

Basic Arithmetic Skills as Predictors of Mathematics Achievement: A Systematic Review of Foundational Numeracy and Academic Performance

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Abstract: This review synthesizes literature on the predictive role of basic arithmetic skills in mathematics achievement among senior high school students. The objective is to examine how proficiency in fundamental operations; addition, subtraction, multiplication, division, fractions, decimals, and percentages affects learners' performance in higher-level mathematics. Literature was gathered from ERIC, ScienceDirect, Google Scholar, and Philippine E-Journals, covering studies published between 2018 and 2025. Findings consistently highlight that arithmetic fluency is a significant predictor of mathematics achievement, reducing cognitive load and enabling students to focus on complex problem-solving. International assessments such as PISA reveal persistent gaps in foundational numeracy, particularly in the Philippines, where many learners struggle with basic computations. Theoretical frameworks including Piaget's Constructivism and Sweller's Cognitive Load Theory support the argument that arithmetic competence underpins advanced mathematical learning. However, gaps remain in localized empirical studies that specifically investigate Grade 11 students in the Philippine context. This synthesis underscores the importance of strengthening arithmetic foundations to improve mathematics achievement and recommends targeted interventions, remedial programs, and regression-based studies to establish predictive relationships.

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I. INTRODUCTION

➤ Background Context

Mathematics is hierarchical, with advanced concepts building upon foundational arithmetic skills. Weaknesses in basic operations hinder learners' ability to grasp algebra, geometry, and statistics. International assessments such as PISA (OECD, 2023) reveal that Filipino students perform below average in mathematics, raising concerns about foundational numeracy.

➤ Scope and Purpose

This review focuses on literature examining the relationship between arithmetic skills and mathematics achievement. It covers studies on arithmetic fluency, cognitive load, mathematics anxiety, and predictive models of achievement. Studies outside mathematics education or unrelated to arithmetic skills are excluded.

➤ Thesis Statement/Objective

The review aims to synthesize research on how basic arithmetic skills predict mathematics achievement, identify

systemic challenges, and highlight gaps in localized studies among Grade 11 learners.

II. METHODOLOGY

➤ Search Strategy

- Databases: ERIC, ScienceDirect, Google Scholar, Philippine E-Journals. Search terms: basic arithmetic skills, mathematics achievement, numeracy predictors, cognitive load theory, senior high school mathematics.

➤ Selection Process

• Inclusion Criteria:

- ✓ Studies focusing on arithmetic skills and mathematics achievement.
- ✓ Research examining predictive relationships using regression or correlation.
- ✓ Published between 2018–2025.

• *Exclusion Criteria:*

- ✓ Studies focusing solely on higher mathematics without reference to arithmetic.
- ✓ Non-empirical reports or opinion pieces.

➤ *Main Body*

• *Theme 1: Importance of Arithmetic Skills*

Spiller et al. (2023) and Rebholz et al. (2021) found that arithmetic proficiency significantly contributes to success in algebra and geometry. Liu et al. (2021) emphasized that arithmetic fluency predicts academic achievement, reinforcing its foundational role.

• *Theme 2: Cognitive Load and Arithmetic Fluency*

Sweller's Cognitive Load Theory (1994) explains that arithmetic fluency reduces working memory demands, allowing learners to focus on complex reasoning. Students lacking fluency experience cognitive overload, hindering achievement.

• *Theme 3: Mathematics Anxiety and Confidence*

Namkung et al. (2019) reported that weak arithmetic skills contribute to mathematics anxiety and low confidence, negatively affecting classroom participation. Conversely, arithmetic competence fosters motivation and engagement.

• *Theme 4: International and Local Contexts*

OECD (2023) reported that only 16% of Filipino students reached Level 2 proficiency in mathematics, compared to 69% OECD average. Local studies (Galangco, 2023) found that prior mathematics achievement strongly influences senior high school performance, underscoring the predictive role of foundational skills.

III. CONCLUSION AND RECOMMENDATIONS

➤ *Summary of Main Findings*

Arithmetic skills are consistently shown to predict mathematics achievement. Fluency reduces cognitive load, improves confidence, and supports advanced learning. Weaknesses in arithmetic hinder achievement and contribute to anxiety.

➤ *Significance*

This synthesis highlights the critical role of arithmetic in mathematics education, particularly in the Philippine context where foundational numeracy gaps persist.

➤ *Future Research*

- Conduct regression-based studies on Grade 11 students to quantify predictive relationships.
- Explore interventions that strengthen arithmetic fluency before senior high school.
- Investigate the long-term impacts of arithmetic proficiency on STEM readiness and employability.

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