

Digi-Block Learning SystemSM

Summer School Study of Digi-Block Implementation

Boston, Massachusetts 1999¹

Student conceptual understanding of mathematics has become an increasingly studied topic. There is mounting evidence that the traditional approach to teaching elementary number sense, with emphasis on rote memorization of algorithms, produces significant negative long-term conceptual and procedural difficulties in children. An independent study of the Digi-Block Learning System, which emphasizes building a concrete understanding of number sense, was performed in a short-term setting to determine its effects on low achieving students. A group of university-based independent researchers, retained by Digi-Block, proposed, developed and implemented the Boston study. Their methods reflect a descriptive study of enumerative understanding.

The purpose of this study was to determine to what extent the Digi-Block Learning System affected student's skills in base ten numeration and arithmetic algorithms. The researchers maintained a position of independent, unbiased investigation throughout. Their quest for information in regards to improved student understanding dictated the methodology, sample selection, and analysis of the acquired data.

During the summer of 1999, the Boston Public School system implemented its first summer school program, with a major focus on mathematics and reading. The summer school classes met four days a week, four hours per day, for four weeks. The student participants were elementary and middle grade students. The population for the study was comprised of low achieving students.

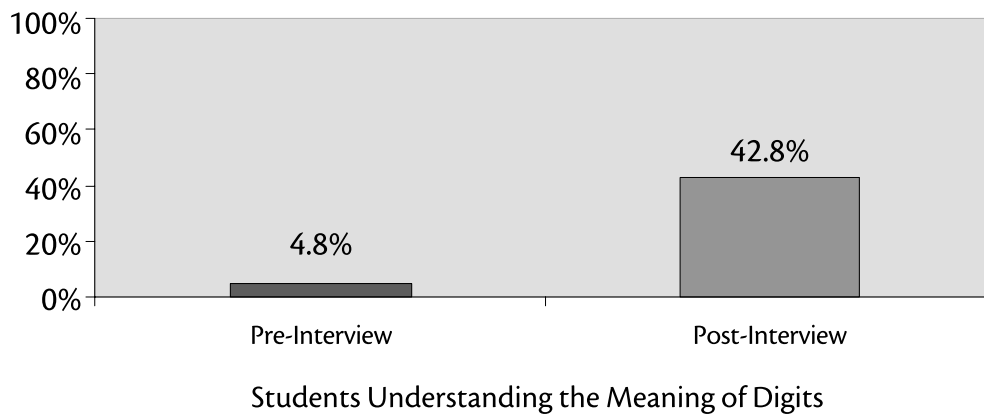
Volunteer teachers were solicited for the program. A total of 30 teachers, representing 30 classrooms, participated in the Digi-Block study. Those teachers received training on the Digi-Block Learning System prior to implementation in the classroom and they received ongoing support during the summer session. The pre-implementation workshop focused on using the Digi-Block Learning System for teaching base ten numeration, arithmetic operations and other grade-specific curriculum.

¹ Thomas, David A., Thomas, Cynthia S., Hall, William D., Strohmeyer, Eric R.(2000) *The Effect of Digi-Block Based Instruction in Base Ten Numeration and Arithmetic on the Conceptual and Procedural Knowledge of Second and Fifth Grade Summer School Students in the Boston Public Schools.*

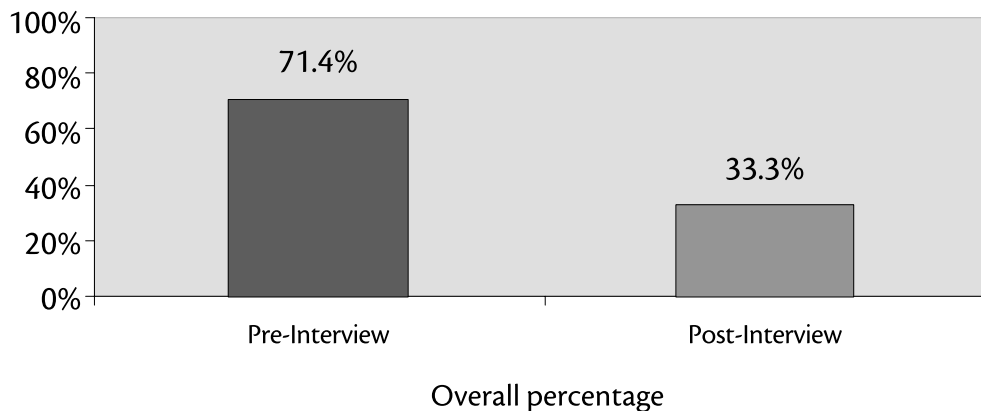
The chosen assessment strategy to determine the mathematical growth of the students, in both grades two and five was through a ten-minute individual interview scheduled at the beginning and end of the summer with focused questions centered on number and operation understanding. Each response was evaluated according to a rubric designed by the researchers. The rubric consisted of four levels with level one being the lowest level of understanding and level four the highest.

Grade two tasks were developed according to the goal of determining whether specific fundamental misconceptions about place value and regrouping changed significantly during the summer session. The gains of the second grade students ranged from 0.52 to 1.28 levels. When the gains from all six tasks were averaged the second grade students showed a mean gain of .93 levels. During the initial interviews of the second grade students, only 4.8% of the students could correctly and confidently identify the meaning of digits. At the end of the four-week study, the number increased to 42.8%. During this same time period, the percentage of students responding at the lowest level decreased from 71.4% to 33.3%. This shift, over such a short time period, has both statistical and practical significance.

Second Grade Results

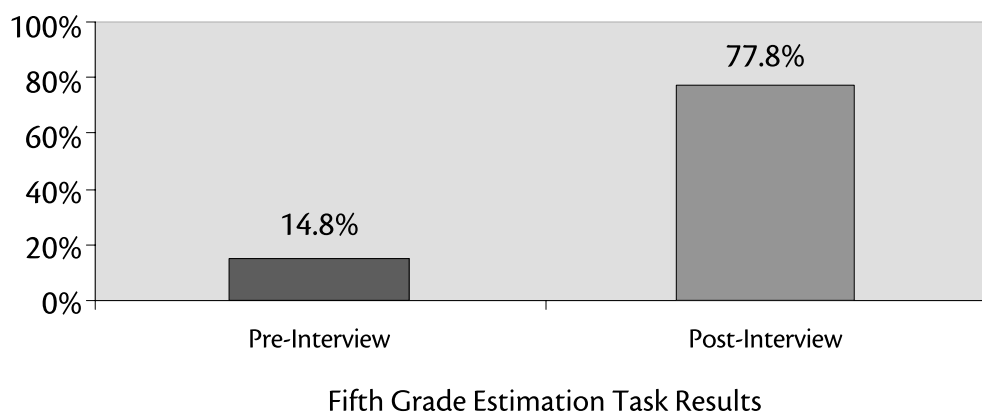


Students Scoring at the **Lowest** Level



The questions and rubric for fifth grade students revolved around the goal of determining whether specific higher order thinking skills, reliant on a grasp of base ten numeration concepts and procedures, changed significantly during the summer session. The fifth grade pre- and post interviews revealed similar gains to second grade with respect to estimation skills. Pre-interview responses from fifth graders appeared to be largely based on guessing. The post-interview, after the use of the Digi-Block Learning System for four weeks, showed that students responded readily using base-ten numeration concepts to facilitate both estimation and mental math. On the estimation items the number of students scoring at the highest level, on the assessment rubric, rose from 14.8% to 77.8%. This dramatic change reflected a clearer grasp of number sense in a short period of time through Digi-Block usage.

Percentage of Students Scoring the **Highest Level**



In general, the gains from this study are both statistically and practically significant. The use of the Digi-Block Learning System over the four-week time period illustrates the ability to increase student understanding over a short period of time. This study also reflects the use of the Digi-Block Learning System in an urban setting, with low achieving students. This significant gain for these students has an impact on other urban areas in terms of methods to increase student achievement. In addition, the important component of teacher training, regardless of the time period of use, is a significant part of the study.

The summary of findings is as follows:

- **There was no significant difference between the gains of male and female student subjects. Both boys and girls enjoyed equal benefits from using Digi-Blocks over the four-week period.**
- **On average, all second grade students using Digi-Block gained roughly one skill level during Summer School.**
- **The fifth grade students who used the Digi-Block Learning System showed similar level gains on tasks dealing with estimation.**

Summarized by Donna Leak, Ph.D.

