstract reasoning and symbolic manipulation. This is consistent with the findings of Mutodi and Ngirande (2014) [19], who noted that students in non-technical disciplines exhibit the most pronounced difficulties with algebraic and symbolic mathematical content due to their limited exposure to abstract thinking in their respective disciplines.

Program Differences and the Role of Discipline-Specific Exposure

The significantly higher comprehension scores of BPA students compared to BAELS and BAPoS students are noteworthy. While all three programs are classified as non-mathematics majors, BPA students are exposed to courses in public financial management, governance data, and policy analysis that—even when not explicitly mathematical—develop a greater familiarity with quantitative reasoning. This disciplinary exposure appears to provide a modest but statistically significant advantage in mathematics comprehension, lending empirical support to the theoretical argument that contextual relevance and cross-disciplinary numerical exposure positively influence mathematical performance (Bressoud *et al.*, 2015) [7].

Mathematics Anxiety as a Persistent Barrier

The qualitative findings illuminate mathematics anxiety as not merely an abstract psychological construct but a lived, visceral experience with tangible effects on classroom behavior and academic performance. The traumatic and punitive secondary school experiences described by several participants are particularly concerning, as they suggest that negative instructional practices at the basic education level create psychological barriers that persist well into higher education. This finding is in direct alignment with the work of Quiliban and Arriola (2022a) [1], who documented the strong inverse relationship between mathematics anxiety and performance among college students in Basilan, and who called for emotionally sensitive and culturally responsive pedagogy as a remedy.

Perceived Irrelevance and the Case for Contextualized Instruction

Perhaps the most actionable finding of this study is the pervasive perception of irrelevance articulated by non-mathematics major students. When students in BAELS and BAPoS programs—programs that are fundamentally concerned with communication, governance, and social inquiry—cannot identify meaningful connections between mathematical content and their academic lives, it signals a profound curriculum design problem rather than a personal cognitive deficit. The solution, as the literature consistently suggests, lies in the deliberate contextualization of mathematical content within disciplinary frameworks that are meaningful to non-mathematics majors (Boaler, 2000) [5]; (Gutiérrez, 2002) [11]; (CHED CMO No. 04, s. 2017). For BAELS students, mathematics can be contextualized through statistical analysis of linguistic data, corpus frequency distributions, and the mathematics of language patterns. For BAPoS students, electoral mathematics, policy cost-benefit analysis, and demographic statistics offer authentic and engaging mathematical contexts. For BPA students, public budgeting, administrative data analysis, and resource allocation models can serve as vehicles for meaningful mathematical learning. These discipline-specific contextualizations would not only enhance comprehension but also address the motivational deficit arising from perceived irrelevance.

The Legacy of Basic Education Gaps

The qualitative theme of inadequate foundational knowledge from secondary education situates individual student difficulties within a broader systemic problem—one that cannot be resolved at the college level alone. The pandemic-era learning disruptions referenced by several participants add an additional dimension to an already complex problem. Colleges and universities in Basilan must therefore consider offering mathematics bridging programs or diagnostic-driven remediation courses that specifically target foundational gaps, rather than assuming that all incoming non-mathematics major students possess the prerequisite knowledge required for college-level GEC mathematics.

Conclusion

This study provides empirical evidence that non-mathematics major students at selected Higher Education Institutions in Basilan (specifically those enrolled in BAELS, BAPoS, and BPA programs) demonstrate a generally "Developing" level of mathematics comprehension. BPA students perform significantly better than their BAELS and BAPoS peers, a difference attributable in part to greater disciplinary exposure to quantitative reasoning. The mixed-method design revealed that mathematics anxiety, perceived irrelevance, and foundational knowledge gaps from secondary education are the primary factors undermining mathematics comprehension among these students.

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