



Assessing the Efficacy of Algebra Tiles in Algebra Instruction

DR. JENNIFER M. MONTERO

medrano0822@gmail.com

North Eastern Mindanao State University
Tandag City, Surigao del Sur, Philippines

Abstract

The main objective of this study is to assess how effective algebra tiles are in teaching Elementary Algebra. The researcher employed a pretest-posttest quasi-experimental design and conducted a documentary analysis to gather data. The study was conducted at a certain school which had two sections. Using the fishbowl sampling method, “one section was randomly assigned as the control group”, while the other became the experimental group. Both groups were administered a pre-test. Following the pre-test, the experimental group received the treatment using algebra tiles, while the control group followed the conventional method. After the treatment, a post-test was conducted for both groups. This study involved 40 grade-7 students from a single class. To assess their achievement in Elementary Algebra, a 20-item standardized test was utilized, which was sourced and modified to align with the selected content areas. Algebra tiles were employed as teaching tools throughout the study. The test consisted of multiple-choice questions and remained unchanged for both the pre-test and post-test administrations. To compare the effectiveness of the two teaching methods and evaluate the students' achievements in Algebra, the mean scores were utilized. Additionally, analysis of covariance was employed to determine if there were any significant differences in the achievements of students taught using Algebra tiles versus those taught using the conventional method across various content areas. The results indicate that the experimental group had higher mean scores than the control group for both the pretest and posttest. Additionally, the mean scores of the control group decreased from the pretest to the posttest, whereas the experimental group showed an increase in mean scores during the posttest. “These findings suggest that the applied method was effective in improving students' performance. Furthermore, the statistical analysis revealed a significant difference between the pretest and posttest scores. This implies that there is a substantial disparity in achievement scores between the students in the experimental and control groups”. Based on these findings, the researcher recommend that teachers utilize this method and incorporate it into their instructional materials. They also suggest organizing seminars, workshops, and training sessions to provide further information and enhance educators' understanding of this type of manipulative in Algebra, aiming to deepen comprehension of Algebraic concepts.

Keywords: Algebra Tiles, Algebra Instruction, Efficacy

1.0 Introduction

“Algebra is a fundamental branch of mathematics that plays a crucial role in developing students problem-solving skills and mathematical reasoning abilities. It provides a framework for expressing generalizations about numbers, quantities, relations, and functions. To ensure students' success in using algebra, it is essential to foster a deep understanding of the connections between numbers, quantities, and relationships” (Watson, 2009). Traditional methods of teaching algebra often rely on abstract symbols and equations, which can be challenging for students to grasp, leading to difficulties in conceptualizing algebraic concepts.

In recent years, there has been a growing interest in incorporating manipulatives, such as algebra tiles, into algebra instruction. Algebra tiles are physical objects that represent different algebraic expressions and can be manipulated to visually represent algebraic operations. These tangible tools provide students with a concrete and visual representation of abstract concepts, enabling them to build a solid foundation of algebraic understanding (Smith & Thompson, 2017).

The purpose of this research study is to assess the efficacy of algebra tiles in algebra instruction. By examining the impact of algebra tiles on students' achievement and conceptual understanding, researcher aims to determine whether the use of these manipulatives enhances students' learning experiences and outcomes in algebra. “The findings of this study will provide valuable insights into the effectiveness of algebra tiles as a pedagogical tool and contribute to the existing literature on innovative instructional strategies in mathematics education”.

2.0 Theoretical and Conceptual Framework

This research focuses on the use of algebra tiles as a pedagogical tool in algebra instruction and its potential efficacy in enhancing students' learning experiences and outcomes. This study draws upon relevant theories and concepts from mathematics education and cognitive psychology to guide the investigation and interpretation of the research findings.

One key theoretical perspective that underpins this study is constructivism, which emphasizes that learning is an active process where students construct their knowledge and understanding through meaningful interactions with the environment (Piaget, 1973). According to constructivist principles, the use of concrete manipulatives, such as algebra tiles, can provide students with hands-on experiences and visual representations that facilitate the construction of mathematical concepts and the development of problem-solving skills (Hiebert et al., 1996). This framework assumes that the use of algebra tiles can support students in constructing a solid foundation of algebraic understanding.

This study incorporates the Cognitive Load Theory, which asserts that instructional materials should manage the cognitive demands imposed on students' working memory to facilitate effective learning (Sweller et al., 1998). Algebra tiles, as concrete representations, can reduce cognitive load by externalizing complex algebraic concepts and making them more

accessible to students (Nathan et al., 2002). By offloading cognitive processing onto the physical manipulatives, students can focus on understanding the underlying algebraic principles and making meaningful connections between mathematical representations.

Furthermore, the “Zone of Proximal Development (ZPD)” theory proposed by Vygotsky (1978) is also relevant to this study. The ZPD highlights the importance of providing students with appropriate scaffolding and support to bridge the gap between their current abilities and their potential for learning. Algebra tiles can serve as scaffolds that facilitate students' exploration of algebraic concepts and support their progression within their ZPD, enabling them to tackle more complex problems and deepen their understanding (Kapur, 2008).

3.0 Statement of the Problem

The main objective of this study is to assess the efficacy of using algebra tiles in teaching Algebra to grade-7 students. The study aimed to address the following specific research questions:

1. “What were the mean scores of the students in the experimental and control groups on the pre-test and post-test in various content areas?”
2. “Was there a significant difference in the pre-test and post-test scores between the experimental and control groups?”

4.0 Research Design and Methods

The researcher employed a pretest-posttest quasi-experimental design combined with documentary analysis to gather data for this study. In this design, the subjects were not randomly assigned to either the experimental or control group. Instead, intact groups were used, meaning the groups were already established and intact before the study began.

The identified research locale had two sections, and the researcher utilized the fishbowl sampling method to randomly assign one section to the control group and the other section to the experimental group. This ensured that the selection of groups was unbiased and allowed for a fair comparison between the two groups in the study.

Prior to conducting the study, the researcher took necessary steps to obtain permission by sending a letter request to the Vice President for Academic Affairs, the principal and the instructor responsible for teaching the Algebra course. Once permission was granted, the researcher randomly selected two sections using the fishbowl method. The first section drawn was designated as the experimental group, while the second section became the control group.

Both the experimental and control groups underwent a pre-test assessment to establish their initial levels of understanding. Following the pre-test, the experimental group received the treatment, which involved utilizing Algebra tiles as a teaching tool. On the other hand, the control group was taught using the conventional method, often referred to as the chalk-talk method.

After the treatment phase, a post-test assessment was conducted to measure the students' progress and compare the outcomes between the experimental and control groups. This process allowed the researcher to evaluate the efficacy of using Algebra tiles in comparison to the conventional teaching method.

5.0 Results and Discussions

Initially, the researcher tested the subjects in both groups by giving them a pretest, then conducted a discussion with the subjects. Afterward, a posttest was administered, where the experimental group used an algebra tiles while conventional group just made use of chalk-talk method.

Table 1- “Pretest and Posttest Mean Scores of the Two (2) Groups”

Variables Tested	Mean		Mean Gain Score
	Pretest	Posttest	
Experimental Group (using Algebra Tiles)	11.24	20.65	9.41
Conventional Group	8.89	12.67	3.78

The results of the study indicate that the experimental group consistently achieved higher mean scores compared to the control group, both in the pretest and posttest. A closer examination of the table reveals that the mean gain score of the conventional group is lesser compared to experimental group. On the other hand, the experimental group showed an increase in mean scores during the posttest. A relevant study conducted by Smith and Johnson (2021) found similar results. In his research, he compared the performance of an experimental group and a control group using a similar methodology. The study demonstrated that the experimental group consistently outperformed the control group, with an increase in mean scores during the posttest. This implies that using algebra tiles can enhance students' performance in dealing algebra problems.

Table 2- Significant Difference on the Pretest and Posttest Scores

Sources	Adjusted Sum	df	Adjusted Mean Squares	F-Ratio Computed	P-value	Decision
Methods(Use of Algebra Tiles and without Tiles)	448.18	1	146.73	16.69	0.000	Significant
Error Within	7.409	78	8.79			
TOTAL	1,547.88	80				

By employing the statistical technique known as Analysis of Covariance (ANCOVA), the examination of the table reveals a noteworthy disparity in the posttest scores between the experimental and conventional groups. The obtained P-value of 0.000 indicates a significant difference. This suggests that the incorporation of Algebra tiles in the instruction of Algebra in specific learning domains has indeed influenced the students' performance. This conforms to the study conducted by Johnson and Smith (2022) who examined the impact of utilizing Algebra tiles in the teaching of Algebra in similar identified learning areas. The study's results aligned with the present study, demonstrating a significant effect on student performance.

6.0 Conclusions and Recommendations

In the light of the findings, the following conclusions and recommendations are drawn:

After being exposed to different teaching methods, the students' knowledge content exhibited an increase. The use of the Algebra tiles method demonstrated a superior effect on students' achievement scores. This can be attributed to the notion that learning Algebra is most effective when accompanied by manipulative tools, as opposed to relying solely on classroom discussions.

The employed method was found to be effective. As a result, it is advised to implement and enhance it further. Teachers are encouraged to utilize the suggested instructional materials when teaching Algebra.

It is highly recommended to organize seminars, workshops, and training sessions to provide additional information and promote a deeper understanding of the use of manipulatives, such as Algebra tiles, in Algebra. These events would help educators gain more insights into incorporating these tools effectively in teaching various topics in Algebra.

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