Research: Place Value: Discovering Tens and Ones

Study 1 Overview

The Place Value Program is used to teach students place-value concepts and skills. This study was conducted to compare two methods of teaching basic place-value skills: a concrete, semiconcrete, and abstract teaching sequence versus an abstract teaching method. The 24 participants were elementary and middle-school students with learning disabilities (LD). They were randomly selected into two groups of 12 students each. Their regularly assigned teachers provided the instruction after receiving training. Two types of measures were administered at three points in time: immediately following instruction, one week after instruction was terminated, and three weeks after instruction ended. The acquisition test measured students' skill at identifying ones and tens in two-digit numbers; the generalization test measured students' skill at identifying ones and tens in three- and four-digit numbers (i.e., a skill not taught in the program). A 2 x 3 mixed design with one between groups factor (instructional method) and one within (performance over time) group factor was employed. A multivariate analysis of variance was used to determine whether differences were present related to the different instructional methods used. This was followed by two univariate analyses of variance.

Results

Students who were taught place-value skills using the concrete-to-abstract teaching method earned scores that were significantly higher than the scores of students who participated in the abstract teaching method on some of the posttest measures. The MANOVA revealed a significant main effect for instruction method, $F(2, 21) = 4.49$, $p < .05$. A univariate ANOVA revealed a significant main effect for the instructional method variable on the acquisition tests, $F(1, 22) = 8.79$, $p < .01$, in favor of the experimental instruction. No differences were found on the generalization measure.

Conclusions

This study shows that the concrete-to-abstract teaching sequence that is used in the Math Strategies Curriculum and particularly in the Place Value Program is more effective than an abstract-only teaching method. It also shows that generalization to untaught, higher-level place value skills does not occur without explicit instruction on those skills.

Reference

Peterson, S. K., Mercer, C. D., & O'Shea, L. (1988). Teaching learning disabled students place value using the concrete-to-abstract sequence. *Learning Disabilities Research*, 4(1), 52-56.

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Study 2 Overview
A field test was conducted that involved 6 teachers and 30 elementary students who were experiencing difficulties learning math. This student group included 21 students with learning disabilities, 3 students with emotional disabilities, and 6 students who were at-risk for school failure. The students in this field test received three lessons at the concrete level, three lessons at the representational level, and three levels at the abstract level from the *Place Value: Discovering Tens and Ones* program.

Results
On the pretest, the students' mean place value score was 20%. On the posttest, the students' mean score was 88%. On the retention test administered 5 to 10 days after instruction ended, the students' mean place value score was 96%.

Conclusions
The results of this field test show that students with difficulties in math can acquire place value skills using the *Place Value: Discovering Tens and Ones* program. More importantly, students are able to retain their learning at very high levels.

Reference
Mercer, C. D., & Miller, S. P. (1992). Teaching students with learning problems in math to acquire, understand, and apply basic math facts. *Remedial and Special Education*, 13(3), 19-35, 61.

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Study 3 Overview
Multiple field tests were conducted that involved 56 teachers and 248 elementary students who were experiencing difficulties learning math. These field tests took place in seven school districts in self-contained, resource, and general education classes. The teachers were trained to use programs in the *Math Strategies Series*. Different groups of students were taught addition facts, subtraction facts, multiplication facts, division facts, and place value concepts and skills, depending on their needs.

Results
Substantial gains were made by the students in all areas. See the figures below for the results in each math area. Figure 1 shows the results on untimed acquisition tests, and Figure 2 shows the results on timed proficiency tests (i.e., fluency tests). The number of students participating in each field test is shown beneath each pair of bars on the graph.

Figure 1: Student performance on acquisition tests

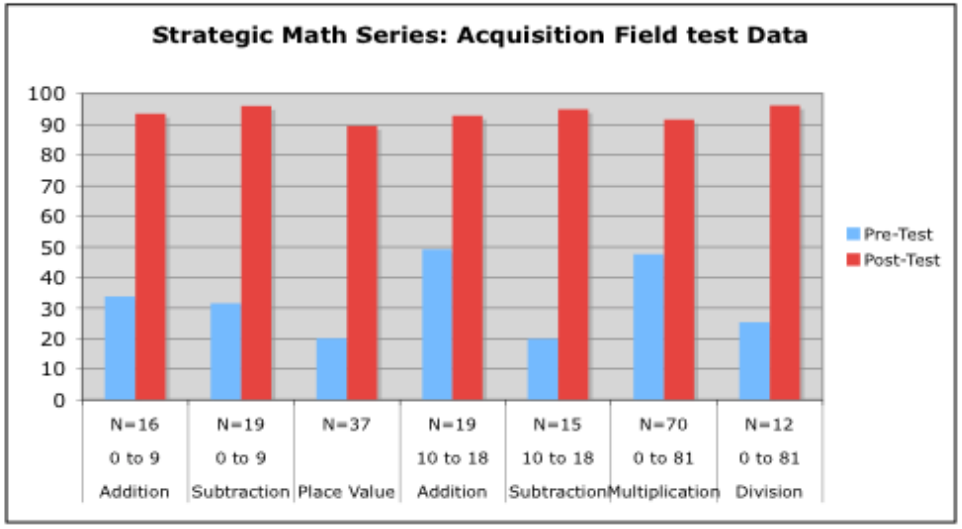

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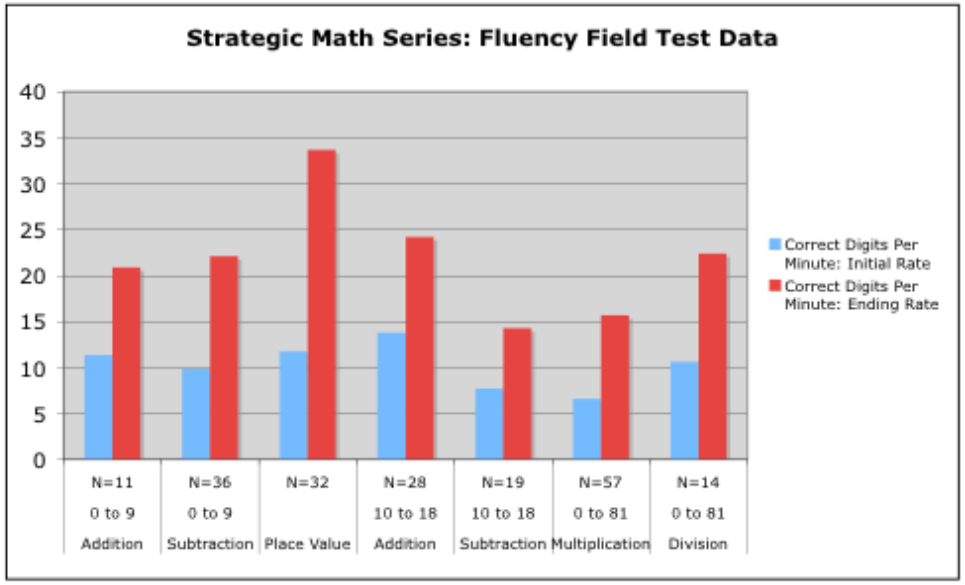
Figure 2: Student performance on fluency tests



The results for the Place Value program are shown in the third pair of bar graphs in each figure. Students earned a mean score of 20% on the acquisition pretest and 89% on the posttest. They correctly answered 12 place-value tasks per minute in baseline and 34 tasks per minute after instruction.

Conclusions

The results of this field test show that students with difficulties in math can acquire place value skills using the *Place Value: Discovering Tens and Ones* program. More importantly, students are able to retain their learning at very high levels.

Reference

Mercer, C. D., & Miller, S. P. (1992). Teaching students with learning problems in math to acquire, understand, and apply basic math facts. *Remedial and Special Education*, 13(3), 19-35, 61.