

# A Study of Manipulative Use in Grade 2 Mathematics: Enhancing Student Engagement and Problem-Solving Skills

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## Abstract

This study explored the impact of manipulatives in Grade 2 mathematics at the School of the Nations, Georgetown, Guyana. Despite known advantages, manipulatives are underutilized in classrooms, leading to decreased engagement and weaker problem-solving skills. Using action research, this study introduced base-ten blocks, geometric shapes, and clock faces across selected lessons. Twenty-six pupils participated, and data were collected via observations and assessments. Results revealed significant improvements: comprehension of place value and arithmetic increased by 20%, understanding of time by 25%, and geometry skills by 15%. Pupils demonstrated heightened engagement, motivation, and confidence. The study concluded that manipulatives effectively enhance understanding, participation, and retention in mathematics. Recommendations include integrating manipulatives into daily teaching and conducting long-term studies with larger samples.

## Keywords

Manipulatives, Grade 2 mathematics, engagement, problem-solving, concrete learning

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## 1. Introduction

Manipulatives have long been recognized as effective tools in mathematics instruction, yet many Grade 2 classrooms either underuse or overlook them. This gap limits pupils' engagement and problem-solving development (Smith, 2017). In the School of the Nations, observations indicated similar patterns, prompting the need to explore how hands-on materials could influence learning outcomes. The study's objectives were to examine how manipulatives affect student engagement, problem-solving skills and to determine which

types are most effective. The overarching goal was to enhance instructional strategies and student outcomes through the systematic integration of manipulatives.

## Literature Review

Manipulatives, defined by the [National Council of Teachers of Mathematics \(2000\)](#) as tangible items aiding the comprehension of abstract ideas, include base-ten blocks, number lines, and geometric shapes. The theoretical foundation draws from [Piaget's \(1952\)](#) cognitive development theory and [Bruner's \(1966\)](#) theory of representation. Piaget emphasized hands-on learning during the concrete operational stage, while Bruner underscored multiple representations. Together, these theories justify manipulative-based teaching as supporting both cognitive and conceptual development.

[Clements and Sarama \(2009\)](#) emphasized the role of developmental learning trajectories in mathematics, advocating manipulative use aligned with children's cognitive readiness. [Van de Walle and Lovin \(2006\)](#) further supported inquiry-based, student-centered instruction where learners build understanding through physical interaction. Research consistently highlights improved comprehension, motivation, and collaboration through manipulatives ([Adams et al., 2018](#); [Brown & Garcia, 2016](#); [Johnson, 2020](#)). Conversations with educators and math specialists reinforced these findings, emphasizing manipulatives' role in fostering engagement, inquiry, and deep understanding.

## Materials and Method

This action research employed a pre-action, action, and reflection cycle with one Grade 2 class ( $n = 26$ ) at the School of the Nations. The manipulatives included base-ten blocks, geometric shapes, and clock faces.

Research Questions:

1. How does the use of manipulatives influence problem-solving skills in Grade 2 pupils?
2. What impact does manipulative use have on pupil engagement?

Procedure:

- Pre-Action Phase: Baseline data were collected via observations and math tests. Lesson plans were modified to incorporate manipulatives.
- Action Phase: Manipulatives were systematically introduced in arithmetic, geometry, and time lessons. Data were collected through structured observation forms and periodic assessments.
- Reflection Phase: Pre- and post-intervention data were compared using statistical analysis (paired t-tests, ANOVA) to determine significant changes in engagement and achievement.

## Results

Base-Ten Blocks: Pupils demonstrated enhanced understanding of place value and arithmetic, with a 20% improvement in test scores. Engagement and participation notably increased.

Clock Faces: Mastery of time-telling improved by 25%, with students displaying greater comfort interpreting time and elapsed intervals.

Geoboards: Geometry comprehension improved by 15%. Pupils enjoyed creating shapes and exploring properties, resulting in heightened motivation.

Overall Results:

- Pre-intervention mean score: 32.54
- Post-intervention mean score: 45.46
- Mean improvement: 10.55
- Normalized final score: 74.84

## Discussion

The findings affirm that manipulatives are effective in enhancing both understanding and engagement in mathematics. Students developed concrete representations of abstract concepts, aligning with Piaget's and Bruner's frameworks. The tactile, visual, and interactive elements of manipulatives made learning more accessible and enjoyable. Increased motivation and confidence were evident, as students demonstrated improved test performance and participation. Moreover, manipulatives fostered collaboration and communication among pupils, enhancing classroom interaction and peer learning.

## Conclusion

Manipulatives transform mathematical instruction from abstract to experiential learning. They provide tangible representations of abstract concepts, enhance engagement and motivation, support diverse learning styles, strengthen problem-solving skills, and improve retention. The research underscores manipulatives' importance in foundational mathematics and recommends their systematic use to build lasting mathematical competence in early learners.

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## Conflict of interest

The author declares no conflict of interest.

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