ABSTRACT. In two parallel one-year studies, solution strategies for subtraction number facts and achievement patterns of matched groups of first graders in two different instructional programs were examined. The experimental program emphasized strategies for answering unknown facts. Control group instruction emphasized drill as the dominant approach. Children were interviewed individually every three weeks during a five month period and given written follow-up tests. Significant differences between groups in the number of memorized facts and in children's approaches to deriving answers to unknown facts were found favoring the strategy approach.

INTRODUCTION

Children should be able to model, explain, and demonstrate reasonable proficiency with subtraction number facts (e.g., 9 - 7, 13 - 5). Research and analyses of Baroody (1984), Fuson (1986), Fuson and Willis (1988), Steinberg (1985) and Thornton and Toohey (1985), however, highlight the difficulties many children experience and conclude that learning subtraction number facts typically is more difficult for children than mastering addition facts.

Common attempts to solve these difficulties are to allow children to manipulate counters to determine subtraction solutions, and then to rely heavily on drill to promote automatic recall. These methods were prevalent in the classrooms and mathematic textbooks in the schools in which this study was carried out.

A conceptual framework for learning number facts consisting of three major phases, drawn from the work of researchers including Rathmell (1978), Steinberg (1985) and Thornton and Toohey (1985), may serve as an alternative basis for alleviating these difficulties: Phase 1: Understand the concept; Phase 2: Learn strategies or procedures to derive answers to unknown facts; and Phase 3: Practice so facts are memorized to the point of automatic recall. At the time of the study, current practice did not consider Phase 2 of this model.

Relative to the first two phases of the model, researchers including Carpenter and Moser (1984) and DeCorte and Verschaffel (1987) have documented that children initially count to solve subtraction problems. Fuson (1986) and Fuson and Willis (1988) further have shown that first
grade children can learn to solve subtraction problems using a single counting strategy (counting up). Thornton (1984) found that intermediate-level learning handicapped students could learn and use a variety of solution strategies for answering unknown subtraction facts. Little, however, is known about the ability of first grade children to learn and select from multiple solution strategies, counting and non-counting, to solve unknown subtraction number facts or the transition to automatic recall.

Research on Counting Backwards/Up

Baroody (1984) and Carpenter and Moser (1984) have found that counting backwards (down) is more difficult than counting up for first grade children, especially when the count goes beyond three numbers or when the count starts with a number greater than 10. Baroody (1984) has pointed out that, in order for children to use counting up or counting back procedures successfully to solve subtraction problems, they must be able to count on and back from given numbers "with ease". Fuson and Secada (1986), Fuson and Willis (1988) and Thornton (1989) also have emphasized the need to precede any basic fact instruction involving counting with conceptually-based learning activities that enable children to reflect on and refine their own counting understandings and skills. Thornton (1984) further has demonstrated that children who can listen to short, oral, forward or backward counts and recognize "how MANY numbers were said" do not rely on finger counting for short counts when subtracting.

Having taught the prerequisite counting skills, Fuson (1986) taught children to count up to solve subtraction problems, keeping track using one-handed finger patterns. A justifiable alternative suggested by the considerations above is to emphasize counting-up and counting-back activities prior to subtraction, and then encourage children during subtraction to count backwards only for short counts of 1, 2 or 3 (as in 9 - 1, 9 - 2, or 9 - 3).

Previous Research on Grouped Facts Approaches

Ways of grouping number facts with similar structure/by strategy for recall have been described in several studies including Cook and Dossey (1983), Jerman (1970), Rathmell (1981), Steinberg (1985), Thornton and Toohey (1985). Most of these studies have emphasized addition or multiplication number facts. Following conceptual work for an operation, the long-range goal of a grouped facts approach is to help children develop a repertoire of