A STUDY TO INVESTIGATE THE EFFECT OF COOPERATIVE GROUP LEARNING ON SELECTED COGNITIVE AND AFFECTIVE OUTCOMES FOR PRESERVICE ELEMENTARY TEACHERS IN A MATHEMATICS METHODS CLASS

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PREFACE

This purpose of this study was to examine the effect of cooperative group learning on mathematics achievement and attitude in a mathematics methods class. Two groups of preservice elementary teachers were taught the same material, one by a cooperative learning group method, and the other by a traditional lecture method. Achievement in mathematics, achievement in methods of teaching mathematics, locus of control for success in achievement in mathematics, and attitude toward mathematics were measured at the end of the experimental period.

I wish to express my appreciation and gratitude to those who have made this study possible. I was fortunate to have the assistance of Dr. Vernon Troxel, who served as the chairman of my committee, and I thank him for the understanding, advice and encouragement that he has given me over the years. I also wish to thank Dr. Margaret Scott, my dissertation advisor, for her assistance and patience. I also extend my appreciation to Dr. Joyce Friske, Dr. Douglas Aichele, Dr. David Yellin and Dr. Joseph Pearl for serving on my committee. I would further like to thank Dr. Jo Campbell for her advice and help with the statistical analyses.

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CHAPTER I

INTRODUCTION

Interest in the effects of cooperative group learning is evident in current literature. Grouping students for instructional purposes is not a new practice in the schools; rather, it is the most common procedure used by educators to respond to student diversity and different rates of learning. Students are most commonly grouped according to ability, either within the classroom or as whole classes as in tracking. Decisions are made for the placement of individuals on the basis of intelligence test scores or on some measure of achievement. However, the regular use of cooperative group learning methods, where students of varying abilities are grouped for the study of academic materials, is uncommon.

Background to the Problem

In 1902 John Dewey recommended that students be encouraged to work in small groups. He believed that social and moral development as well as intelligence would be enhanced through social interaction. In 1984, John Goodlad published the results of observations in over 1,000 classrooms, spanning a period of eight years. The picture

Goodlad painted of classroom life was very different from the one envisioned by Dewey. Goodlad noted that the students mainly sat in desks "arranged in rows, oriented toward the teacher at the front of the room" (p. 94), and that the teacher did most of the talking. Explaining and lecturing were the most frequent teacher activities whereas students were passive, responding through "written work, listening, and preparing for assignments" (p. 105).

Over the years, research has shown that cooperative group learning enhances students' achievement, self-esteem, and satisfaction while reducing performance anxiety. A meta-analysis of 122 studies concluded that all forms of cooperative group learning were more effective than individual or competitive learning (Johnson, D., Maruyama, Johnson, R., Nelson, and Skon, 1981). In 1989, Slavin conducted a meta-analysis of 60 studies and concluded that the effects of cooperative group learning on achievement were clearly positive. Sharan, Ackerman and Hertz-Lazarowitz (1980) reported the positive effects of cooperative group learning on self-esteem, and Slavin (1985) found similar effects for intergroup relations. Cooperative group learning is a term used to describe students working together to help one another to learn academic material.

Based on the ideas of Dewey (1902) and Vygotsky (1978) concerning the social development of intelligence, the processes used in cooperative group learning are believed to contribute to higher-order thinking skills, which are needed afor problem formulation and solution. Slavin (1990) has attributed the positive effects of cooperative group learning to motivational factors.

Results from recent national and international studies have indicated a need for reform in mathematics education. The Second International Mathematics Study (SIMS), conducted in 1982, and the fourth mathematics assessment of the National Assessment of Educational Progress (NAEP), conducted in 1986, provided the data that underscored the dissatisfaction felt with the mathematics curriculum. The authors of The Underachieving Curriculum (1987) concluded that the mathematics curriculum needed restructuring throughout all grades. The call for reform in mathematics education has led the National Council for Teachers of Mathematics (NCTM) to examine both the content and instructional method of mathematics education at all grade levels. The result has been the publication o the Curriculum and Evaluation Standards for School Mathematics (1989). In this publication, the NCTM has not only called for content revision, but has specifically addressed the instructional methods, recommending that for students in Kindergarten to Grade 4, a social approach to t teaching of mathematics be taken. The vision of the mathematics classroom for the elementary school student created by the NCTM in this publication is not unlike the classroom called for by Dewey. It is, however, entirely different than the classroom reality as described by Goodlad.

Statement of the Problem

With this statement from the National Council for Teachers of Mathematics concerning the need for a different instructional approach to the teaching of mathematics, educators have been challenged to change. Change, however, is not easy. Previous attempts at extensive reform of traditional methods in public schools have not met with widespread success, although minor changes have taken place. Conventional practices of instruction are deeply entrenched.

Cooperative group learning is a little-used method in the university classroom. When the student teacher enters the elementary classroom as a teacher, he or she has had little experience with and preparation for organizing cooperative learning groups for instruction. In order to address this problem, researchers have been investigating the effects of cooperative group learning for instruction at the college level. The research has focused on a variety of methods with the aim of making the student more active in the learning process.

Goodlad (1984) remarked that there was no obvious reason why teachers could not use cooperative group learning methods in the classroom. Cohen (1986) suggested that the utilization of cooperative group learning methods may require a whole new set of teaching skills, and that the lack of such skills may have accounted for the failure of widespread use of this approach. In the working draft of the Professional Standard for Teaching Mathematics (1989), prepared by the NCTM, it was noted that "teachers teach as they were taught (p. 62). From research evidence over the years, the way teachers were taught, from the elementary school through their college classes, was in the manner described by Goodlad, that is, they silently listened as their teacher talked. These experiences, according to the NCTM (1989) have a profound impact on the way teachers' view both the teaching and learning of mathematics.

The lecture, or some minor variation of the lecture, is the traditional method of teaching at the university level (McKeachie, 1967). Laboratory work is a component of some classes. In the professional education classes of preservice elementary teachers there may be discussion of the research that supports the use of cooperative group methods as an instructional approach in the elementary classroom.

Cooperative group learning been shown to have positive effects on elementary-age children. A concern is that in when preparing elementary teachers using this approach the mathematics achievement scores of the preservice elementary teachers would be lower than the mathematics achievement scores of preservice elementary teachers taught by the traditional lecture method. The research would suggest that if the elementary teachers were taught by the small cooperative group method during their teacher preparation they would acquire as much knowledge as by the traditional method and in addition enhance their interpersonal skills and possibly improve their higher cogitive skills. The instructor would provide a model for cooperative group instruction for the preservice teachers.

Purpose of the Study

The purpose of the study was to examine the effects of replacing the traditional lecture with cooperative group learning in a mathematics methods class designed for undergraduate students majoring in elementary education. It was designed to investigate the possible differentiating effects on achievement in mathematics, achievement in methods of teaching mathematics, locus of control for success in mathematics, and attitude toward mathematics between two different groups: a cooperative group learning group and a traditional lecture group.

Objective

The objective of this investigation is to answer the following question:

Will the means on achievement in mathematics, achievement in methods of teaching mathematics, locus of control for success in achievement in mathematics, and attitude toward mathematics for students in the two groups be significantly different?

Hypotheses

Stated in the null form, the hypotheses to be tested using an alpha level of .05 are:

H_1 : The type of treatment group does not significantly affect achievement in mathematics as measured by the Tests of Achievement in Basic Skills (TABS) Level C, Form 1.

H_2 : The type of treatment group does not significantly affect achievement on methods of teaching mathematics as measured by the Methods of Teaching Mathematics Test.

H_3 : The type of treatment group does not significantly affect internal locus of control for success in achievement in mathematics as measured by the Hickey's Locus of Control in Mathematics Test.

H_4 : The type of treatment group does not significantly affect attitude to mathematics as measured by t Confidence in Learning Mathematics Scale, a subscale of the Fennema-Sherman Mathematics Attitude Scales.

Importance of the Study

Elementary teachers tend to be generalists. Mathematics is but one of the curriculum areas for which the teacher ha responsibility. Preservice elementary teachers have expressed concern about their ability in mathematics. One reason for the researcher to undertake this study was as a response to comments made by students during their mathematics methods class. Some of these comments were:

"I'm not very good at math"

"Math was my worst subject at school"

"I never liked math"

"Problem solving scares me"

The concern was that these preservice elementary teachers did not feel comfortable about mathematics themselves and yet would soon be in the classroom teaching mathematics to elementary age children. It is possible that those who feel uncomfortable about mathematics themselves will manifest this in classroom practices. Some elementary teachers spend a great deal of time teaching mathematics, whereas others spend relatively little. Berliner (1979) found that teachers varied widely in time allocation of subject matter. For example, the time allocated to second-grade mathematics ranged from a low of twenty-four minutes to a high of sixty one minutes. Schmidt and Buchmann (1983) found that teachers allocate time to various subjects partly on the basis of their attitudes toward that subject matter. Although many variables contributed to this allocated time differential, attitude to the subject was accountable for some of the variation. Efforts to change the attitudes of those preservice elementary teachers who indicate a less than favorable attitude toward mathematics would therefore appear to be essential.

Noddings (1989) also found that elementary teachers were not highly confident in teaching mathematics and suggested that this was one reason that teachers were reluctant to us cooperative group instruction in mathematics. With a lack of confidence it is easier to keep tight control over the instructional sequence so that questions the teacher might not be able to answer will not be asked.

Efforts to improve the mathematical ability and the attitude toward mathematics of preservice elementary teachers are essential if the goals of the NCTM are to be realized. The importance of this study is that it is designed to provide research data related to the possible effects of cooperative group learning as a way of achieving this goal.

Assumptions

It is assumed that the effect of the cooperative group learning method on achievement in mathematics will be measurable on the Tests of Achievement in Basic Skills (TABS) Level C, Form 1. It is also assumed that the effect of the traditional method of learning will be measurable on the Tests of Achievement in Basic Skills (TABS) Level C, Form 1. It is assumed that the effect of the cooperative group learning method and the traditional method of learning on achievement in methods of teaching mathematics will be measurable on the Test of Achievement in Mathematics Methods.

It is assumed that the Hickey's Locus of Control in Mathematics Test is a reliable index of a student's internal or external locus of control of reinforcement for success or failure in mathematics achievement situations. A further assumption is that the locus of control construct is a reliable indicator of the personal control a student feels he or she has over the mathematical environment.

The results of the Confidence in Learning Mathematics Scale, a subscale of the Fennema-Sherman Mathematics Attitude Scales, is assumed to be a reliable index of a student's confidence in learning mathematics.

Limitations

This study was limited to preservice elementary education students who were enrolled in two sections of a methods course for teaching mathematics at the intermediate level at the university in which the study took place during the Fall semester of 1988 and completed the pretesting with the Tests of Achievement in Basic Skills, Level C, Form 1, the Methods of Teaching Mathematics Test, the Hickey's Locus of Control in Mathematics Test, and the Confidence in Learning Mathematics Scale, one of the subscales of the Fennema-Sherman Mathematics Attitude Scales. This study was also limited to the extent to which these instruments measure the constructs they are intended to measure for each of the students involved. Furthermore, this study was limited in that there were only forty-nine subjects and they were not randomly assigned to the different sections of the methods course. Another limitation is that the experimenter was the instructor for both treatment groups. The two approaches to instruction, the cooperative group learning method and the traditional lecture method, were selected from a range of possible instructional approaches, based on a review of the literature.

Definition of Terms

The following definitions apply to this study:

Subjects. Preservice elemetary education students enrolled in a university class for teaching mathematics at the intermediate level during the Fall semester 1988.

Experimental Group. Students enrolled in the 10.30 a.m. section of CIED 4142, Teaching Mathematics at the Intermediate Level. The section was randomly chosen to be the experimental group by the toss of a coin. There were twenty-five subjects in this group. Twenty-four were female, one was male. This group was taught by the cooperative group learning method using traditional curriculum materials and manipulatives.

Control Group. Students enrolled in the 8.30 a.m. section of CIED 4142, Teaching Mathematics at the Intermediate Level. The section was randomly chosen to be the control group by the toss of a coin. There were twenty-four subjects in this group. Twenty-three were female, one was male. This group was taught by the traditional lecture method using traditional curriculum materials and manipulatives.

Traditional Method. This refers to the lecture method of presentation of the material regularly studied in the course, "Teaching Mathematics at the Intermediate

Level". Textbook materials, research findings and manipulative materials were used.

Cooperative Group Learning Method. This refers to the cooperative group method of presentation of the material regularly studied in the course, "Teaching Mathematics at the Intermediate Level". The students were randomly assigned to groups of six or seven by selecting names from a pool. There were three groups of six and one group of seven. Textbook materials, research findings and manipulative materials were used.

Mathematics Achievement. Each student's achievement in mathematics was measured by the Tests of Achievement in Basic Skills (TABS) Level C, Form 1. Subjects were administered Form 1 as both the pretest and the posttest. Achievement was determined by using an analysis of covariance with the pretest serving as the covariate.

Achievement in Mathematics Methods. Each student's achievement in methods of teaching mathematics was measured by a test in methods of teaching mathematics. Subjects were administered the same test as a pretest and a posttest. Achievement was determined by using an analysis of covariance with the pretest serving as the covariate.

Tests of Achievement in Basic Skills (TABS) Level C, Form 1. A sixty-four item multiple choice test measuring knowledge and application of basic arithmetic skills (35 items), geometry and measurement (14 items), and modern concepts (15 items).

Methods of Teaching Mathematics Test. A thirty-item test measuring understanding of appropriate methods of teaching mathematics to elementary age children in grades four through seven.

Locus of Control Construct. The allocation of responsibility for an outcome ranging from internal to external locus of control of reinforcement. Locus of control in mathematics was determined by using an analysis of covariance with the pretest of the Hickey's Locus of Control in Mathematics Test serving as the covariate.

Internal Locus of Control of Reinforcement. The perception of positive and/or negative events as being a consequence of one's own actions or relatively permanent characteristics and thereby under personal control.

External Locus of Control of Reinforcement. The perception of positive and/or negative events as being unrelated to one's own actions or relatively permanent characteristics and thereby beyond personal control.

Hickey's Locus of Control in Mathematics Test. A scale for assessing beliefs for internal or external locus of control of reinforcement responsibility in mathematics achievement situations. The scale is composed of twenty-seven items each answered on a five-point Likert scale ranging from definitely-agree to definitely-disagree. Sixteen of the items are weighted positively and eleven are weighted negatively. Each subject has a total internal responsibility score which reflects the degree to which they are internally or externally rated.

Attitude Toward Mathematics. Attitude toward mathematics refers to the perception of oneself as a learner of mathematics. The attitude affects the learning of mathematics. Attitude toward mathematics was determined by an analysis of covariance with the pretest of the Confidence in Learning Mathematics Scale as the covariate.

Confidence in Learning Mathematics Scale. A subscale of the Fennema-Sherman Mathematics Attitude Scales. The scales each assess an attitude that has been hypothesized to be related to the learning of mathematics. The Confidence in Learning Mathematics Scale is intended to measure confidenc in the ability to learn and perform well in mathematics.

Summary

This report is divided into five chapters. The first chapter presents a summary of the background establishing the foundation of the problem, the statement of the problem under consideration and definitions of terms used in the study. In Chapter II, relevant studies are presented and discussed. These studies are presented under the following headings:

a) cooperative group learning

b) cooperative group learning in the elementary school

c) cooperative group learning in the college classroom

d) cooperative group learning for preservice elementary teachers

e) locus of control

f) attitude toward mathematics

In Chapter III details of the experiment are given. The design, the sample, the measuring instruments, the collection of data, and the methods of analyses used in the treatment of the data are described. The results are reported in Chapter IV where the data are analyzed. In Chapter V, the summary, conclusion, and suggestions for further study are presented.

CHAPTER II

RELATED REVIEW OF THE LITERATURE

Introduction

> We are born for cooperation, as are the feet, the hands, the eyelids, and the upper and lower jaws.
>
> Marcus Aurelius

Cooperative group learning has received considerable attention from researchers. The review of the literature for this study involved research that investigated the effect of cooperative group learning on the cognitive and affective outcomes of students in the elementary and college classrooms, primarily in relation to mathematics. The theoretical background to cooperative group learning has also been examined. Therefore, the review of the literature will be organized according to the following outline:

1. cooperative group learning.
2. cooperative group learning in the elementary school.
3. cooperative group learning in the college classroom.
4. cooperative group learning for preservice elementary teachers.
5. locus of control.
6. attitude toward mathematics.

A summary of the research studies will be provided at the end of each of these sections. In conclusion, a summary of the chapter will be provided.

Cooperative Group Learning

> Achievement is a we thing, not a me thing always the product of many heads and hands no matter how it may appear to one involved in the effort and enjoyment of it or to a casual observer.
>
> John Atkinson

Although researchers have suggested many theoretical models to explain the positive results found with cooperative group learning, Slavin (1990) described these theories as falling into two major categories, cognitive and motivational. For the cognitive theorists it is the effect of working together in itself that leads to higher achievement. Motivational theorists focus on the reward structure offered to the student (Slavin 1990).

Cognitive Theories

Piaget discussed the effect of social interaction on cognitive and moral development (1923, 1928, 1932). Piaget theorized that when the children discuss things with other children the opportunity for becoming less egocentric is much greater. In such a situation the child is faced with the fact that not everyone has the same perspective on the problem or event. It is the resulting exchange of perspective that creates the opportunity for the child to learn how to take different points of view into account. Piaget believed that this was more likely to occur in a situation of peer interaction than when a child was dealing with an adult, because children are less likely to disagree with, or present their own ideas to, an adult. Kuhn (1972) found that a small difference in cognitive level, such as is found between children, provided more of an opportunity for cognitive growth than a large difference. A study by Schunk and Hanson (1985) found that when peers demonstrated cognitive skill, achievement was greater than when the teacher modeled the skill or when there was no model. One reason suggested is that the student identifies easier with the peer than with the teacher, and so feels more confident.

Researchers in developmental psychology have investigated Piaget's theory that social interaction leads to cognitive development (Perret-Clermont, 1980; Ames and Murray, 1982; Murray, 1982). Much of the work by these researchers has been in the area of conservation, where a non-conserver was paired with a conserver and a conservation task assigned to the pair. Control children worked alone. Cognitive development was defined by whether or not a child who was a non-conserver prior to the task attained conservation. Perret-Clermont (1980) and Ames and Murray (1982) found that non-conservers paired with a conserver were able to solve conservation tasks at a higher level, whereas the control children could not. It has been argued that the non-conservers learn to conserve by imitation.

However, as the children who attained a higher level of cognitive development were able to provide explanations that were different from their partners (Botvin and Murray, 1975), or were able to apply the higher level of thinking to different tasks (Murray, 1972; Perret-Clermont, 1980), imitation is not believed to be the explanation. Silverman and Stone (1972) reported that the cognitive development was evident in children who had learned to conserve up to a month later.

Tudge and Caruso (1988) reported that their research failed to support the earlier research studies concerning the effect of a more cognitively advanced partner on the cognitive development of the less advanced partner. In this study, 150 children, ages five to nine, were either paired with a same-age, same-sex partner who used either the same rule or a different rule on the pretest of the balance beam task by Siegler (1976), or were not paired at all for control. The children were instructed to decide on one answer to questions about the balance beam. The results indicated that only when a child was paired with a partner who used a different rule was a different perspective given and cognitive conflict created. Although some children whose partner used a higher rule were influenced by the arguements of their partner, many of the advanced partners were persuaded to change their mind by the less advanced partner. The control group did better than many of the higher partners. Tudge (1986) had found the same results in a study with Russian children. Tudge suggested that cognitive conflict brought about by pairing children with different perspectives helps children who reason at a less advanced level only when the partner is confident in his or her opinion, otherwise the pairing could lead to no development or even regression. Tudge therefore believed that cognitive conflict is insufficient to explain cognitiv development. As his earlier studies relied upon verbal persuasion, Tudge (1987) undertook another study under the constraints, except that this time the children were allowed to see what would happen to the balance beam after they had decided upon their joint prediction. In this study, all the children improved whether or not their partner was at a higher level of cognitive development.

Kamii (1985) discussed Piaget's theory of how young children construct their own logical mathematical framework from within, and the importance of social interaction in the process:

> It puts the child in a social context that encourages him to think about other points of view in relationship to his own (p.32).

For this kind of construction Kamii (1985) saw the social climate and cooperative learning situations that the teacher created as crucial. The child has to be in a cooperative learning situation with his peers, as interaction among children increased their mastery of critical concepts.

Bandura's theory of social learning is a cognitive theory that emphasizes the impact of people on people. According to Bandura (1977), whether learning occurs from direct experience or from vicarious experience, most of the learning involves other people in a social setting. Further, on the basis of observations and interactions with others, our cognitions are developed.

Thelen (1960) recommended that knowledge from any academic area should not be taught without also teaching the social process by which it was negotiated. He described this process as a situation in which students could:

> . . . react and discover basic conflicts among their attitudes, ideas, and modes of perception. On the basis of this information, they identify the problem to be investigated, analyze the roles required to solve it, organize themselves to take these roles, act, report and evaluate these results. These steps are illuminated by reading, by personal investigation, and by consultation with experts. The group is concerned with its own effectiveness, and with its discussion of its own process as related to the goals of investigation (p. 82).

Motivational Theories

Slavin (1990) identified the motivational theory of cooperative group learning as a focus on the reward or goal structure of the situation. Deutsch (1949) described the cooperative goal structure as one in which individual goal efforts contribute to other individuals goal efforts. The individual can only attain their personal goal is the group is successful in attaining its goal. Johnson and Johnson

(1987) described such interaction as positive interdependence:

> Positive interdependence is the perception that you are linked with others in such a way that you cannot succeed unless they do (and vice versa), and that their work benefits you and your work benefits them (p. 125).

In this situation, the motivation arises not only from the desire to achieve one's own goals but also to help others to achieve theirs so that the group can share in the joint reward. In a classroom where cooperative groups are utilized, students who work hard, attend class, and help others, are rewarded by approval from the other group members. The students are motivated to succeed academically in order to help their group, and therefore this has an effect on individual achievement.

The study of academic material in a cooperative group learning situation is the common thread throughout the variety of organizational approaches to learning that involve students working together. The theory that cooperation is important for learning has been with us for a long time and comes from a variety of sources. The literature presented here is but a brief review of that available. A summary of the research presented in this section is given in Table I.

TABLE I

SUMMARY OF THE LITERATURE
ON COOPERATIVE GROUP LEARNING

Study/Year	N	Discussion	Findings
Piaget (1923; 1928; 1932)	N/A	Discussed the effect of social interaction on cognitive and moral development	Theorized that discussion between children helped them develop perspective-taking skills and so become less egocentric
Deutsch (1949)	N/A	Described the cooperative goal structure	Individuals only achieve their own goals by helping others
Thelen (1960)	N/A	Stated that academic learning enhances problem solving	Social learning should take place in in a social setting
Kuhn (1972)	87	Investigated cognitive growth with 4, 6, 8 year olds, where different levels of modeling was involved	Found that a small difference in cognitive level provided more opportunity for cognitive growth than a large difference
Murray (1972)	108	In 2 experiments with conservation tasks, paired a non-conserver with 2 conservers, then tested them again at the end of aone week (Experiment I - n = 57 Experiment II - n = 51)	Higher level thinking transfered to different tasks

TABLE I (Continued)

Study/Year	N	Discussion	Findings
Silverman & Stone (1972)	51	Used conservation of area tasks to examine cognitive development of 3 groups: pairs of conserver/non-conservers, conservers, and nonconservers	Found that cognitive development was still evident in children who had learned to conserve up to a month earlier
Botvin & Murray (1975)	78	Nonconserving children assigned to one of 3 groups: 1) social interaction (2 nonconservers and 3 conservers) 2) modeling group (observed a conserver and a nonconserver) 3) a control	Children who attained a higher level of cognitive development provided different explanations than their partners
Bandura (1977)	N/A	Formulated a social learning theory that emphasizes the social aspect of learning	Most learning occurs in a social setting and involves others
Perret-Clermont (1980)	-	Children ages 5-7 were paired into conserver, non-conserver groups, or were the control group who worked alone. All were given a conservation of liquid task	Cognitive development was achieved when a previously non-conserving child conserved. Found that children paired with a more advanced child were later able to solve conservation tasks at a higher level

TABLE I (Continued)

Study/Year	N	Discussion	Findings
Ames & Murray (1982)	-	Examined cognitive development	Found that non-conservers paired with a conserver were able to solve conservation tasks at a higher level
Murray (1982)	N/A	Discussed research on the shift from preoperational to operational thought	Concluded shift occurs most effectively in social settings where the information challenges the child's beliefs
Schunk & Hanson (1985)	72	Children who had difficulty with subtraction with regrouping observed either a same-sex peer or a teacher demonstrate the skill	Found that when peers demonstrated a cognitive skill, achievement was greater than when the teacher modeled the skill or when there was no model
Siegler (1976)	N/A	Described balance scale problems for assessing cognitive development	Proposed 4 models of rules that might govern performance on balance scale problems
Kamii (1985)		Discussed Piaget's theory of logico-mathematical development	Agreed with Piaget that social interaction is important of the development of logico-mathematical thought

TABLE I (Continued)

Study/Year	N	Discussion	Findings
Tudge (1986)	-	Examined cognitive development with Russian children	Many advanced partners were persuaded to change their mind
Johnson & Johnson (1987)	N/A	Described the motivational aspect of cooperative group learning	Defined positive interdependence as the perception that personal goals are achieved only when group goals are achieved
Tudge (1987)	-	Looked at the effect of allowing children to see how their prediction affected the the balance beam in a study to examine cognitive development with conserving, non-conserving pairs	All children improved
Tudge & Caruso (1988)	150	Children ages 5-9 paired with same age, same sex, by type of rule used. Control children were not paired. Given balance beam task. Pairs asked to give one answer.	More advanced partners were persuaded to change their mind than vice versa. Control group did better than many of the higher partners.

TABLE I (Continued)

Study/Year	N	Discussion	Findings
Slavin (1990)	N/A	Discussed theories of cooperative group learning	Stated that the cooperative group learning theories fall into two major categories: cognitive and motivational

Cooperative Group Learning in the Elementary School.

So wherever I am, there's always Pooh,
There's always Pooh and me.
"What would I do?" I said to Pooh,
"If it wasn't for you," and Pooh said, "True,
It isn't much fun for One, but Two
can stick together," says Pooh, says he.
"That's how it is," says Pooh.

A. A. Milne

The effects of cooperative group learning in the elementary school have been extensively researched. These studies have investigated a wide range of outcomes. The research presented here will focus on achievement and affective outcomes, with an emphasis on the effects in mathematics. However, other outcomes and other curriculum areas will be briefly reviewed.

Achievement

There have been two meta-analyses of studies involving the effects of cooperative group learning on achievement in the 1980's. The first of these, by Johnson, Maruyama, Johnson, Nelson and Skon (1981) included 122 studies and concluded that all forms of cooperative group learning were more effective than individual or competitive learning. Researchers were critical of the studies included in this meta-analysis leading to doubts about its validity. To address the problems raised in the first meta-analysis, Slavin (1989) conducted a meta-analysis of 60 studies under more rigorous selection procedure. He specifically looked a the effect of achievement under the conditions of cooperative group learning and traditional methods and concluded that the effects of cooperative group learning on achievement were positive.

The 60 studies considered by Slavin, to assess the effect of cooperative group learning on achievement, provided 68 comparisons of cooperative group learning and control methods as some of the studies compared more than one cooperative group learning method. Of these 68 comparisons 49 favored the cooperative group learning method and eight the control groups. Fifty-eight of these studies were concerned with the elementary grades, specifically grades two to eight. A wide variety of subject matter was included.

Mathematics

This section examines the effect of cooperative group learning in the elementary mathematics classroom. Of the 58 elementary grade studies included in the Slavin meta-analysis, twenty of these studies were undertaken in mathematics classes. Fourteen reported results in favor of the cooperative group learning method. Some studies compare cooperative group learning to more than one learning condition and additionally compared the other learning conditions to each other. In some of the studies, effects found in more than one subject area are considered. Additionally, some studies examined noncognitive outcomes as well as cognitive ones. In the studies detailed in this section, only the effects of cooperative group learning versus other learning conditions in mathematics are examined.

Edwards, DeVries and Snyder (1972) used four general mathematics classes, two of average ability students and two of low ability students, all taught by the same teacher, in a study that lasted for nine weeks. There were 96 students in the seventh grade in the four classes. The study took place in Baltimore, Maryland. The experimental group was organized into small cooperative groups and each group played a nonsimulation game (EQUATIONS), where mathematical skill is needed to win. The control group was taught by the traditional method. The results indicated that all students increased in achievement over the experimental period but that the cooperative group classes increased more than the control group. In 1976, Hulton and DeVries found similar results in a study that lasted for ten weeks and consisted of 299 students in grade seven in Maryland.

Slavin and Karweit (1981) used a sample of 456 students in grades four and five in Hagerstown, Maryland. The students were in seventeen classes from six schools. Cooperative group learning was used in a variety of subject areas, one of which was mathematics, and the results were compared with matched control groups. The teachers were assigned by school to the experimental conditions and the experimental period lasted for a semester. Pre- and posttest measures were used to assess the effects of cooperative group learning on academic achievement, student attitudes, academic achievement accountability, sociometric measures and student self-esteem. The results of the mathematics achievement subscales of mathematics computations and of mathematical concepts and applications on the achievement test indicated no significant differences between the two conditions. For the affective measures, the results were mixed. The experimental condition significantly exceeded the control for seven of the affective scales, but there were no significant differences for the other five affective scales.

Slavin, Leavey and Madden (1984) undertook two studies, comparing the effects of cooperative group learning to a control group in mathematics. The first study lasted for eight weeks and had a sample size of 504 students in grades three, four, and five, in eighteen classes in six schools. The schools were randomly assigned to one of three conditions: a cooperative group condition, an individualized program condition, or a control condition. Data was collected to assess achievement in mathematics computation, attitudes, and behavior. The results indicated that the cooperative group treatment gained significantly more in achievement, attitude and behavior than the control group. The cooperative group treatment did not have significantly higher scores for any of the posttests except for two of the behavioral scales when compared to the individualized program condition.

The second study (Slavin, Leavey, and Madden, 1984) lasted for ten weeks and had a sample size of 375 students in grades four, five, and six in sixteen classes in four schools. Two schools assigned to the cooperative learning condition were matched to two control schools on the criterion of socio-economic status. The same measures were taken as in study one and the data was analyzed in the same way. The results for achievement in mathematics computation showed significant gains for the cooperative group learning condition. There were no significant differences for the attitude measures. Of the behavioral scales, there were significant results in favor of the cooperative learning group for two of the scales (self-confidence and friendships), but there were no significant results for the other two scales (classroom behavior or negative peer behavior).

Slavin Madden and Leavey (1984) conducted a study that lasted for twenty-four weeks and had a sample size of 1371 students in grades three, four and five. There were 719 students in 31 classes in five schools were assigned to the cooperative learning condition, and 652 students in 28 classes in three schools were assigned as the control group. The experimental period lasted for twenty-four weeks. The mathematics achievement measures were the computations and the concepts and applications subscales of the Comprehensive Test of Basic Skills (CBTS). Significant treatment effects were found for both subscales in favor of the cooperative group. Slavin, Madden and Leavey attribute the more significant results to the length of the experimental period.

Johnson, Johnson and Scott (1978) reported results in favor of the control group in a study in Minnesota which compared the effects of cooperative group learning and individual instruction on mathematics achievement. The study lasted for ten weeks and had a sample size of 30 of the highest achieving students chosen from a sample of 120 students in grades five and six. The students studied topics from set theory, number theory, geometry and measurement, with an emphasis on higher level thinking skills. Although the control group achieved significantly higher on the posttest measuring achievement, the cooperative students were significantly more accurate and worked faster throughout the experimental period. Teachers reported that the children in the control group expressed frustration and loneliness. The children in some of the cooperative groups were not able to work together. The teachers noted that there appeared to be a lack of helping and sharing, tutoring skills, and that there was evidence of competitiveness or inattentiveness.

Robertson (1982) conducted a study in Suburban New Jersey with 166 students in grades two and three. The study lasted for six weeks. Three conditions were examined, cooperative group learning, individual/competitive, and a control group. The study was undertaken in a mathematics class. Positive effects for cooperative group learning versus the control were found, but in the cooperative group learning versus the individual/competitive condition, the latter was favored.

Johnson (1985) in a study that compared the use of the "Groups of Four" method by Marilyn Burns with matched controls in a mathematics classroom found positive results for the group method in application and problem solving, but not in comprehension. The study lasted for 27 weeks and had a sample size of 859 students (51 classes) in grades four and five. The study was undertaken in Houston, Texas.

However, in a similar study, also in Houston, Texas, Johnson and Waxman (1985) found positive results for the group condition only with low achievers. The sample consisted of 150 students in grade eight and lasted for a year.

The research in mathematics with cooperative group learning in the elementary school tends to favor the cooperative group learning method over the traditional method (Slavin, 1989; Slavin, 1983; Johnson et al., 1981). A selection of the available studies were presented here. Studies chosen for inclusion were those that used relatively large sample sizes.

Lindquist (1989) suggested that, in order to implement the kind of mathematics curriculum that is being recommended by the leaders in mathematics education, elementary children be taught in small groups, and that such groups be flexible and heterogeneous. She lists seven reasons for these recommendations:

1. Small-group work can encourage verbalization.
2. Small-group work can increase students' responsibility for their own learning.
3. Small-group work cna encourage students to wordk together, a social skill that all persons need.
4. Small-group work can add variety to the routine of mathematics classes.
5. Small-group work enables teachers to individualize instruction and to accommodate students' needs, interests, and abilities.
6. Small-group work can increase the possibility of

students solving certain problems or looking at problems in a variety of ways.

7. Small-group work can assist in classroom management.

Most of these reasons are reflected in the literature on cooperative group learning.

In Great Britain, elementary school students routinely are seated in groups. Small group instruction was suggested as the best method of instruction to address the wide range of abilities to be found in the classroom. Cooperation was viewed as preferable to competition. However, there is evidence that although students sit in groups, they are not instructed in groups (Roberts, 1984). This study by Roberts was in agreement with the findings of earlier studies (Boydell, 1975, and Galton et al., 1980). Just sitting together does not ensure cooperation, the teacher has to plan for and develop it. In the study by Roberts, most of the teachers interviewed prefered whole class instruction or individual instruction to small group instruction.

Reading and Language Arts

Research involving the effects of cooperative group learning on achievement in reading and language arts will also be presented in this section. However, research into the effects of cooperative group learning on achievement is not limited to mathematics, reading and language arts.

DeVries and Mescon (1975), and Slavin and Oickle (1981) studied the effects of cooperative group learning in a language arts classes. The DeVries and Mescon sample consisted of 60 students in grade three in Syracuse, New York. The study lasted for six weeks, and the results favored the cooperative group. The Slavin and Oickle students were in grades six through eight in rural Maryland. There were 230 students in the sample and the study lasted for twelve weeks. The results again favored the cooperative group. However, a study by Slavin in 1979 with 424 students in grades seven and eight in Baltimore, Maryland found no positive results. This study was also in a language arts class.

Four studies that investigated the effects of cooperative group learning on achievement in reading and reading comprehension all reported results in favor of the cooperative group. Three of these studies involved large samples. Stevens, Madden, Slavin, and Farnish (1987) conducted two studies in Maryland. The first had a sample size of 461 students in grades three and four, and lasted for twelve weeks. The second had a sample size of 450 students, also in grades three and four, and lasted for twenty-four weeks. Talmage, Pascarella, and Ford (1984) had a sample size of 493 students from grades two to six, in Elgin, Illinois. Their study lasted for a year. Franz (1979) had a sample size of 48 students in rural Virginia. The students were in grades four and five and the study lasted for six weeks. Moskowitz, Malvin, Schaeffer, and

Schaps (1985) has a sample of 480 students in grade five, in California. Their study lasted for 30 weeks, but they did not find any significant results.

There is considerable evidence that those working cooperatively together perform better (Johnson, Maruyama, Johnson, Nelson and Skon, 1981). Students explain material to each other, listen to explanations, and arrive at a joint understanding. Smith, Johnson and Johnson (1981) report that this results in later student achievement on individual tests. Other research (Beane and Lemke, 1971) has refuted this claim. Webb (1982) concludes that evidence from studies of student interaction in small groups in not yet sufficiently consistent to allow an unqualified conclusion that this is the most useful teaching method, but that the evidence is strong enough to defend the importance of interaction in small groups.

Affective Research

Researchers have also investigated the social, motivational, and attitudinal outcomes of cooperative group learning on elementary school students. Some of the research into these noncognitive areas is presented in this section.

Inergroup Relations

One area of the research on social issues has looked at the effect of cooperative group learning on intergroup relations. Although children from different ethnic groups may attend the same school, the research has shown that students are more likely to have friends from the same ethnic group than from other ethnic groups (Gerard and Miller, 1975). Allport (1954) pointed out that interracial contact was essential but that such contact had to be where individuals worked together on and equal basis and were persuing common goals. Cooperative group learning can meet these conditions. The evidence from the research has generally been in favor of the cooperative group in this area. Students are more likely to have friend from other ethnic groups in the cooperative group learning condition than they are in the traditional learning condition.

Weigel, Wiser, and Cook (1975) investigated the effects of cooperative group learning on attitudes to other ethnic groups in a study that lasted seven months and involved 168 students in the experimental condition and 156 in the control condition. Of these students, 231 were white, 54 black, and 39 Mexican-American. The students were placed in multi-ethnic teams and worked on cooperative activities in several subjects. Positive effects were reported for the attitudes of whites toward Hispanics, but not for Hispanics to whites, whites to blacks, blacks to whites, blacks to Hispanics, nor Hispanics to blacks. Teachers reported fewer interracial conflicts for those in the cooperative condition. DeVries, Edwards, and Slavin (1978) presented a summary of four studies that examined the effect of cooperative group learning on interracial friendships. In three of the studies, students in the cooperative condition gained more friends in other racial groups than did those in the control condition. In the fourth study no differences were found. Results in favor of the cooperative learning condition were reported by Slavin (1977, 1979), Slavin and Oickle (1981), Zeigler (1981), Cooper, Johnson, Johnson, and Wilderson (1980). These studies used different cooperative group learning techniques but all arrived at similar results.

Handicapped Relations

The effects of cooperative group learning on the social relationships of handicapped children has also been investigated. The research in this area has mainly relied on sociometric and observational measures to assess the outcomes. Results of the research in this area are mixed but tend to favor the cooperative condition. Cooper, Johnson, Johnson, and Wilderson (1980) reported that handicapped students had significantly more friendship choices in the cooperative condition than the individualistic condition, but no differences were reported between the cooperative condition and the competitive one. One of the largest studies in this area, by Ballard, Corman, Gottlieb, and Kaufman (1977), indicated that the handicapped students in the cooperative condition were better accepted than were those in the control condition. There were

37 classes in grades three to five in this study, with one educable mentally retarded student in each class. Johnson and Johnson (1982) also reported findings in favor of the cooperative group.

Student Behaviors

Motivational outcomes have been investigated by looking at student behaviors. Two of the variables that have been investigated are classroom behavior and time-on-task. Observational research has provided the data for these behaviors. Slavin, Leavey, and Madden (1984) used a teacher rating to assess student classroom behavior in two experiments. The results indicated significantly higher ratings for the control group in the first experiment but no differences in the second. Time-on-task has been defined as engaged time in the studies that have compared cooperative group learning to other learning conditions. The majority of the research in this area has found significantly higher proportions of engaged time for the cooperative condition (Slavin, 1978, 1980; Janke, 1978; Ziegler, 1981;). Johnson and Johnson have reported mixed results, finding in favor of the cooperative group in one study in 1981, but not in another in the same year, nor in a study in 1982.

Reseach into cooperative group learning in the elementary school has found significant results in favor of the cooperative learning condition in most of the studies in a wide variety of areas. It would appear that the beneficial effects of cooperative group learning for elementary age children is well established by this body of research. This section reviewed a small portion of the available literature in this area. A summary of this research is presented in Table II.

TABLE II

SUMMARY OF THE LITERATURE ON COOPERATIVE GROUP LEARNING IN THE ELEMENTARY SCHOOL.

Study/Year	N	Discussion	Findings
Allport (1954)	N/A	Discussed theory of interracial contact	Contact had to be where individuals worked together on an equal basis, persuing common goals
Beane, & Lemke (1971)	64	Refuted claim that working together increased student achievement on individual tasks	Low ability students working in groups of 4 did not perform well on individual transfer tasks
Edwards, DeVries, & Snyder (1972)	96	Two groups of students played a nonsimulation game in a mathematics class. One group used the cooperative group method, the other was control	The results showed that although both groups increased in achievement over the experiemental period, the students in the cooperative groups increased more than the control group

TABLE II (Continued)

Study/Year	N	Discussion	Findings
Boydell (1975)	N/A	Examined the instructional method	Students were seated in groups but not instructed in groups
DeVries & Mescon (1975)	60	Studied the effects of cooperative group learning in a language arts class	Reported results in favor of cooperative group learning condition
Gerard, & Miller (1975)	N/A	Looked at friendships of ethnic groups	Students were more likely to have friends from the same ethnic group than from other ethnic groups
Weigel, Wiser, & Cook (1975)	324	Investigated attitudes between ethnic groups in cooperative group learning situation where multi-ethnic teams worked in a variety of subject	There were positive attitude changes from whites to a hispanics, but for no other combination (whites, hispanics, blacks). Fewer interracial conflicts were reported by teachers in the cooperative situation
Hulton & DeVries (1976)	299	Looked at achievement differences between a control group and a cooperative group in a mathematics class	The cooperative group increased in achievement more than the control group

TABLE II (Continued)

Study/Year	N	Discussion	Findings
Ballard, Corman, Gottlieb, & Kaufman (1977)	-	In a study that included students from 37 classes in grades 3-5, handicapped student relations with peers were examined	Handicapped students in the cooperative group condition were better accepted than those in the control condition
Slavin (1977)	65	Investigated the effect of biracial learning teams on cross-racial friendships	Reported results in favor of the cooperative group
DeVries, Edwards, & Slavin (1978)	N/A	Summarized 4 studies that examined the effect of cooperative group learning on interracial friendships	In 3 studies, students in the cooperative group condition gained more friends from other racial groups than did those in the control. In the fourth study, there were no differences
Johnson, Johnson, & Scott (1978)	30	Compared the effects of cooperative group learning to individual learning with high achieving students	Reported results in the control group
Janke (1978)	-	Examined time-on-task and achievement with two groups: team reward and an achievement reward	Found significantly higher proportions of engaged time for the cooperative condition, but no achievement effect

TABLE II (Continued)

Study/Year	N	Discussion	Findings
Slavin (1978)	205	Examined the effects of cooperative group learning on time-on-task in and English class	Found significantly higher proportions of engaged time for the cooperative condition
Franz (1979)	48	Studied the effects of cooperative group learning in a reading class	The results were in favor of the cooperative group
Slavin (1979)	424	Studied the effects of cooperative group learning in a language arts class	Found no difference between the two groups
Cooper, Johnson, Johnson, & Wilderson (1980)	60	Studied the effects of cooperative, competitive, and individual methods on cross-ethnic, sex, and ability interpersonal attraction	Found in favor of the cooperative condition for both intergroup relations and the social interactions of handicapped students
Galton, Simon, & Croll (1980)	N/A	Examined grouping practices in elementary schools	Found that students were seated in groups but not instructed in groups
Slavin (1980)	336	Examined student achievement and time-on-task for cooperative and control groups	Found significantly higher proportions of engaged time for students in the cooperative group

TABLE II (Continued)

Study/Year	N	Discussion	Findings
Johnson, & Johnson (1981)	51	Looked at cross-racial friendships and time-on-task with a cooperative learning group and an individual condition	Reported more engaged time for students in cooperative groups and more cross-ethnic interactions in free time
Johnson, Maruyama, Johnson, Nelson, & Skon (1981)	N/A	Conducted a meta-analysis of 122 studies of cooperative group learning	Concluded that all forms of cooperative group learning were more effective than either individual or competitive learning
Smith, Johnson, & Johnson (1981)	84	Examined the effects of controversy in concurrence seeking groups versus individual study	Reported that students who work together transfer this learning to individual tests and that controversy promoted higher achievement and retention
Slavin, & Karweit (1981)	456	In a study that lasted for a semester, the students were assigned to a cooperative group learning condition or a matched control condition	No significant differences were found between the two conditions on 2 math subscales: computations, and concepts and applications. The experimental group significantly exceeded the control group on seven of the affective scales, but there were no differences on the other five

TABLE II (Continued)

Study/Year	N	Discussion	Findings
Slavin & Oickle (1981)	230	Compared the cooperative group condition to a control group in a language arts class	Found that the cooperative group students performed better than the control group. The study took place in a rural area
Zeigler (1981)	146	Students were rated as below average, average, or above average by their teachers and put into a cooperative group or a control. Intergroup relations and time-on-task were examined	Reported results in favor of the cooperative learning group for intergroup relations and engaged time regardless of ability
Robertson (1982)	166	Examined mathematics achievement under three conditions: cooperative, individual/ competitive, and a control	Found positive effects for cooperative group learning versus the control, but not for the cooperative group versus the individual/ competitive
Webb (1982)	N/A	Examined the research on cooperative group learning	Claimed that it was not possible to conclude that cooperative group learning is the most useful teaching method, but that the evidence in strong enough to defend its importance

TABLE II (Continued)

Study/Year	N	Discussion	Findings
Johnson, & Johnson (1982)	51	Cooperative and competitive learning experiences on time-on-task and interpersonal attraction of handicapped and nonhandicapped were examined	Found in favor of the cooperative group for both time-on-task and interpersonal attraction
Slavin (1983)	N/A	Conducted a meta-analysis of 46 cooperative group learning versus control group experiments and examined the effects on achievement	Concluded that the effects of cooperative group learning on student achievement was positive
Roberts (1984)	N/A	Examined how students were instructed in mathematics classes in Britain	Found that although students were seated in groups they were not instructed in groups
Slavin, Leavey, & Madden (1984)	504	Six schools were randomly assigned to one of three conditions: a cooperative group condition, an individualized program condition, and a control condition	The cooperative treatment gained significantly more in achievement, attitudes and behavior than the control group, but only for two of the behavioral scales when compared to the individualized program condition

TABLE II (Continued)

Study/Year	N	Discussion	Findings
Slavin, Madden, & Leavey (1984)	1371	In a study that lasted for 24 weeks, students divided into a cooperative learning condition or a control condition	The results were in favor of the cooperative group on a mathematics achievement test
Talmage, Pascarella, & Ford (1984)	493	Compared the cooperative group to a control in a reading class	Found in favor of the cooperative group. The study lasted for a year
Johnson (1985)	859	Compared the "Groups of Four" method by Marilyn Burns to matched controls in mathematics	Found positive results for the group method in application and problem solving, but not in comprehension
Johnson & Waxman (1985)	150	Compared the "Groups of Four" method to matched controls in mathematics	Found positive results for the group method only with low achievers
Moskowitz, Malvin, Schaeffer, & Schaps (1985)	480	Looked at the effects of cooperative group learning on reading achievement	Found no significant results. The study lasted for 30 weeks
Stevens, Madden, Slavin, & Farnish (1987)	461	Examined the effects of cooperative group learning on reading achievement	Found results in favor of the cooperative group condition. The study lasted for 12 weeks

TABLE II (Continued)

Study/Year	N	Discussion	Findings
Stevens, Madden, Slavin, & Farnish (1987)	450	Examined the effects of cooperative group learning on reading achievement	Found results in favor of the cooperative group condition. The study lasted for 24 weeks
Lindquist (1989)	N/A	Suggested small groups be used to teach mathematics to elementary age children	Listed seven reasons for her recommendations
Slavin (1989)	N/A	Conducted a meta-analysis of 60 studies on cooperative group learning, looking specifically at achievement	Concluded that the effects of cooperative group learning on achievement were positive

Cooperative Group Learning in the College Classroom

> One man may hit the mark, another blunder; but heed not these distinctions. Only from alliance of one, working with and through the other, are great things born.
>
> Saint-Exupery

McKeachie (1967) identified the lecture as the traditional method of teaching at the college level. Nelson (1986) noted that although the lecture method has frequently been criticicized, it remained the most widely used form of instruction in universities. According to Osterman (1982), eighty-eight percent of college and university classes in his survey were taught by the lecture method. The lecture method of instruction is a situation where the "flow of information ... is more formal and primarily from the instructor to the students" (Michaelsen, Watson, and Shrader, 1984-5, p. 20).

Researchers have been investigating a variety of methods with the aim of making the student more active in the learning process. Bloom (1976) stated that "In general, about 20% of the variation in achievement is accounted for by their participation in classroom learning." (p. 123). Interaction analysis research has shown that less learning occurs in the classroom in which the teacher does all or most of the talking in an uninterrupted sequence (West, 1968). Browne and Kelly (1985) stated that there is "an enormous chasm between what is said in class and what he student hears or infers" (p. 81). According to Napell (1978), the lack of involvement by the learner often leads to a classroom of day-dreamers, blank-lookers, head-nodders, chin-holders, doodlers, and sleepers. A committee formed by the National Institute of Education to investigate higher education, recommended in their report of 1984 that the faculty make greater use of active modes of teaching and require that students take greater responsibility for their learning. Knowles (1980) commented about higher education "The best education takes place in nursery school and kindergarten, and it tends to get progressively worse ... reaching its nadir in college." (p. 41).

One area of research that has sought to make the students active learners rather than passive learners has been research into the use of discussion as a way to learn academic material at the college level. Discussion is a cooperative activity that is being encouraged in many areas of study, such as engineering (Brillhart and Debs, 1982) and mathematics (Dahlke and Morash, 1982). Haines and McKeachie (1967) undertook a study that compared cooperative class discussion to competitive class discussion. Eighty-two students from an introductory psychology class took part in the experiment. Observers were used to measure the amount of tension produced, student performance and student satisfaction. The study lasted for two weeks. The results suggested that higher tension, less satisfaction and poorer achievement were associated with the competitive discussion group.

Other researchers have examined the effect of peer teaching on both the achievement and attitude of college students. Bruffee (1978) found that the writing skills of both the tutors and the students greatly improved when peer tutors were used. Newcomb (1962) had identified the peer group as the single, most powerful force in undergraduate education. Bruffee wanted to see if this force could be harnessed to influence cognitive growth. His results support this. Bruffee (1978) described the process that occurs when peers work together as:

> ...students do not tend, as we might expect, to reinforce a single, perhaps incorrect interpretation of the problems presented. Instead they begin their discussion of each problem by trying to force their preconceptions upon each other. The result of this attempt, however, is that contradictory inferences emerge which the group cannot leave unresolved. Through the process of struggling toward a consensus in order to resolve the problem, the students first uncover the biases and limitations others bring to the judgemental task, only to discover, second and most importantly, the biases and limitations which they bring to it themselves (p. 454).

The effect of the peer on cognitive development would therefore appear to be valid at the college level.

A third area of research is looking at the effect of cooperative group learning in the university classroom. The goal of those seeking to replace the lecture with cooperative group learning is, as with the discussion method and peer tutoring, to increase the amount of participation by the student in the learning process, that is, to make the student an active learner rather than a passive learner. Early evidence by social psychologists suggested that the knowledge that others are present to observe one's work has strong effect on performance (Davis, 1969).

Research with cooperative group learning at the university level has shown that content is retained at least as well as in the more traditional class and that the same amount of material can be covered (Michaelsen, Watson, Cragin and Fink, 1982). However, attitudes and behavior are positively influenced (Bouton and Garth, 1983), and interpersonal skills, such as leadership, communication, and conflict resolution, are learned in a natural way. Such interpersonal skills, essential in the workplace, are not well addressed in the traditional lecture class. According to McKeachie (1978), problem-solving, reasoning, and logic skills are also improved by the cooperative group learning method.

Beach (1970) studied student interactions in an experiment with cooperative learning groups in a social psychology course. Beach wanted to distinguish activities that were helpful to learning from activities that were harmful to learning in a cooperative group learning situation. Control students did not work in groups. Data were gathered from pre- and post-experiment questionnaires, course tests, a survey of study habits, and the Watson-Glaser Critical Thinking Appraisal Test. The two conditions (groups and no groups) were also observed from behind a one-way mirror. The results showed a significant difference in achievement test scores in favor of the control group. However, on the Watson-Glaser test there was a significant improvement in critical thinking for the students in the cooperative learning groups. The study habits self-report indicated that those in the cooperative learning groups who had lower grade point averages consulted more books in preparing their paper than did the control students and the had a greater increase in their interest of the subject area.

Michaelsen, Watson, and Shrader, (1984-85) developed a cooperative group learning method that they term "team learning". In the team learning approach, students are divided into permanent groups of about six or seven. These groups are the focus of all class activity. The permanence of the groups is seen as an important factor, as it gives the group time to develop social as well as intellectual skills. The instructional method integrates knowledge acquisition and the application of the knowledge. Students learn the material by doing something with it, such as discovering, communicating, organizing, interpreting, applying, etc. Communication roles differ from the traditional classroom where the instructor does most of the talking. The student's peers become the role model instead of the instructor. Students learn to depend on their own resources and are motivated to contribute to the common goal of the group. They are forced to listen to each other, to discover and correct errors, to accept criticism, and to provide evidence for their conclusions.

Controlled experiments with the team learning approach have produced no significant results. Jones (1982) conducted an experiment with 288 students in sixteen sections of an introductory zoology course. Eight of the sections were taught using the team learning approach and eight sections by a traditional approach. The results indicated that the team learning approach produced increased academic performance but not at a significant level. The students in the team learning approach were more cooperative with each other than those in the control group, but the results were inconclusive with respect to student satisfaction.

Wilson (1982) designed a study to examine differences in achievement, interpersonal relationships, and satisfaction, between students in either a team learning or a control group in six sections of an introductory accounting class. There were 185 students in the study. The results of the study indicated that students in the experimental condition performed higher on achievement than those in the control condition but that the differences were not statistically significant. The students in the experimental condition scored significantly higher than the students in the control condition on most of the interpersonal relationship satisfaction measures.

Kraft (1985) described a cooperative group learning method which he termed "group-inquiry". He reviewed the ten basic skills listed by employers as essential, and described six of them as related to group-inquiry. These six skills are:

1. A functional command of the English language in its

written and spoken form.

2. The ability to reason, solve problems, and understand the consequences of alternative courses of action.
3. The ability to read, comprehend, and interpret written materials.
4. The ability to write in a clear, concise manner with correct grammar.
5. The ability to communicate orally.
6. A capacity to deal constructively and effectively with others.

Kraft noted that in traditional classrooms, only the teacher practices these skills, whereas students practice these skills only on rare occasions. The purpose of group-inquiry was therefore to reverse the roles so that it is the student who reads, writes, consults, organizes and solves the problems. They do all of this by working together, using structured activities organized by the teacher. Kraft stated that his measure of the effectiveness of this method is in the positive reaction of his students.

The role of the teacher is seen as that of arousing interest (Howe, 1967). If cooperative group learning as an instructional method is to be effective, the teacher has to structure the activities to enhance student cooperation. Beard (1972) described the role of the teacher as being to inspire confidence and to incite to action, not to interpret the textbook.

Feichtner and Davis (1984-85) investigated how students felt about their small cooperative group instruction experiences. Positive and negative feelings were studied. Common reasons for both the positive and negative reactions were found. More students reported positive attitudes if the groups were stable, few class presentations were required, three or less group written reports were required, there were group examinations, and there was time for group work in class. As the attitude of the student to the way that the class is structured is an important factor, these findings are significant. Bouton and Rice (1983) found that although students had highly rated courses structured in this manner, they had not subsequently enrolled in similarly structured courses. The students reported that the reason that they did not enroll, despite their enjoyment of the classes, was that more work was required of them than in traditional classes. Kraft (1985) believes such actions on the part of the students to be the result of the many years of passivity, which has led students to "disengage from genuine involvement and come to believe that learning is the same as note taking" (p. 150).

Research into cooperative group learning in the college classroom has not provided conclusive evidence of increased achievement, but there does not appear to be a decline in achievement. In addition, students appear to gain on affective measures by coooperative group activity. A summary of this research is presented in Table III.

TABLE III

SUMMARY OF THE LITERATURE ON COOPERATIVE GROUP LEARNING IN THE COLLEGE CLASSROOM

Study/Year	N	Discussion	Findings
Newcomb (1962)	N/A	Examined the influences on undergraduate college and university students	Identified the peer group as the most powerful single force in under-graduate education
Howe (1967)	N/A	Described the role of the university teacher	Stated that the role of the teacher was to arouse interest
Haines & McKeachie (1967)	82	Compared cooperative class discussion to competitive class discussion in an introductory psychology class	Results suggested higher tension, less satisfaction, and poorer achievement with competitive discussion
Mckeachie (1967)	N/A	Described teaching at the college level	Identified the lecture as the traditional method of teaching at the college level
West (1968)	N/A	Discussed interaction analysis research	Stated that less learning takes takes place in a classroom where the teacher does all of the talking and the students are passive rather than active

TABLE III (Continued)

Study/Year	N	Discussion	Findings
Davis (1969)	N/A	Examined the that working with others has on performance	Concluded that the knowledge that others are present to observe one's work has a strong effect on performance
Beach (1970)	-	Studied student interactions in a social psychology class. Compared cooperative and control groups	Found significant difference in achievement test scores in favor of the control group, but significant improvement in critical thinking skills for the cooperative group
Knowles (1980)	N/A	Examined the system of higher education	Concluded that the higher education was poor
Beard (1972)	N/A	Described the role of the teacher in higher education	Said that the teacher should inspire confidence and incite to action, not to interpret the textbook
Bloom (1976)	N/A	Described factors that affected achievement of college students	Stated that about 20 percent of the variation in achievement was accounted for by the amount of participation by the student

TABLE III (Continued)

Study/Year	N	Discussion	Findings
Bruffee (1978)	N/A	Described peer tutoring and the effect of peer tutoring at Brooklyn College	Found that the writing skills of both tutors and students improved when peer tutors were used
McKeachie (1978)	N/A	Discussed issues in higher education	Stated that problem -solving, and logic skills were improved by the cooperative group method
Nappell (1978)	N/A	Described the modes of interaction of college students	Concluded that lack involvement by the learner leads to passivity in the classroom
Brillhart & Debs (1982)	N/A	Examined the effects of discussion in an engineering class	Found students highly rated the course which combined technical information and rhetoric
Dahlke & Morash (1982)	N/A	Examined the effects of discussion in a mathematics class	Outlined ways to include discussion in mathematics classes
Jones (1982)	288	Conducted a study with team learning versus a control condition in an introductory zoology class	The group taught by the team learning approach increased their academic performance, but not at a significant level

TABLE III (Continued)

Study/Year	N	Discussion	Findings
Michaelsen, Watson, Cragin, & Fink (1982)	N/A	Described the team learning approach as used in college classrooms	Stated that content is retained at least as well in the team learning classroom as in traditional classrooms, and that the same amount of material can be covered
Osterman (1982)	N/A	Examined the use of the lecture as a method of instruction at the university level	From the results of a survey, 82 percent of university classes were taught by the lecture method
Wilson (1982)	185	Investigated the effect of the team learning approach in an introductory accounting class	The team learning group scored higher than the control group on measures of achievement, but not significantly higher. On measures of interpersonal relationship satisfaction, the team learning group scored significantly higher
Bouton & Garth (1983)	N/A	Discussed the team learning approach	Stated that attitudes and behavior were positively influenced when students were taught by the team learning method

TABLE III (Continued)

Study/Year	N	Discussion	Findings
Bouton & Rice (1983)	N/A	Examined student satisfaction with classes organized into teams	Found that although students highly rated the team learning approach, they did not enroll in classes similarly organized.
National Institute of Education (1984)	N/A	Examined higher education	Recommended greater use of active modes of teaching
Feichtner & Davis (1984-5)	N/A	Examined positive and negative student feelings about working in cooperative groups from 155 questionnaires	Found that more reported a positive attitude to group activity if there were 1) few class presentations, 2) 3 or less written reports, 3) group exams, 4) time for group work in class, and 5) the groups were stable
Michaelsen, Watson, & Shrader (1984-5)	N/A	Described the lecture. Discussed team learning	Stated that the lecture was formal, with information flowing from the instructor to the student. Stated that in team learning the groups do most of the interacting
Browne & Kelly (1985)	N/A	Described the patterns of interaction in college classrooms	Said that there was chasm between what is said and what the student hears

TABLE III (Continued)

Study/Year	N	Discussion	Findings
Kraft (1985)	N/A	Described a cooperative group method he termed "group-inquiry"	Stated that the purpose of group inquiry was to increase student activity
Nelson (1986)	N/A	Discussed the lecture	Noted that although the lecture at the college level has been criticized, it remained the most widely used form of instruction at universities

Cooperative Group Learning for Preservice Elementary Teachers

Learning to cooperate, cooperating to learn.

Schmuck

The National Council for Teachers of Mathematics (NCTM) has recently examined both the content and instructional method of mathematics education at all grade levels. The result has been the publication of the Curriculum and Evaluation Standards for School Mathematics (1989). In this publication, the NCTM has specifically addressed the instructional method. For students in Kindergarten to Grade

4, NCTM recommended that a social approach to the teaching of mathematics be taken:

> Young children are active, social individuals. Much of the sense they make of the world is derived from their communications with other people. Communicating helps children to clarify their thinking and sharpen their understandings (p. 26).

and

> When small groups of children discuss and solve problems, they are able to connect the language they know with mathematical terms that might be unfamiliar to them (p. 27).

Similarly, the NCTM recommended that students in grades 5-8 should become active learners and that "communication with and about mathematics and mathematical reasoning should permeate the 5-8 curriculum" (p. 66). NCTM noted that:

> Individual work can help students develop confidence in their own ability to solve problems but should constitute only a portion of the middle school experience. Working in small groups provides students with opportunities to talk about ideas and listen to their peers, enables teachers to interact more closely with students, takes positive advantage of the social characteristics of the middle school student, and provides opportunities for students to exchange ideas and hence develops their ability to communicate and reason (p. 67).

In contrast to the stated goals of the NCTM, the classroom described by Goodlad (1984) is teacher centered:

> . . . on the average, about 75% of class time was spent on instruction and that nearly 70% of this was "talk"--usually teacher to

> students. Teachers out-talked the entire class of students by a ratio of about three to one. If teachers in the talking mode and students in the listening mode is what we want, rest assured we have it (p. 229).

Goodlad's study was based on observations over eight years in 1000 classrooms in 38 schools. Thirteen of these schools were elementary schools (grades one through six). In all, 134 classrooms at the elementary level were studied. These classrooms were selected to provide maximum diversity of location, size, family incomes, etc. Goodlad's study has provided a detailed portrait of classrooms. Students were observed seated at desks which were arranged in rows facing the teacher at the front of the classroom, working independently, primarily on identical tasks. The activity that the students were usually engaged in is described as passive:

> . . . three categories of student activity marked by passivity--written work, listening, and preparing for assignments--dominate in the liklihood of their occurring at any given time at all three levels of schooling (p. 105).

The activities of the teacher were also found to be consistent across the observed classrooms:

> The data from our observations in more than 1,000 classrooms support the popular image of teacher standing or sitting in front of a class imparting knowledge to a group of students. Explaining and lecturing constituted the most frequent teaching activities, according to the teachers, students, and our observations. And the frequency of these activities increased

> steadily from the primary to the high school years (p. 105)

Goodlad noted that variations from this description did occur but mainly at the primary level, where a greater variety of methods were used, but added that these varied methods were rarely seen in the later elementary years.

The authors of The Underachieving Curriculum (McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers, and Cooney, 1987), also reported similar teaching methods to those described by Goodlad, when commenting on strategies used in mathematics classrooms. They noted that:

> Although active learning strategies such as constructing, measuring, counting and so on, were available for many topics, the single strategy most frequently emphasized by teachers was presenting and demonstrating procedures or stating definitions and properties - what has been characterized as "tell and show" approaches. (p. 81).

They suggested that such strategies were geared to rote learning and that such activities "along with class time devoted to listening to teacher explanations followed by individual seatwork and routine exercises" (p. 81) indicated a view of learning that saw students as passive learners.

Recognizing that in order for instructional practices to change in the elementary classroom teachers have to be prepared to implement these ideas, the NCTM has begun to examine the professional education of preservice mathematics teachers. In September of 1989, a working draft was prepared entitled <u>Professional Standards for Teaching Mathematics</u>. One section is concerned with the professional development of teachers of mathematics and states as as assumption that teachers must have a thorough understanding of the vision of mathematics education outlined in <u>The Curriculum and Evaluation Standards</u> and that "their education should include the development of the knowledge, skills, understandings, and dispositions needed to implement the recommended standards" (p. 62). A knowledge of cooperative group instructional methods is therefore essential. Cohen (1986) suggested that the utilization of cooperative group learning methods may require a whole new set of teaching skills. Sharan and Sharan (1976) indicated the importance of acquiring such skills:

> . . . one of the most critical challenges to classroom teachers is how to help students become involved in their learning experiences and to assume a large measure of personal responsibility for these experiences. A feeling of genuine involvement does not develop when students have no control over their school activities, and no share in decision-making (pp. 9-10)

Noddings (1989) indicated that for teachers to be effective in implementing cooperative group methods, they need to be prepared to respond to children as well as to initiate. Noddings discussed the use of cooperative group learning methods for preservice elementary teachers for the study of at least part of their mathematical pedegogy. She suggested that the purposes of cooperative group learning for preservice elementary teachers would be at least threefold:

1. to learn about cooperative group learning through participation.
2. to gain a wide grasp of approaches to mathematical problems.
3. to understand more fully the role of a teacher in this setting.

Noddings noted that the gain on mathematical understanding might be the most desirable, for if teachers realize how much they have learned in this way and experience greater confidence, they may be more able and more willing to try cooperative group learning methods in their own teaching.

In 1986, the International Commission on Mathematical Instruction discussed the role of the teacher in the 1990's. The findings from this Commission were presented by Howson and Wilson (1986) and indicated that there were three possibilities to be considered:

> 1. The teacher retains the traditional role of "supreme answer giver", individually (and solely) supplying motivation, explanations and assistance for the class, and rapidly adjusting to its moods and the varying demands of the subject.
>
> 2. The teacher becomes a guide to learning, and the designer (possibly together with colleagues within the school) of a curriculum which makes use of a variety of different resources - micros, booklets and other written materials, peer group interest and assistance.
>
> 3. The role of the teacher changes to that

> of administrator of a multi-resource learning kit which, it is hoped, will carry the main instructional burden. (pp. 78-79)

The cooperative group learning method would require a teacher with the skills to implement the second category.

Johnson and Johnson (1987) commented that cooperative group learning has been ignored in teacher training for the past fifty years and suggested a reason for the ommission:

> One answer is found in the fact that over 90 percent of all human interaction is cooperative! Cooperation to a human is like water to a fish; it is so persuasive that it remains unnoticed. Cooperation is a non-conscious goal of interaction, socialization, and education. Within most situations no alternative to cooperation seems possible to humans. All competitive and individualistic efforts take place within a broader cooperative framework. Cooperation is the forest; competitive and individualistic efforts are but the trees. (p. 45).

An extensive literature search did not reveal any experimental studies where cooperative group learning was used with preservice elementary teachers in a mathematics methods class. There were a few studies where cooperative group learning was used with preservice elementary teachers in other subject areas, or with practicing elementary teachers. A selection of these studies is presented in this section.

Sherman (1986) designed a study to replicate findings regarding the effectiveness of cooperative group learning as opposed to individually competitive learning with preservice education majors. The students were enrolled in an introductory educational psychology course that was a required course for preservice education majors. There were 136 students enrolled in four sections, of which ninety percent were majoring in education. Three sections were taught by the cooperative group learning method; one had intergroup competition within the cooperative group structure. The control group was taught using the individual competitive structure. Achievement was assessed by the use of a 63 item multiple choice test, the items being selected from the course text. A fourteen-item survey of student attitudes toward classroom cooperation, grading practices and general feelings toward the class was also administered three of the sections. In addition, a four-item Semantic Differential survey about learning was completed by the students. The results showed that although all groups showed significant gains from pretest to posttest scores on the achievement test, there were no significant differences among the treatment groups. The results of the attitude survey of the individual-compete group and the cooperate-compete groups indicated that all of the students tended to see cooperation as desirable. On the Semantic-Differential survey, statistically significant differences were obtained on three of the four adjectives between the individual-compete and the cooperate-compete groups, in favor of the cooperating group. Sherman noted that this study supported Slavin (1983) in that cooperative group learning is at the least as good as competitive learning with regard to achievement. The findings with regard to affective outcomes are consistent with previous research findings in that more positive attitudes are found with cooperative group learning (Slavin, 1990).

Fenton (1988) conducted a study in which more than 2,000 teachers were given training in cooperative learning. Teachers with more than fifteen hours of training were then compared to teachers with fewer hours of training on their use of cooperative learning groups. It was found that those with more than fifteen hours of training were more likely to use cooperative learning methods, in more areas of instruction, and more frequently. However, when gains in academic achievement of the students were investigated, it was found that the students of teachers who had received fewer hours of training gained more than the students of teachers who had received more hours of training.

As stated previously, few studies have examined the effect of cooperative group learning in the area of preservice elementary education. Yet, as Sherman (1986) noted, such pedagogical strategies could be the content of preservice elementary education. This study was designed to provide further insight into the effects of cooperative group learning for preservice elementary teachers. A summary of the research presented in this section is given in Table IV.

TABLE IV

SUMMARY OF THE LITERATURE ON COOPERATIVE GROUP LEARNING FOR PRESERVICE ELEMENTARY TEACHERS

Study/Year	N	Discussion	Findings
Sharan & Sharan (1976)	N/A	Discussed aspects of cooperative group learning	Noted the importance of teachers acquiring the skills to teach using cooperative group learning methods so that students would become active learners
Slavin (1983)	N/A	Conducted a meta-analysis of 46 cooperative group learning versus control group experiments	Concluded that cooperative group learning was at least as good as competitive with regards to achievement involving a wide variety of subjects
Goodlad (1984)	N/A	Conducted an observational study of 1000 classrooms	Found that direct instruction was the most common form of instruction. Found students to be passive, with the teacher doing most of the talking, and individual seatwork the most common activity
Cohen (1986)	N/A	Discussed the needed to teach using cooperative groups	Suggested that for teachers to use cooperative group methods they require a new set of skills

TABLE IV (Continued)

Study/Year	N	Discussion	Findings
Howson & Wilson (1986)	N/A	Reported the findings of the International Commission on Mathematical Instruction	Described three possibilities for the role of the mathematics teacher: 1) stay traditional 2) become a guide to learning, or 3) be an administrator of individual programs
Sherman (1986)	136	Undertook a study in an educational psychology class. There were 3 cooperative groups of which 1 had intergroup competition, and a control group	All groups made significant gains from pre- to post-tests on achievement but there were no significant differences among the groups. There were significant differences in favor of the cooperative groups for attitude measures
Johnson & Johnson (1987)	N/A	Discussed why teacher education has largely ignored cooperative group learning	Believed emphasis on competitive and individualistic learning misguided
McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers & Cooney (1987)	N/A	Discussed possible causes of the low test scores of students in mathematics as compared to other countries	Concluded the spiral curriculum and an emphasis on students as passive learners were major causes of low mathematics test scores

TABLE IV (Continued)

Study/Year	N	Discussion	Findings
Fenton (1988)	2000+	Teachers were given training in cooperative group methods. Those given more than 15 hours of training were compared to those given less than 15 hours of training	Teachers with more than 15 hours of training were more likely to use cooperative group methods, in more instructional areas and more frequently. Students of teachers with less than 15 hours of training gained more on achievement
NCTM (1989)	N/A	Examined both the content and instructional method of mathematics education	Recommended active modes of learning and cooperative methods as well as content revision
NCTM (1989)	N/A	Examined the professional education of mathematics teachers	Stated that teachers need to be able to implement the Standards
Noddings (1989)	N/A	Discussed the use cooperative group methods for preservice elementary teachers for mathematical pedegogy	Suggested that the purpose of such an instructional approach would be to provide a model as well as help improve their understanding of mathematics
Slavin (1990)	N/A	Examined aspects of cooperative group learning in detail	Concluded that the results in all areas were positive

Locus of Control

Social learning theorists emphasize interactions among people as the major source of information about ourselves and/or the physical world (Hergenhahn, 1988). According to Rotter (1966), a proponent of social learning theory, behavior is influenced by an individual's view of the environment, and the role that reinforcement and reward play regarding that behavior. Rotter's research investigated the importance of the reinforcement expectancy of behavior, a construct he termed locus of control. Rotter defined locus of control as a generalized expectancy determined by the degree that individuals perceive the outcome of the reinforcement to be a result of their own actions and aptitudes (internal) or as a result of fate, chance or external forces around them (external).

An individual's belief in being internally versus externally in control of reinforcements or rewards influences the expectancy of an event or a behavior. The relationship between behavior and reward is established by the formation of a set of expectancies indicating the probability that the same reinforcement of a particular behavior will occur in the future. Expectancies are built by encountering similar situations or events and remain in a state of evaluation. The reinforcement received in similar situations plays an important part in the strengthening or weakening of these expectancies. According to Rotter, if the same reinforcement is received across similar situations, then a generalized expectancy is established.

Researchers have investigated the locus of control construct over the last twenty-five years. Rotter developed an instrument, the I-E Scale, to measure the locus of control construct. The validity and reliability of the instrument have been established by Rotter and others. A summary of their findings using the I-E Scale are found in Rotter (1966), Lefcourt (1976), and Phares (1976).

Although Rotter (1966) has made positive statements about the locus of control construct, Strickland (1977) reported that the interpretation of the results of locus of control research depended upon the interpretation of the researcher. In reviewing the literature, Lefcourt (1976) and Phares (1976) indicated that the locus of control construct may be unstable. Individuals varied according to the situation with regards to the degree of internal or external locus of control. The same reinforcement may be interpreted from an internal frame of reference by one individual and from an external frame of reference by another (Crandall, Katkovsky, and Crandall 1965; Rotter, 1966; Lefcourt,1976). Lefcourt (1976) defined locus of control as "a circumscribed self-appraisal pertaining to the degree which individuals view themselves as having some causal role in determining specific events" (p. 141).

Researchers have investigated the relationship between locus of control and other constructs. The need for achievement was shown to have a relationship to locus of control (Rotter, 1966). Those who measure high on the need for achievement may have some belief in their own ability or skill to determine the outcome of their efforts (Crandall et al., 1965). Individuals high in the need for achievement attributed high success to high ability (internal) and failure to bad luck (external), while individuals low in the need for achievement attributed success to good luck (external) and failure to lack of ability (internal).

No relationship has been found between locus of control and measures of intelligence (Rotter, 1966; Hersch and Schiebe, 1967). However, relationships have been found between locus of control measures and measures of achievement among boys (Cellura, 1963; McGhee and Crandall, 1968). Chance (1965) found internality was positively related to reading, arithmetic, and spelling achievement test scores for both sexes with subjects in third through seventh grade. McGhee and Crandall (1968) in a study with 923 elementary, junior high and high school students found that overall internals of both sexes received higher report card grades and higher achievement scores, although the results were mixed when analyzed for significance by grade level. Girls in grade four did not receive significantly higher achievement scores, but girls in grades three and five did. None of the achievement scores in grades six, eight or twelve were significantly higher. Phares (1976) and Lefcourt (1976) reviewed the literature on the relationship between locus of control and achievement. Their reviews indicated higher achievement test scores or higher school grades for internals in some studies, whereas in other studies no relationships were found. Lefcourt (1976) stated:

> The research . . . fails to support a simplistic, one to one relationship between locus of control and achievement. As in most instances when a topic is closely scrutinized, the observed relationships are found to be anything but simple and conclusive (p. 66).

Messer (1972) found internals had higher grades and achievement test scores than externals even when intelligence and cognitive impulsivity were controlled statistically. He found that boys who took credit for their success and girls who accepted blame for their failures were those most likely to have higher grades and achievement test scores. McGhee and Crandall (1968) saw locus of control as a determinant of grade and achievement test scores. Messer (1972) thought that higher grade and achievement scores were the cause and not the result of perceived locus of control. Messer (1972) also indicated that a perception of internal locus of control could determine and be determined by high grades and achievement scores.

Gozali, Cleary, Walster, and Gozali (1973) investigated the relationship between time utilization and locus of control. They believed that time utilization on a test, with internals allocating their time according to task difficult but externals not, might result in higher achievement scores. The results indicated that internals used time in a manner more appropriate to the test-taking situation than did externals. As tests are normally timed, they suggested that two students of equal achievement levels might receive different test scores as a result of their locus of control. Rotter and Mulry (1965) found that internals spent more time on an angle-matching task when they were told performance involved skill than when they were told it was a matter of luck. Externals tended to take longer when told it was chance not skill determining the outcome, but there were no statistically significant differences. Julian and Katz (1968) found that internals spend more time on difficult items than on easy ones and that externals decision time was not related to item difficulty.

Eisenman and Platt (1968) and Hjelle (1970) failed to find differences between internals and externals on achievement test scores. Their subjects were adults, unlike the subjects in the studies mentioned previously. The locus of control construct appears to be a developmental construct. Responses tend to become more internal with age. Parent, Forward, Canter, and Mohling (1975), in a study with 54 college students, investigated the effect of different teaching strategies on students according to their locus of control. Internal locus of control students performed better in the low discipline condition, while external locus of control students performed better under high discipline condition.

Janzen, Beeken, and Hritzuk (1973) predicted that teachers classified a internal on Rotter's I-E Scale would score high on measures of student autonomy, integrative learning, personal adjustment ideology, student challenge, and consideration of student viewpoint. It was further predicted that teachers scoring as external on Rotter's I-E Scale would score higher in measures of classroom order, subject matter emphasis, and emotional disengagement. A sample of 80 teachers were classified as either internal or external from their score on the I-E Scale. The sample was then given Wehling and Charters' Dimensions of Teacher Beliefs questionnaire to measure the attributes listed above. The results indicated that it was the internal teacher who desired more classroom control, which led to a rejection of student autonomy.

Olsen (1985) presented generalized findings for descriptions of internal/external behaviors from reviews of studies by Rotter (1966) and Strickland (1977):

1. Locus of control appears to be related to conforming and compliant behavior with internals maintaining individual judgement and resisting influence and externals succumbing to pressure from others. However, if the internally oriented person perceives it is advantageous to conform, he or she may do so without yielding any control to others.

2. Internals depend on their own abilities

and interpretation of task demands while externals respond to social influence.

3. Internals work harder at intellectual performance tasks and can delay immediate gratification.

4. Internals prefer to rely on their own efforts while externals may need more initial structure and support from others.

5. Internals seem less threatened by persons who are different from them and are more tolerant of others.

6. Internals attempt to take responsibility for their lives and change uncomfortable and aversive situations taking steps to improve environmental conditions. Externals may be more concerned with control on individuals exerted by institutional pressures.

7. Internals are more willing to take risks to test their abilities. Externals put themselves in low risk situations so they can easily attain goals or in extremely high risk situations so failure is not under their control.

8. Internals are more alert to those aspects of the environment that provide useful information for future behavior.

9. Internals place greater value on skill or achievement reinforcements and are generally more concerned with their ability. (pp. 86-87)

Tenebaum (1988) stated that an internal locus of control is believed to be more desirable than an exteranl locus of control. Strickland (1977) did not believe this to be always true and pointed out that although internals appeared to be higher achievers and independent, they may also be controlling. Externals, while described as lower achievers and low risk takers, may be more able to adjust and be more realistic. As the study by Janzen, Beeken, and Hritzuk (1973) found, internal teachers may not possess the needed traits to allow students to be independent in the classroom. Bryant (1974) found that external children attributed significantly more negative attributes to their teachers and themselves than did internal children. The external children were found to have more painful relationships with their teachers. The teacher-child relationship is an extremely important one, and it appears as if the locus of control construct, when applied to both the teacher and the student has an important effect on the relationship.

Hickey (1980) studied the interaction between general reasoning ablity, locus of control, and high and low support treatments. Four classes of college students enrolled in a finite mathematics course were assessed on the aptitudes. Rotter's I-E Scale was used to measure locus of control. The students were randomly assigned to one of the two treatment conditions. Her findings indicated that internal subjects who were high in general reasoning ability performed better under low support conditions. External subjects with low general reasoning ability performed better under the high support conditions.

Hickey (1981) developed a scale to measure locus of control in mathematics. The scale was piloted with college students. Friske (1982) used Hickey's Locus of control in mathematics scale to investigate the interaction of locus of control in mathematics and other aptitudes and two instructional treatments in a geometry unit. The subjects were eighth and ninth grade students. No significant aptitude/treatment interactions were found. Kouchak (1989) examined the interaction of locus of control in mathematics and general reasoning ability and high or low structure treatments in a college computing course. The results indicated that students classed as internal on Hickey's Locus of Control in Mathematics Test but high on general reasoning ability performed better under the low structure. Those classed as external and low on general reasoning ability performed better under the high structure.

Locus of control has been extensively researched. The review of the literature presented here is a selected review. A summary of the literature presented here is given in Table V.

TABLE V

SUMMARY OF THE LITERATURE ON LOCUS OF CONTROL

Study/Year	N	Discussion	Findings
Cellura (1963)	-	Investigated the relationship between locus of control and achievement	Found a relationship between locus of control measures and measures of achievement

TABLE V (Continued)

Study/Year	N	Discussion	Findings
Chance (1965)	-	Investigated the relationship between locus of control and achievement	Found that internality was positively related to reading, arithmetic, and spelling achievement for students in grades three to seven
Crandall, Katovsky, & Crandall (1965)	923	Examined childrens beliefs in intellectual and academic reinforcement responsibility	Noted that the same reinforcement may be interpreted from an internal frame of reference by one individual and an external frame of reference by another
Rotter & Mulry (1965)	120	Two ggroups of elementary psychology students were examined on an angle-matching task	Found that internals spent more time on an angle-matching task when told skill was important but externals spent more time on the task when told chance was important, but the differences were not significant
Rotter (1966)	N/A	Investigated the importance reinforcement expectancy on behavior and termed the construct locus of control	Stated that behavior was influenced by a person's view of the environment and the role played by reinforcement and reward. Did not find any relationship between locus of control and intelligence

TABLE V (Continued)

Study/Year	N	Discussion	Findings
Hersch & Schiebe (1967)	481	Examined the relationship between locus of control and intelligence using students from the Service Corps and college students	Found no relationship between locus of control and intelligence
Eisenman & Platt (1968)	131	Investigated the relationship of locus of control, grades, and birth order with college students	Failed to find differences between internals and externals on achievement
Julian & Katz (1968)	98	Conducted two studies with college students 1) a synonym/ antonym task 2) a math pattern task and looked at time allocation	Internals spent more time on difficult items, externals time allocation was not related to task difficulty
McGhee & Crandall (1968)	923	Investigated the locus of control construct as a determinant of grades and achievement scores	Found a relationship between measures of locus of control and measures of achievement but when analyzed by grade level the results were mixed
Hjelle (1970)	139	Examined grade point average of students identified as internal or external	No significant differences were found between internals and externals on achievement scores

TABLE V (Continued)

Study/Year	N	Discussion	Findings
Messer (1972)		Examined the effect of locus of control on grades and achievement	Found internals had higher grades and achievement test scores even when intelligence and cognitive impulsivity were controlled statistically
Gozali, Cleary, Walster, & Gozali (1973)	148	Investigated the relationship between time utilization and locus of control	Found that internals used time more appropriately when taking a test in a college class
Janzen, Beeken, & Hritzuk (1973)	80	Predicted that teachers classified as internal would give students more autonomy	Internal teachers desired more classroom control
Bryant (1974)	40	Examined attributions of children to teachers according to locus of control	External children attributed significantly more negative attributes to themselves and had a more painful relationship with the teacher
Parent, Forward, Canter, & Mohling (1975)	54	Examined the effect of different teaching strategies on students according to their locus of control	Found that internals performed better in low discipline conditions and externals did better under high discipline conditions

TABLE V (Continued)

Study/Year	N	Discussion	Findings
Lefcourt (1976)	N/A	Described locus of control as a self-appraisal measure, influenced by the degree of belief one has in influencing events	Reviewed the locus of control literature and found mixed results for achievement. Indicated that the construct may be unstable
Phares (1976)	N/A	Reviewed the locus of control literature	Concluded that the the locus of control construct may be unstable
Strickland (1977)	N/A	Reviewed the locus of control literature	Reported that the interpretation of locus of control research results depended on the interpretation of the researcher
Hickey (1980)	-	Used 4 classes of college students in a mathematics class to investigate the relationship of locus of control, general reasoning ability, and level of support	Found internals high in general reasoning ability performed better under low support conditions and externals low in general reasoning ability performed better under high support conditions
Hickey (1981)	N/A	Developed a scale to measure locus of control in mathematics	Piloted the scale with college students

TABLE V (Continued)

Study/Year	N	Discussion	Findings
Friske (1982)	236	Investigated the interaction of instructional treatment and locus of control in a mathematics class	Found no significant aptitude/treatment interactions
Olsen (1985)	N/A	Presented generalized findings from reviews of the literature	Internals appear to be more in control than externals
Hergenhahn (1988)	N/A	Described social theory	Social learning theory emphasizes interactions among people
Tenebaum (1988)	N/A	Discussed internal achievement responsibility	Stated that internal locus of control is believed to be better than external
Kouchak (1989)	109	Examined the interaction of locus of control level of support and general reasoning	Found that internals with high general reasoning ability performed better under low structure,

Attitude Toward Mathematics

Research has not clearly established that teachers' atitudes toward mathematics have an influence on their students' attitudes, interests and achievements, but popular belief holds that there is a significant relationship. Concern that attitudes of elementary school teachers are transmitted to their students is reflected in many articles over the years dealing with the attitudes of preservice teachers. Mathematics educators have pointed out that those who plan to teach elementary age children generally have poor attitudes toward mathematics. However, other researchers have disputed the claim that preservice elementary education majors have a poor attitude toward mathematics.

Dutton researched the attitudes of preservice elementary teachers over a period of time. He used an attitude scale that he devised to measure their attitude toward arithmetic He used this scale to measure the attitudes of the preservice elementary students in 1954 and then again in 1962, and compared the results. Dutton noted that the attitudes of the students toward arithmetic in 1954 were almost identical with those of the students from the 1962 sample. Thirty-eight percent of the sample reported that they disliked arithmetic very much.

A study by Bulmahn and Young (1982) looked at the attitudes of preservice elementary education students in comparison to students who were persuing other majors. Over 200 students were administered a questionnaire, of which about half were elementary education majors. Approximately ninety percent of the elementary education majors were female, whereas about fifty percent of the non-elementary education majors were female. The authors report that the elementary education majors frequently reported that mathematics "has always been my worst subject" in the essays they wrote on attitude toward mathematics, but did not report the data from the questionnaire.

In order to respond to the made by Bulmahn and Young, Becker (1986) studied the mathematics attitudes of elementary education majors and compared them to data obtained form other populations. The sample consisted of 81 elementary education majors and 71 students who were not elementary education majors. A revised version of the Fennema-Sherman Mathematics Attitudes Scales (1976), consisting of 77 items, was given to each student. The results showed that the elementary education students scored lower on the anxiety scale, indicating they were more anxious, than on any other of the attitude scales. They also scored significantly lower than the non-elementary education students. Over half of the elementary education students agreed or strongly agreed with the statement "Mathematics makes me feel uneasy and confused", but so did forty-five percent of the non-elementary education majors. Becker concludes that although the preservice elementary education majors in this sample cannot be classified as very positive in attitude toward mathematics, neither can they be classified as very negative. She also notes that we cannot expect elementary education majors to be more positive about mathematics than college students in general.

Kelly and Tomhave (1985) used the Mathematics Anxiety Rating Scale (MARS) with college freshmen to assess their mathematics anxiety. Of the group, the elementary education majors scored higher than any other subgroup except for those enrolled in a math anxious workshop. Kelly and Tomhave conclude that if their results are "representative of preservice teacher education, then women elementary school teachers, who constitute the majority of elementary school teachers, may be perpetuating math anxiety with young girls in their own classes" (p. 52).

Elementary teachers have to create an environment of excitement and interest about mathematics in their classrooms. It is difficult for a teacher to be enthusiastic if he or she feels fear and anxiety. Efforts to help elementary teachers overcome these anxieties are essential.

A summary of the literature is presented in Table VI.

TABLE VI

SUMMARY OF THE LITERATURE ON ATTITUDE TOWARD MATHEMATICS

Study/Year	N	Discussion	Findings
Dutton (1954)	289	Examined the attitudes of students toward arithmetic	Many prospective elementary teachers expressed dislike of arithmetic
Dutton (1962)	127	Re-examined attitudes of students toward arithmetic	About 38 percent of of the preservice elementary teachers in this study disliked arithmetic very much
Fennema & Sherman (1976)	N/A	Developed scales to measure attitudes to mathematics	The scales help to identify students who have specific attitudes toward mathematics
Buhlman & Young (1982)	200+	Compared attitudes of preservice elementary education majors toward math to other majors using a questionnaire	Data not reported. Stated elementary education majors frequently reported mathematics was not their best subject
Kelly & Tomhave (1985)	-	Tested college freshmen for math anxiety using the MARS	Elementary education majors scored higher than any other group except for those in a math anxious workshop

TABLE VI (Continued)

Study/Year	N	Discussion	Findings
Becker (1986)	152	Studied attitudes of elementary education majors and compared them to other students	Elementary education majors more anxious than other populations but all groups not sure of mathematics

Summary

Cooperative group learning has come to be accepted as a viable alternative to traditional methods of instruction in the elementary school classroom and the college classroom. Some of the available literature on cooperative group learning has been reviewed in this chapter. In addition, the literature on locus of control and attitude toward mathematics was reviewed.

CHAPTER III

DESIGN OF THE STUDY

This chapter presents the instrumentation, sampling method, materials, and procedures used in the study. The study compared the effects of the traditional lecture method of teaching to cooperative group learning with regard to achievement in mathematics, achievement in methods of teaching mathematics, locus of control for success in achievement in mathematics, and attitude toward mathematics. Traditional textbook materials and manipulatives were used as the primary material for both groups.

Subjects

The subjects were 49 preservice elementary teachers and one certified teacher enrolled in two sections of CIED 4142, Teaching Mathematics at the Intermediate Level, in the Fall semester of 1988. The university was located in a midwestern state, in a city of approximately 42,000 residents, of which approximately 20,000 were students attending the university (Chamber of Commerce, Stillwater, 1990). There were 47 females and two males in the study. This female/male ratio is representative of preservice elementary classes of the university.

Of these students, one had had previous teaching experience at the elementary level, eight had been substitute teachers, two had been a teacher's aide, and twenty had completed observation assignments in the elementary school. Opportunity to learn mathematics has been identified as an important factor in achievement in mathematics (McKnight, Crosswhite, Dossey, Kifer, Swafford, Travers, and Cooney, 1987). In order to assess opportunity to learn, the students completed a survey indicating the number and type of previous mathematics classes they had taken at both the High school and college level. The results of the survey are presented in Figure 1.

	GROUP			
	Experimental		Control	
COURSE	HS	Coll	HS	Coll
Algebra I	17	-	21	-
Algebra II	10	-	15	-
Elementary Algebra	-	4	-	5
Intermediate Algebra	-	7	-	6
General College Math	-	1	-	2

Figure 1. Survey of Previous Mathematics Classes

	GROUP			
	Experimental		Control	
COURSE	HS	Coll	HS	Coll
College Algebra	-	4	-	7
Trigonometry	4	0	5	0
Geometry	17	0	18	0
Calculus	1	1	0	0
Arithmetic for Teachers	-	19	-	20
Structural Concepts for Teachers	-	18	-	22
Primary Mathematics Methods	-	22	-	21

Figure 1. (Continued)

The number of students who had taken each mathematics course was approximately equal in each of the two sections, so that previous opportunity to learn mathematics was about the same for subjects in each section. The experimenter was the instructor for both classes.

Procedures

There were two groups involved in the study. Both groups used the same textbook and manipulatives for instruction. The class met once a week for a one hour and as that of previous semesters.

All students in the study used Teaching Mathematics to Elementary School Children by Cruikshank, D. E., and Sheffield, L. J. (1988) as the course text. Both groups met on a Tuesday, according to the schedule printed in the college directory of classes. One group met from 8:30 to 10:20 a.m., the other from 10:30 to 12:20 p.m. A copy of the course syllabus, a list of the topics covered, and the materials used by both treatment groups, appears in Appendix A.

The two groups involved in the investigation consisted of an experimental group and a control group. The control group was taught by the traditional method which consisted of lecture and demonstration of the material. The students worked individually. Ten minitests consisting of ten questions each were given throughout the semester. The students completed the tests individually and were individually scored. In addition, the experimental group completed the same minitest as a group immediately following the collection of the individual minitests. They were instructed to debate the questions and come to group consensus on the answers and to ensure that each member of the group understood the question and the answer. Members of both groups completed an individual class mid-term and final. The experimental group worked in small cooperative groups of six or seven students. The students were randomly assigned to their groups by drawing names from a hat. The students studied in their groups, and worked on group tasks and assignments for over half of the class period. The rest of the time was used for lecture, discussion and group presentation. A sample of a cooperative group activity is given in Appendix B. The experimental period lasted for eleven weeks.

The instructor planned all lessons. The lessons were essentially the same as those presented in previous semesters. Activities were scheduled for each class session. All activities and manipulatives presented were a result of planning before the study commenced. The instructor was available to all subjects for assistance.

At the first session, a course outline was given to each student. The dates of topics to be presented, assignment due dates, examination dates and the grading scheme for the class were discussed. The outlines were essentially the same except for the designation of activities as group activities for the experimental group. The students were then informed that some data would be collected from them during the semester and allocated a number so that all pretest and posttest information would ensure confidentiality. Three of the pretests were then administered. These were the Methods of Teaching Mathematics pretest, the Hickey's Locus of Control in Mathematics pretest, and the Confidence in Learning Mathematics Scale, a subscale of the Fennema-Sherman Mathematics Attitude Scales, pretest. The fourth pretest, the Tests of Achievement in Basic Skills (TABS) Level C, Form 1, was administered in the second class meeting. There were four testing sessions, two for the pretests and two for the posttests.

Assignment to Groups

The subjects enrolled in either section 1 or section 2 of CIED 4142, Teaching Mathematics at the Intermediate Level, according to normal university procedures for enrollment. Other than convenience of scheduling, students indicated that there was no reason for enrolling in one section rather than the other, therefore no systematic differences were evident. Of the twenty-four students enrolled in section 1, 8:30 to 10:20 a.m., over twenty were enrolled in another college class at 10:30 a.m. Of the twenty-five students enrolled in section 2 from 10:30 to 12:20 p.m., over twenty were enrolled in another college class immediately preceding this section, from 8:30 to 10:20 a.m. Therefore time of day was not considered a factor in this study as both groups experienced similar time commitments. CIED 4142, Teaching Mathematics at the Intermediate Level, is a required course for all preservice elementary teachers at the university. The groups were randomly assigned to either the experimental condition or the control condition by the toss of a coin. Section 1, the 8:30 to 10:20 a.m. class, was assigned to be the control group. Section 2, the 10:30 to 12:20 p.m. class, was assigned to be the experimental group.

Instruments

The dependent measures used in this study were selected for their appropriateness to the experiment and for their ability to measure the variables under consideration. All of the measures were objective, paper-and-pencil instruments, with either multiple choice or Likert scale responses. The four instruments used were the Tests of Achievement in Basic Skills (TABS) Level C, Form 1 (1971), the Methods of Teaching Mathematics Test (1988), the Hickey's Locus of Control in Mathematics Test (1981), and the Confidence in Learning Mathematics Scale, a subscale of the Fennema-Sherman Mathematics Attitude Scales (1976). Each instrument was administered twice, once prior to the study and again at the completion of the study. The pretests were administered in August, at the beginning of the semester, with the testing completed in two class periods. The posttests were administered in December, at the end of the treatment period. The testing again took two class periods. One form of each test was used as both the pretest and posttest. Figure 1 is a summary of the instruments and the variables they measure. A detailed discussion of each instrument and the subtests of the variables measured by the instrument is given following Figure 1.

INSTRUMENTS	VARIABLES MEASURED
Tests of Achievement in Basic Skills (TABS) Level C, Form 1	a) Arithmetic skills; whole number, integer, rational number. b) Geometry, measurement, application. c) Modern concepts
Methods of Teaching Mathematics Test	Methods of teaching elementary school mathematics to students in grades 4-8, including knowledge of: a) manipulatives b) concrete, semi-concrete and abstract models c) appropriate content
Hickey's Locus of Control in Mathemetics Test	a) Locus of control is generalized expectancy of control of reinforcement. b) Locus of control in mathematics refers to the control of reinforcement in mathematics.
Confidence in Learning Mathematics Scale, a subscale of the Fennema-Sherman Mathematics Attitude Scales.	Confidence in one's ability to learn and perform well on mathematical tasks.

Figure 2. Insrumentation and Variables

The Tests of Achievement in Basic Skills (TABS) Level C, Form 1, is a sixty-four item multiple choice test designed to assess mathematics achievement at the seventh to ninth grade level. It is a criterion-referenced standardized test, the norms being for seventh, eighth and ninth grade students.

The test measures knowledge and application of basic arithmetic skills (thirty-five items), geometry and measurement (fourteen items), and modern concepts (fifteen items). The arithmetic skills section includes the four operations within the sets of whole numbers, integers, rational numbers, irrational numbers, and literal numbers. The geometry and measurement section items measure basic geometric concepts, arithmetic measurements, and applications. Under modern concepts, knowledge of sequences, functions, number properties, properties of operations, primes, other number bases, and sets are measured. This test was selected due to the correspondence of the test items to the content of the Teaching Mathematics at the Intermediate Level course and because of the reported high reliability and validity coefficients. Content validity was established by asking teachers of mathematics and curriculum specialists to evaluate the objectives and items of the test and it is reported that ninety percent of the responses indicated that content coverage was appropriate. Concurrent validity was established by performing Pearson product-moment correlations comparing test results of TABS with the results of other tests of achievement in mathematics. The reported r for TABS Form 1 with the Iowa Tests of Basic Skills (ITBS) was .85, and with the California tests of Basic Skills (CTBS) was .89. Internal consistency was determined by applying the Spearman-Brown formula to the Pearson product-moment correlation between test halves. The resulting reliability coefficients are reported as .83 (seventh grade), .88 (eighth grade), and .91 (ninth grade). Sample items from the TABS are given in Appendix C.

The Methods of Teaching Mathematics Test was designed by the researcher. This test is a thirty-item multiple-choice test measuring understanding of appropriate methods of teaching mathematics to elementary age children in grades four through seven. The items for the test were selected from items on previous tests used in the class. Posttest reliablity was established the KR-8 method of establishing internal consistency. A reliability of .58 was reported. Sample items from this test are given in Appendix C.

Locus of control in Mathematics was assessed using the Hickey's Locus of Control in Mathematics Test. The scale is designed to assess beliefs for internal or external locus of control of reinforcement responsibility in mathematics achievement situations. The scale is composed of twenty-seven items each answered on a five-point Likert scale ranging from definitely-agree to definitely-disagree. Sixteen of the items are weighted positively and eleven are weighted negatively. Each subject has a total internal responsibility score which reflects the degree to which they are internally or externally rated. The test was developed by Hickey to measure locus of control in mathematics and was modeled on Rotter's (1966) I-E Scale of internal versus external locus of control. The Hickey's Locus of Control in Mathematics Test is composed of twenty-seven items, answered by a five point Likert Scale. Sixteen of the items describe a positive attribution and eleven of the items describe a negative attribution. A copy of this test is given in Appendix D.

The Confidence in Learning Mathematics Scale is a subscale of the Fennema-Sherman Mathematics Attitude Scales (1976). The scales each assess an attitude that has been hypothesized to be related to the learning of mathematics. The Confidence in Learning Mathematics Scale is intended to measure confidence in the ability to learn and perform well in mathematics. Fennema and Sherman (1966) describe the dimension of the scale as ranging from distinct lack of confidence to definite confidence. Content valididy was established by each author judging the other author's items and agreed upon items chosen for testing with 367 students in grades nine to twelve. The Confidence in Learning Mathematics items were randomly distributed amongst the items for the other scales. The twelve items selected for the Confidence in Learning Mathematics Scale were chosen from the field test, six being positively weighted and six negatively weighted. The split-half reliability is reported to be .93 for the Confidence in Learning Mathematics Scale. A copy of the Confidence in Learning Mathematics Scale is given in Appendix D.

Collection of the Data

In August 1988, pretest scores were gathered on all four instruments. All testing was in written form and was administered in whole-group sessions, prior to the treatment period. All subjects completed the four pretests.

The treatment for the study began at the third class session of the semester, in September 1988. The treatment lasted for eleven weeks and ended in December 1988. Posttests for each of the four instruments were administered during the last two sessions of the semester. All testing was again in written form and administered in group sessions. All subjects completed the four posttests.

Hypotheses

The purpose of this study was to examine the effects of cooperative group instruction on achievement in mathematics, achievement in methods of teaching mathematics, locus of control for success in mathematics, and attitude toward mathematics. Hypotheses were developed to provide a direction for the study. These hypotheses are stated in the null form on page 6 and tested at the .05 level of significance experimentwise. The .05 level of significance was chosen in order to control for the probabilities of Type I and Type II errors occurring.

Treatment of the Data

The design of the study was a non-equivalent control group design, which involved the use of two intact groups, one being randomly assigned as the experimental group and the other as the control group. The study had one between groups measure and one within-groups measure. The between-groups measure was treatment, and the within-groups measure was the repeated measures on the pretest and the posttest. The treatment factor was under the direct control of the researcher. The effects of the treatment factor were of primary interest to the experimenter.

Analysis of covariance was selected as the statistical method because if the covariate has relatively high correlation with the dependent variable, the power of the experiment will be higher than would be the case if analysis of variance were used (Huitema, 1980). The correlation matrix for the covariates and the dependent variables in the study is presented in Figure 2. The principal reason for employing the covariate is to increase the precision of the statistical analyses by controlling for sources of systematic variations (Pedhazur, 1982). In a pretest-posttest design, the covariate is an early measurement on the variable to be used as the dependent variable. There are four variables measured with two identical measurements

	Pre AM	Post AM	Pre AMM	Post AMM	Pre LC	Post LC	Pre AT	Post AT
Pre AM	1.000							
Post AM	.735	1.000						
Pre AMM	-.090	.093	1.000					
Post AMM	.026	.298	.397	1.000				
Pre LC	-.423	-.333	-.022	.129	1.000			
Post LC	-.372	-.300	-.032	.083	.749	1.000		
Pre AT	.404	.281	.067	.013	-.809	-.744	1.000	
Post AT	.317	.212	.032	-.071	-.653	-.811	.838	1.000

Figure 3. Correlation Matrix of Covariates and Dependent Variables

AM Achievement in Mathematics
AMM Achievement in Methods of Teaching Mathematics
LC Locus of Control for Achievement in Mathematics
AT Attitude Toward Mathematics

on two separate occasions for each of the four variables.

Summary

The design of the study and the treatments for the two groups were described. Students enrolled in two sections of a mathematics methods class designed to teach methods of teaching mathematics to intermediate grade students (grades four through seven) were the subjects of the study. The groups were randomly assigned to either the experimental or the control condition. The students were tested on four measures, and four analyses of covariance were calculated to analyze the data with each pretest serving as the covariate for the respective posttest.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

In this chapter the results of the analyses of the data are presented. This study investigated the effects of cooperative group instruction on the achievement in mathematics, the achievement in methods of teaching mathematics, the locus of control for success in achievement in mathematics, and the attitude toward mathematics of preservice elementary teachers in a mathematics methods class. The design of the study was a quasi-experimental, non-equivalent control group design, which involved the random assignment of two intact sections of a mathematics methods class to either the treatment or control condition. Subjects completed both a pretest and a postest of a mathematics achievement test, a methods in teaching mathematics test, a locus of control in mathematics scale, and an attitude toward mathematics scale. The chapter is organized according to the statistical technique used in the analyses.

Analyses of covariance were calculated to analyze the four sets of data. Students were administered four instruments on each of two occasions. The same test was used for both the pretest and the posttest on each criterion measure. Pretest scores were used as the covariate for each respective posttest. The purpose of using pretests as a covariate is to adjust for initial differences between the experimental and control groups and to increase the sensitivity of the analyses. The null hypothses presented in Chapter I were tested for rejection at the .05 level of significance. To control for error rate across the multiple analyses, the overall alpha level of .05 was divided by four to calculate the per comparison rate to be used in assessing each analysis and still maintain the familywise error rate. Each separate analysis was therefore tested at an alpha level of .0125. This adjustment provides a conservative test of significance. The hypotheses tested in this study, stated in the null form, were that:

1. The type of treatment group does not significantly affect achievement in mathematics.
2. The type of treatment group does not significantly affect achievement in methods of teaching mathematics.
3. The type of treatment group does not significantly affect internal locus of control for success in achievement in mathematics.
4. The type of treatment group does not significantly affect attitude toward mathematics.

All null hypothses were tested against non-directional alternative hypotheses. No tests were performed for the assumption of homogeneity of variance, as F tests are robust with respect to minor violations of this assumption.

Analysis of covariance using the SPSS-X REGRESSION procedure was used to determine whether there were any significant differences between the experimental and control groups on any of the four posttests after adjustment for the covariates. Prior to the treatment all subjects were administered the four instruments to determine their level of mathematics achievement, their knowledge of methods of teaching mathematics, their locus of control for success in achievement of mathematics, and their attitude toward mathematics. Table VII presents the means and standard deviations of the four dependent variables for both groups prior to treatment. There was one independent variable, treatment, with two levels. Dummy coding was used to code the data for the categorical independent variable of treatment.

Results

The analysis of covariance results for each dependent measure were evaluated separately. The overall regression R^2 y.ABC) for each analysis was inspected to establish that a meaningful proportion of variance was accounted for by the full model. The R^2 y.ABC for each analysis of covariance procedure is presented in Table VIII.

TABLE VII

SUMMARY OF PRETEST MEANS AND STANDARD DEVIATIONS

Dependent Variable	Group: Experimental n=25 $\bar{X}$	Experimental n=25 S	Control n=24 $\bar{X}$	Control n=24 S
Mathematics Achievement	42.60	8.94	43.83	9.11
Achievement in Methods of Teaching Mathematics	13.20	3.85	12.58	2.59
Locus of Control	74.00	14.39	75.08	13.37
Attitude Toward Mathematics	37.60	9.39	36.88	9.97

TABLE VIII

PROPORTION OF VARIANCE OF THE FULL MODEL

Source	R^2 y.ABC
Mathematics Achievement	.48115
Achievement in Methods Teaching Mathematics	.30528 of
Locus of Control	.57517
Attitude Toward Mathematics	.64648

Results of evaluations of assumptions of normality, linearity, multicollinearity and homogeneity of regression were satisfactory for each regression analysis. Covariates were judged to be reliable for covariance analysis. The assumptions were tested using SPSS-X REGRESSION. The assumption of normality was tested by inspection of the plot of the standardized residual scores. The assumption of linearity was tested by inspection of the scatterplot of the data for each set of scores and the data fitted the linear model. Multicollinearity was tested by applying the Durbin-Watson Test.

The assumption of homogeneity of regression was tested at an alpha level of .20. Assumptions are tested at a higher alpha level to protect against a Type II error. At an alpha level of .20, the R^2 increase was not significant for any of the analysis of covariance procedures. The R^2 increase, the F ratio, and the significance of the F for each analysis of covariance are presented in Table IX. The slopes are therefore regarded as parallel for each procedure.

The common regression coefficient was analyzed and tested for significance. The test of the common regresion coefficient answers the question of whether the covariate is significantly related to the dependent variable. The test of the common regression coefficient is the test of the partial slope, that is, the slope of the dependent variable is regressed on the covariate controlling for the treatment variable. At the predetermined alpha level of .05, the common regression slopes were significant in each of the analyses. Table X presents the coefficient of the common regression slope for each analysis, the t-ratio and the signficance of the t-ratio.

As each common regression slope was found to be significant, the F ratio statistics related to the intercepts in the analyses were inspected for significance. Table XI, presents the pretest means, the posttest means on the dependent variables, and the adjusted posttest means. The change was inspected for each analysis to see if a meaningful proportion of variance was accounted for by separate intercepts.

The results of the ANCOVA of achievement in mathematics

TABLE IX

RESULTS OF TESTS FOR HOMOGENEITY OF REGRESSION

	R^2 Increase	F Change	Significance Level *
Mathematics Achievement	.00793	.88116	.3529*
Achievement in Methods of Teaching Mathematics	.00733	.47488	.4943*
Locus of Control	.00813	.87763	.3539*
Attitude Toward Mathematics	.00007	.01115	.9164*

* alpha = .20

TABLE X

RESULTS OF THE TEST OF THE
COMMON REGRESSION SLOPES

	Common Regression Coefficient	$\underline{t}$ ratio	Significance Level *
Mathematics Achievement	.758147	7.896	.0001*
Achievement in Methods of Teaching Mathematics	.307748	2.909	.0056*
Locus of Control	.740888	7.736	.0001*
Attitude Toward Mathematics	.812623	10.411	.0001*

* alpha = .05

TABLE XI

TABLE OF MEANS

Dependent Variable	Achievement in Mathematics		Achievement in Methods of Teaching Mathematics		Locus of Control		Attitude Toward Mathematics	
	C	E	C	E	C	E	C	E
PRETEST	43.83	42.6	12.58	13.2	75.08	74.0	36.88	37.6
POSTTEST	46.04	49.0	18.25	20.52	75.71	71.64	38.50	39.28
ADJUSTED POSTTEST	45.57	49.47	18.35	20.43	75.31	72.04	38.79	38.99

C Control Group (n=24)

E Experimental Group (n=25)

are presented in Table XII. These results indicate that there was no significant ($p > .0125$) difference between the adjusted means of the treatment groups. The effects of the treatment conditions on achievement in mathematics did not significantly ($p > .0125$) differ from each other, and therefore the first null hypothesis was not rejected.

The results of the ANCOVA of achievement in methods of teaching mathematics are reported in Table XIII. It is concluded that there was a significant ($p < .0125$) difference between the adjusted means of the treatment groups, and the effects of the treatment conditions on achievement in methods of teaching mathematics significantly ($p < .0125$) differed from each other. The graph of the pretest and unadjusted and adjusted posttest scores for both groups is presented in Figure 4. The experimental group scored significantly higher than the control group and therefore the second null hypothesis is rejected.

The results of the ANCOVA of locus of control in mathematics are presented in Table XIV. The results indicate that there was no significant ($p > .0125$) difference between the adjusted means of the treatment groups. The effect of the treatment conditions on locus of control for success in achievement in mathematics did not differ significantly from each other, and the third null hypothesis was not rejected.

The results of the ANCOVA of attitude toward mathematics are presented in Table XV. These results

TABLE XII

ANCOVA SUMMARY TABLE

ACHIEVEMENT IN MATHEMATICS

SOURCE	SS	DF	MS	F
COVARIATE	2198.75	1	2198.75	63.35*
TREATMENT (ADJUSTED)	184.71	1	184.71	5.24
RESIDUAL	1622.20	46	35.27	

* $p<.05$.

TABLE XIII

ANCOVA SUMMARY TABLE

ACHIEVEMENT IN METHODS OF
TEACHING MATHEMATICS

SOURCE	SS	DF	MS	F
COVARIATE	48.29	1	48.29	8.46*
TREATMENT (ADJUSTED)	52.51	1	52.51	9.20**
RESIDUAL	262.45	46	5.71	

* $p<.05$
** $p<.0125$

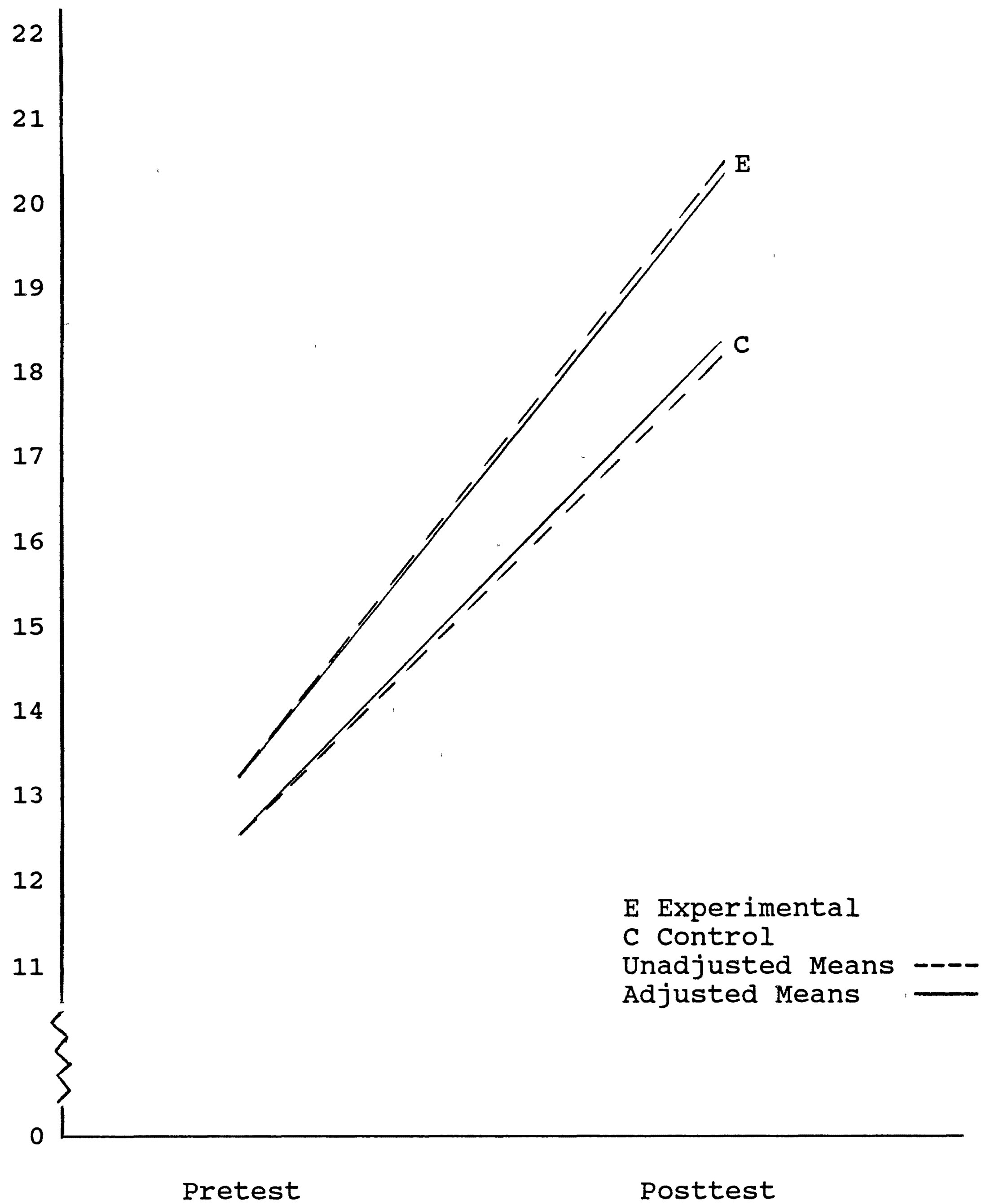

Figure 4. Group Means for the Pretest (Covariate) and Posttest Scores for Achievement in Methods of Teaching Mathematics.

TABLE XIV

ANCOVA SUMMARY TABLE

LOCUS OF CONTROL FOR SUCCESS
IN ACHIEVEMENT IN MATHEMATICS

SOURCE	SS	DF	MS	F
COVARIATE	4987.35	1	4987.35	59.85*
TREATMENT (ADJUSTED)	130.38	1	130.38	1.56
RESIDUAL	3833.37	46	83.33	

* $p < .05$

TABLE XV

ANCOVA SUMMARY TABLE

ATTITUDE TOWARD MATHEMATICS

SOURCE	SS	DF	MS	F
COVARIATE	2908.62	1	2908.62	108.39*
TREATMENT (ADJUSTED)	.45	1	.45	0.02
RESIDUAL	1234.42	46	26.84	

* $p<.05$

indicate that there was no significant ($p>.0125$) difference between the adjusted means of the treatment groups. The effects of the treatment conditions on attitude toward mathematics did not significantly differ from each other, and therefore the fourth null hypothesis was not rejected.

Summary

Four analyses of covariance were calculated to examine the differences between the two groups with regards to achievement in mathematics, achievement in methods of teaching mathematics, internal locus of control for success in achievement in mathematics, and attitude toward mathematics. The results presented in this chapter indicate there was a significant ($p<.0125$) difference between the groups achievement in methods of teaching mathematics at the .0125 level of significance. Furthermore, no significant ($p>.0125$) differences between the groups for achievement in mathematics, internal locus of control for success in achievement in mathematics, nor attitude toward mathematics were identified.

These results are discussed further in Chapter V. Also in Chapter V, the conclusions from the study, implications, and recommendations for further study are reported.

CHAPTER V

SUMMARY OF RESEARCH METHODS, DISCUSSION OF RESULTS, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

Overview

A summary of the research methods, a discussion of the results, and conclusions are presented in Chapter V. Recommendations for further study, and a summary are given at the conclusion of the chapter.

Providing preservice elementary teachers with the skills needed for the implementation of cooperative group learning methods in mathematics is essential if the goals of the _Curriculum and Evaluation Standards for School Mathematics_ (NCTM, 1989) are to be achieved. As Bandura (1977) has demonstrated, modeling is a powerful form of human learning Therefore providing the preservice elementary teachers with a model for coopertive group learning in mathematics is an effective way to help them to learn the skills needed for implementing the method in their own classroom.

The purpose of the study was to examine the effects of cooperative group learning on the achievement in mathematics, achievement in methods of teaching mathematics, locus of control for success in achievement in mathematics, and attitude toward mathematics, of preservice elementary education students in a mathematics methods class.

The research hypotheses, stated in the null form, follow:

(1) The type of treatment group does not significantly affect achievement in mathematics as measured by the Tests of Achievement in Basic Skills (TABS) Level C, Form 1.

(2) The type of treatment group does not significantly affect achievement on methods of teaching mathematics as measured by the Methods of Teaching Mathematics Test.

(3) The type of treatment group does not significantly affect internal locus of control for success in achievement in mathematics as measured by the Hickey's Locus of Control in Mathematics Test.

(4) The type of treatment group does not significantly affect attitude toward mathematics as measured by the Confidence in Learning Mathematics Scale, a subscale of the Fennema-Sherman Mathematics Attitude Scales.

The statement of the problem indicated that if preservice elementary teachers were taught by a cooperative group learning method instead of a traditional lecture method they would acquire as much knowledge as by the traditional method, improve their interpersonal skills, and have a model to use in the elementary classroom.

Summary of Research Methods

A pilot study was conducted in the summer of 1988. The pilot study lasted for one week. The subjects were twenty-four preservice elementary education students enrolled in a mathematics methods class for intermediate grades, the same class used in the experimental study. The pilot study provided information in the areas of testing conditions, length of testing periods, and clarity of directions for both the experimental and control condition. In addition, some of the cooperative group activities were used in order to assess the degree of cooperation needed to complete the activity.

The design of the study was a quasi-experimental, non-equivalent control group design. Intact groups of preservice elementary teachers enrolled in a mathematics methods class were randomly assigned to either a traditional method group or a cooperative learning group. The traditional group was the control group and the cooperative learning group was th experimental group. There were forty-nine subjects in the experiment which lasted for an experimental period of eleve weeks. In addition there were four testing periods, two fo the pretests and two for the posttests. Pretest and posttest scores were obtained for all subjects on each of four tests the Tests of Achievement in Basic Skills (TABS) Level C, Form 1, the Methods of Teaching Mathematics Test, the Hickey's Locus of Control in Mathematics Test, and the Confidence in Learning Mathematics Scale, a subscale of the Fennema-Sherman Mathematics Attitude Scales.

In order to improve the research base on cooperative group learning the author incorporated several suggestions from the review of the literature into the research design. These include group rewards for group tasks, individual accountability, group tests, stable group assignments, one group presentation, and time for group assignments in class (Feichtner and Davis, 1984-85; Johnson and Johnson, 1987; Slavin 1990). The four dependent variable measures were selected to assess the treatment effects.

Discussion of the Results

Analysis of covariance (ANCOVA) was chosen as the statistical procedure for analysis of the data. Four analyses of covariance procedures were performed, one for each of the measures. The pretest of each dependent measure was used as the covariate. Table XI shows the observed and adjusted means for the four dependent measures. A significant effect at the .0125 level was found for achievement in methods of teaching mathematics. None of the other tests were significant at the .0125 level. The results are discussed in terms of the four measures subjected to statistical analysis and their relationship to the review of the literature in Chapter II.

Achievement in Mathematics Results

The analysis of covariance did not indicate a statistical difference between the groups at the .0125 level. However, the .0125 level is a conservative test. The actual significance level for this test was .0267, with the cooperative learning group scoring higher than the traditional method group. The test used to measure achievement in mathematics was the Tests of Achievement in Basic Skills (TABS) Level C, Form 1. The subskills tested by this test were arithmetic skills, geometry measurement and application, and modern concepts. An examination of the means indicates that the experimental group increased their scores from the pretest ($\bar{X}$ = 42.60) to the posttest ($\bar{X}$ = 49.00). The control group also increased their scores from the pretest ($\bar{X}$ = 43.83) to the posttest ($\bar{X}$ = 46.04). The result is consistent with the research literature on achievement for cooperative group learning at the college level. The differences between the groups did not reach statistical significance but the cooperative group did score higher.

Achievement in Methods of Teaching Mathematics

A significant difference between the achievement scores for the two groups was indicated by the analysis of covariance at the .0125 level. The cooperative learning group scored significantly higher than the group taught by the traditional method after adjustment of the posttest scores for pretest differences. As the Methods of Teaching Mathematics Test was based on the actual material studied in the class for the eleven weeks of the experimental period this is an important result. Preservice elementary teachers taught by the cooperative group learning method significantly increased their scores over preservice elementary teachers taught by the traditional method. Noddings (1989) suggested that this improvement in mathematical understanding might be the most important gain of preservice elementary teachers taught by the cooperative group method. An examination the means indicates that the experimental group increased scores from the pretest ($\bar{X}$ = 13.20) to the posttest ($\bar{X}$ = 20.52). The control group also increased their scores from the pretest ($\bar{X}$ = 12.58) to the posttest ($\bar{X}$ = 18.25).

Locus of Control for Success in Achievement in Mathematics

There were no significant differences between the two groups on the Hickey's Locus of Control in Mathematics Test at the .0125 level. An examination of the means indicates that the experimental group decreased their scores from the pretest ($\bar{X}$ = 74.00) to the posttest ($\bar{X}$ = 71.64). In contrast, the control group increased their scores from the pretest ($\bar{X}$ = 75.08) to the posttest ($\bar{X}$ = 75.71). A lower score on the Hickey's Locus of Control in Mathematics Test indicates that the subject is more internal. The experiemental group therefore became more internal over the experiemntal period whereas the control group became slightly more external. There is still debate over the desired internality of teachers. Janzen, Beeken, and Hritzuk (1973) indicated that teachers classified as internal are in fact more controlling than teachers classified as external.

Attitude Toward Mathematics

The two groups did not differ significantly on the Confidence in Learning Mathematics Scale at the .0125 level. An examination of the means indicates that the experimental group increased their scores from the pretest ($\overline{X}$ = 37.60) to the posttest ($\overline{X}$ = 39.28). The control group also increased their scores from the pretest ($\overline{X}$ = 36.88) to the posttest ($\overline{X}$ = 38.50). This indicates that both groups showed slight gains on the Confidence in Learning Mathematics Scale. It is probable that an eleven week period is not a long enough amount of time for the effects of the cooperative group learning method to significantly affect the attitudes of adults toward mathematics. These students have developed their attitude toward mathematics over a fifteen year period. The literature on cooperative group learning does indicate that the attitude of elementary-age children toward mathematics is significantly and positively affected by cooperative group learning methods (Slavin, 1990).

Conclusions

The importance of the cooperative group learning method for preservice elementary teachers is evident when one examines the Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989). To ensure the implementation of the recommendations of this document, preservice elementary teachers need to be introduced to cooperative group methods in their professional education courses. Being taught by such methods might have a stronger impact than being told about them, according to Bandura's (1977) modeling theory.

The results of this study did indicate a significant difference in the methods of teaching mathematics achievement scores for the experimental group, but there were no significant differences for achievement in mathematics, locus of control for success in achievement in mathematics, nor attitude toward mathematics. The mean scores for achievement in mathematics, achievement in methods of teaching mathematics, and attitude toward mathematics increased for both groups from the pretest to the posttest. The locus of control for success in achievement in mathematics decreased for the experiemental group but increased slightly for the control group, where a decrease indicates a more internal score. It is therefore possible to conclude from this study that cooperative group learning for preservice elementary teachers in a mathematics methods class did not adversely affect achievement in mathematics, locus of control for success in achievement in mathematics, or attitude toward mathematics, and did significantly and positively affect achievement in methods of teaching mathematics.

The literature supports the use of cooperative group learning for elementary-age children. It is only by providing teachers with the skills to implement this method that cooperative group learning will become more widely used as a teaching strategy.

Recommendations

Recommendations for further research include investigating the effects of treatment with a larger sample. A larger sample would increase the power of the of the study. However, at the college level it is difficult to obtain large samples in methods classes at one university in one subject area. To obtain large samples, researchers at more than on university might work together in one subject area, or researchers in the same university but across subject areas might conduct an interdisciplinary research study.

The author further recommends that a more reliable measure to assess achievement in methods of teaching mathematics be developed. In addition, the use of a reliable measure to assess the attitude of preservice elementary teachers toward the teaching of mathematics would be important. Such an instrument would provide additional information concerning the attitude of preservice elementary teachers toward mathematics. A comparison of the attitude of the preservice elementary teachers toward learning mathematics as opposed to teaching mathematics would be helpful. It is possible that the preservice elementary teachers feel more confident in their ability to learn mathematics than to teach it.

A longitudinal study, documenting the teaching strategies of preservice elementary teachers taught mathematics methods for elementary grades either by the cooperative group learning method or the traditional method, is needed. Such a study would indicate whether those who had been taught by the cooperative group learning method implemented cooperative group learning in their elementary classrooms more than those who had been taught by the traditional method.

The author would like to emphasize that the non-significant results of the effects of cooperative group learning on achievement in mathematics, locus of control for success in achievement in mathematics, and attitude toward mathematics should not be considered proof of the lack of viability of the treatment on these constructs. Improvements in research design might well produce different results.

Summary

This study was designed to determine if cooperative group learning would significantly and positively affect the mathematics achievement, achievement in methods of teaching mathematics, locus of control for success in achievement in mathematics, and attitude toward mathematics, of preservice elementary teachers in a mathematics methods class. Significant and positive results were found for only one of these measures, achievement in methods of teaching mathematics. However, as both the experimental and control group increased their scores, the cooperative group method appears to be a viable alternative to the traditional lecture method for preservice elementary education teachers in mathematics methods classes.

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APPENDIXES

APPENDIX A

COURSE SYLLABUS, LIST OF TOPICS, AND MATERIALS USED BY BOTH TREATMENT GROUPS

COURSE SYLLABUS

Curriculum and Instruction 4142
Teaching Math -- Intermediate Level

Date	Topics	Study
Aug 23	Course Description and Requirements Pretests	
Aug 30	Pretests	
Sept 6	Algorithms for Multiplication and Division	137-45,152-5
13	Skills for Probability and Graphing	231-4,238-250
20	Developing and Practicing Measurement Skills	291-2,298-326
	Teaching Geometry	253-6,264-87
27	Organizing for Math Instruction	Chapter 11
	Estimation	145-9,177-80, 219-21,244-5
Oct 4	Developing Concepts of Rational Numbers	157-77,181-4
18	Developing Algorithms for Addition and Subtraction of Common Fractions	187-90,194-6 213-15
25	Developing Algorithms for Multiplication and Division of Common Fractions	198-201, 204-8,216-17
Nov 1	Developing Algorithms for Decimals	191-218
	Developing Algorithms for Percent	166-7,176-7, 203-4,218-19
8	Integers	
15	Introducing Algebra	
22	Problem Solving	149-52,180-1 221-2,245-7
29	Exam I	
Dec 6	Posttests	
13	Posttests	

Notes:
1. All assignments are from "Teaching Mathematics to Elementary School Children", Cruikshank and Sheffield.
2. For out-of-class assignments see assignment sheet.

Cooperative Learning Group

OUT-OF-CLASS ASSIGNMENTS

Curriculum and Instruction 4142
Teaching Math -- Intermediate Level

I. GAME:
Prepare a game to be used in an Elementary School Classroom for grades 4-7. The instructions should be clear and of an appropriate reading level. The mathematical content should be valid.
CRITERIA: accuracy, suitability
SCORE: 0 OR 10

II. EVALUATION OF SOFTWARE:
Use the NCTM Software Evaluation Checklist to evaluate one computer program form the list provided. You will need to reserve a computer in 305A Gundersen and secure the program of your choice from 203 Gundersen. Run the program. Complete the checklist.
CRITERIA: completeness and accuracy (on non-judgemental items).
SCORE: 0-20

III. SURVEY TEST:
Administer a survey test to one child, grade 4-7. Make a record of your findings and interpret the results. A copy of the test will be provided.
CRITERIA: insights gained and congruence of data and observations.
SCORE: 0-50

IV. PRESENTATION: GROUP ACTIVITY
Part I: prepare a presentation on a topic selected from the topic list. The presentation will last about 30 minutes. You will need to provide information on the topic and activities for the class.
CRITERIA: adequacy of activities, clarity of presentation, accuracy of information.
SCORE: 0-100

Part II: prepare a group paper to be submitted at the time of the presentation, with references. The paper should be approximately 8 typewritten, double-spaced, pages.
CRITERIA: content, mechanics of composition.
SCORE: 0-50

V. LEARNING CENTER: GROUP ACTIVITY

Create a learning center on a topic selected from the topic list. You must make two demonstration devices to introduce your learning center and them use them in it. You must have four other manipulative devices in your learning center. You will need a minimum of one task card to accompany each manipulative device.

CRITERIA: suitability of center, appropriateness of task cards.

SCORE: 0-60

LIST OF TOPICS AND MATERIALS

1. Algorithms for Multiplication and Division

   Materials: Numeration Blocks
   Money

2. Skills for Probability and Graphing

   Materials: Ice Cream Cones
   Cubical Blocks
   Colored Squares
   Marbles
   Measuring Tools (Linear)

3. Developing and Practicing Measurement Skills:

   Materials: Measuring Tools (Linear)
   Scales
   File Cards
   Cubical Blocks
   Clocks

4. Teaching Geometry

   Materials: Pattern Blocks
   Tangrams
   Paper (for folding)
   Protractors
   Colored Squares
   Geoboards

5. Organizing for Math Instruction

6. Estimation

   Materials: Marbles
   Popcorn
   Measuring Tools (Linear)

7. Developing Concepts of Rational Numbers

   Materials: Circular Fraction Pieces
   Fraction Strips
   Numeration Blocks
   Cuisenaire Rods
   Pattern Blocks

8. Developing Algorithms for Addition and Subtraction of Common Fractions

   Materials: Circular Fraction Pieces
   Fraction Strips
   Cuisenaire Rods
   Pattern Blocks
   Tangrams

9. Developing Algorithms for Multiplication and Division of Common Fractions

   Materials: Paper (for folding)
   Cuisenaire Rods
   Number Lines
   Discs
   Circular Fraction Pieces

10. Developing Algorithms for Decimals

    Materials: Numeration Blocks
    100 square paper
    Abacus
    Pocket Chart

11. Developing Algorithms for Percents

    Materials: 100 square paper

12. Evaluating Learning

13. Integers

    Materials: Chequers
    Number Line

14. Introducing Algebra

    Materials: Algebra Tiles

15. Problem Solving

    Materials: Cans (different sizes)
    Colored Tiles

APPENDIX B

SAMPLE COOPERATIVE GROUP ACTIVITY

Group Activity

Topic: Multiplication of Common Fractions

Materials needed:

Paper
Cuisenaire Rods
Number Line
Discs
Fraction Circles

Activities:

1. Model each of the problems listed below with each of the materials on your list.
2. Draw a picture of the model and the operation.
3. Come to a group concensus and state which model you think is the best one to use for each problem, and why.
4. Is there one model (or more) that can be used to illustrate all of the problems?

Problems:

1. The school track is 3/8 miles around. Sandy is on the track team, and she has run around the track three times in practice. How far has Sandy run?

2. How many eggs are in 2/3 of a dozen?

3. Steve is planting a rectangular garden. He wants 1/3 of his garden to be flowers. Steve likes roses, so 1/2 of his flowers will be roses. What part of the total garden will be roses?

4. Fred sees 3/4 of a pie on the counter. He is starving, so he eats 1/2 of the 3/4 of a pie. How much of the whole pie does Fred eat?

5. Rachel is building a scale model of a toy tower. The original tower is 1/2 of a foot tall. Rachel wants her tower to be 1/2 of that height. How tall should Rachel build her tower?

6. Brian is making punch. His recipe will serve three people, but Brian needs to serve only two, so he has decided to make 2/3 of the recipe. The recipe calls for 1/2 cup of sugar. Brian needs to know how much sugar to use for 2/3 of the recipe.

7. Raul is looking at a scale drawing of a flower. The scale says the actual flower is 2 1/2 times as large as the drawing. Raul measures the flower in the drawing and sees it is 1 3/4 inches long. How long is the actual flower?

All problems are from the course text "Teaching Mathematics to Elementary School Children", Cruickshank and Sheffield.

APPENDIX C

SAMPLE ITEMS FROM ACHIEVEMENT MEASURES

SAMPLE ITEMS FROM TABS

Part 1: Arithmetic Skills

1. Add

   8,943 + 6,891 + 4,834

   A 20,568
   B 20,678
   C 20,668
   D 21,668

3. Multiply

   958
   x705

   A 672,290
   B 674,390
   C 675,390
   D 775,290

5. Combine

   -11 -13 -16

   A -50
   B -40
   C +40
   D +50

7. Subtract

   (-38) - (-16)

   A -54
   B -22
   C +22
   D +54

11. Reduce to lowest terms

    $\frac{2\ 1/2}{3\ 1/2}$

    A 2/7
    B 2/5
    C 1/2
    D 5/7

15. Which of the following are whole numbers?

    {.7, 3/8, -4, 5, 0, 1/4}

    A {.7, -4, 5}
    B {.7, 3/8, 1/4}
    C {5, 0}
    D {-4, 5, 0}

19. Add

2 1/2 + 3 2/3

A 5 1/3
B 5 3/5
C 6 1/6
D 6 1/3

26. Divide

.93)5.859

A .063
B .63
C 6.3
D 63

27. What is 21% of 67?

A .003
B 14.07
C 19.8
D 319.05

31. A fraction is

A a rational number
B an irrational number
C a whole number
D a complex number

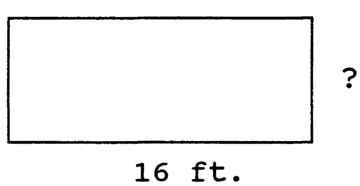
33. Combine

2a -7b +3a +b

A 5a -6b
B -a -6b
C -a +6b
D 5a +8b

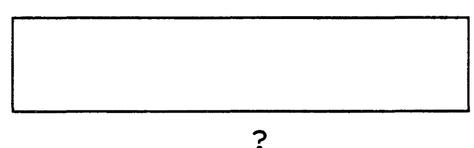
Part 2: Geometry - Measurement - Application

38. The perimeter of this rectangle if 50 ft. What is the width?



A 8 ft.
B 9 ft.
C 10 ft.
D 16 ft.

40. The area of the following figure is 152 square feet. What is its length?



A 9 1/2 sq. ft.
B 19 ft.
C 19 sq. ft.
D 64 ft.

46. What is the sum of 4 feet, 8 inches and 9 feet, 11 inches?

A 13 ft. 3 in.
B 13 ft. 7 in.
C 14 ft. 7 in.
D 15 ft. 3 in.

47. A 16 ounce package of cereal is sold for 18 cents. 2 1/2 pounds of the cereal costs how much?

A 40 cents
B 45 cents
C 60 cents
D 90 cents

Part 3: Modern Concepts

50. Predict the next numbers in the sequence 1, 2, 4, 7, __, __, __ .

A 10, 13, 16
B 10, 14, 19
C 11, 16, 21
D 11, 16, 22

53. Given two sets:
A: {1, 2, 3, 4, 5} and
B: {4, 5, 6, 7, 8}
A intersect B is the subset:

A {1, 2, 3, 4, 5, 6, 7, 8}
B {1, 2, 3}
C {4, 5}
D {6, 7, 8}

61. a(b+c) =ab + bc is an example of

associative property
B closure property
C distributive property
D commutative property

63. A prime number

A has factors of only A one and itself
B is always odd
C is always even
D is none of the above

SAMPLE ITEMS FROM THE METHODS OF TEACHING MATHEMATICS TEST

1. For the number 135, what level of exemplification is described below?

   The number 135 is exemplified with base 10 blocks, using 1 flat, 3 longs and 5 ones.

   A. concrete
   B. semi-concrete
   C. semi-abstract
   D. abstract

3. In which order should these models for the number 25 be presented?

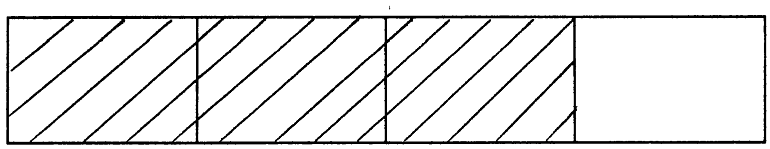
   (a) the written number for 25, (b) twenty-five pencils, (c) twenty-five tally marks, (d) drawings of twenty-five pencils.

   A. b - a - d - c
   B. b - d - c - a
   C. a - d - b - c
   D. a - b - d - c

6. The subtractive algorithm for subtraction is closely related to what action on objects?

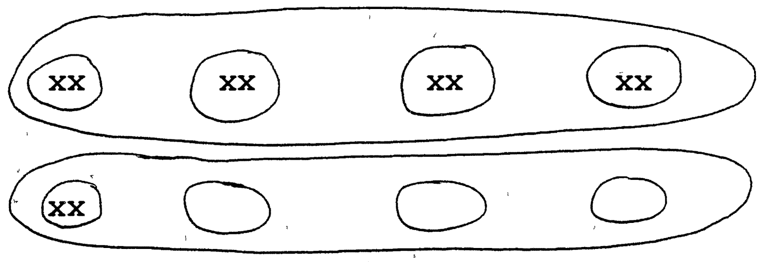
   A. Removing sets of objects from a superset until none is left.
   B. Separating a set into a given number of subsets.
   C. Finding the complements of sets of objects.
   D. Making many-to-one matchings.

9. What interpretation of 3/4 is modeled in this drawing?



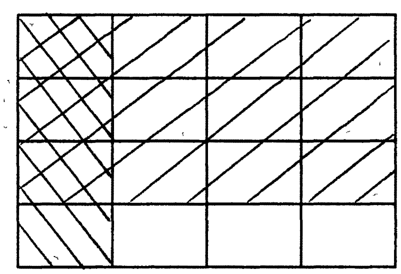
   A. Indicated division
   B. Ratio or rate pair
   C. One or more parts of one or more sets
   D. One or more parts of one or more units

10. What interpretation of 5/4 is embedded in this drawing?



A. One or more parts of one or more sets
B. One or more parts of one or more units
C. Ratio or rate pair
D. Indicated division

13. What mathematical sentence is modeled in this drawing?



A. $\frac{3}{4} + \frac{1}{4} =$

B. $\frac{3}{4} - \frac{1}{2} =$

C. $\frac{3}{4} \times \frac{1}{4} =$

D. $\frac{3}{4} - \frac{1}{4} =$

14. Which procedure for dividing fractions is easiest to explain?

A. Common denominator
B. Invert and multiply
C. Part-part-whole
D. Whole number

15. What would be the proper sequencing of activities for teaching measurement of capacity:

    (a) count the number of cups of styrofoam bits to fill a container, (b) pour styrofoam bits from a container of unknown capacity into a graduated container, (c) pour styrofoam bits from one container of unknown capacity into another of unknown capacity, and (d) find the volume and then divide by an appropriate constant.

    A. a - c - d - b
    B. b - a - c - d
    C. c - a - b - d
    D. d - c - b - a

19. Which of the following is a suitable introductory activity for introducing perimeter?

    A. Measure the four sides of a square then add the four measures together.
    B. Measure the distance all around the top of the desk.
    C. Using the formula P = 4s, find the perimeter of each of the squares on the worksheet.
    D. Measure the distance all the way around the football field. Write your answer down. Now measure each side separately and write down the length of each side. Add to find the total. What do you observe about your two answers?

20. How do children initially establish the congruence of two plane figures?

    A. By placing a tracing of one on the other.
    B. By determining whether they have the same kind of symmetries.
    C. By visually contrasting the figures to establish a Gestaltic impression of each.
    D. By measuring corresponding parts.

21. What is usually the first task for children in organizing a set of data?

    A. Showing how frequently each occurred.
    B. Finding a measure of central tendency.
    C. Deciding what kind of graph to use.
    D. Ordering the data.

28. What kind of problem is most commonly found in elementary school textbooks?

A. Non-routine problems
B. Verbal problems
C. Applications
D. Ordering

29. What is the major difficulty children have in solving verbal problems?

A. Knowing the order of the operations.
B. Poor reading ability.
C. Lack of computational skill.
D. Deciding which operation to use.

APPENDIX D

AFFECTIVE MEASURES

(HICKEY'S LOCUS OF CONTROL INSTRUMENT FOR MATHEMATICS)

DIRECTIONS

MATHEMATICS ATTITUDE SCALE

On the following pages is a series of statements. There are no correct answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed.

Statement No.1 No matter how hard I study I can't do as well as I should in math.

As you read the statement, you will know whether you agree or disagree. If you strongly agree, blacken A opposite Number 1 on your answer sheet. If you agree but with reservations, that is, you do not fully agree, blacken B. If you do disagree with the idea, indicate the extent to which you disagree by blackening D for disagree or E if you strongly disagree. But if you neither agree nor disagree, that is, you are not certain, blacken C for undecided. Also, if you cannot answer a question, blacken C. Now mark your answer sheet. Do the same for statement No. 2.

Statement No.2 What makes math fun to learn is that so many ideas fit together.

Do not spend much time with any statement, but be sure to answer every statement. Work fast but carefully.

There are no "right" or "wrong" answers. The only correct responses are those that are true for you. Whenever possible, let the things that have happened to you help you make a choice. Do not mark on the booklet.

THIS INVENTORY IS BEING USED FOR DATA COLLECTION ONLY AND NO ONE WILL KNOW WHAT YOUR RESPONSES ARE.

MATHEMATICS ATTITUDE SCALE

DIRECTIONS

On the following pages is a series of statements. There are no correct answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. For example Statement No. 1 reads:

1. No matter how hard I study I can't do as well as I should in math.

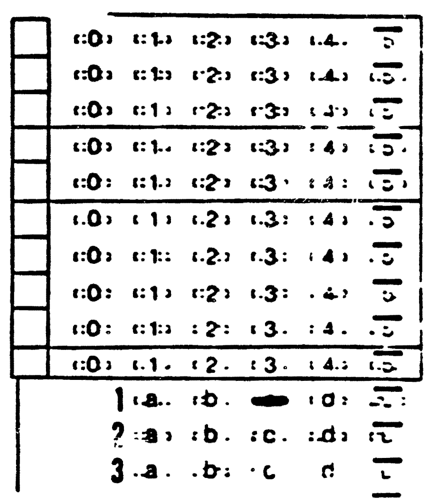
On your answer sheet if you strongly agree blacken a opposite No. 1;

if you agree but with reservations blacken b;

if you disagree with the idea blacken d;

if you strongly disagree with the idea blacken e;

and if you are not certain, undecided, or cannot answer the question blacken c.



The example has been marked c for not certain. Now mark your response on your answer sheet for No. 1. If you have any questions ask the teacher now.

Do not spend much time with any statement, but be sure to answer every statement. Work fast but carefully.

There are no "right" or "wrong" answers. The only correct responses are those that are true for you. Whenever possible, let the things that have happened to you help you make a choice. Do not mark on the test.

THIS INVENTORY IS BEING USED FOR DATA COLLECTION ONLY AND NO ONE WILL KNOW WHAT YOU RESPONSES ARE.

1. No matter how hard I study I can't do as well as I should in math.

2. What makes math fun to learn is that so many ideas fit together.

3. If I have trouble understanding something in math class it is usually because I didn't listen carefully.

4. If I find it hard to work math problems it is usually because I didn't study well enough before I tried them.

5. There is no connection between how hard I study mathematics and the grades I make.

6. There are lots of math problems I could never work no matter how hard I tried.

7. Math is a bunch of unrelated facts I always have to memorize.

8. After taking a math test I usually know how well I've done.

9. I can work most of my math assignments after listening carefully in class.

10. I believe I can work almost any math problem by working hard enough.

11. Now knowing how to begin a math problem is always happening to me.

12. If I find it hard to work math problems it is usually because the problems are too hard.

13. About the only time I do really well on a math test is when the test is easy.

14. My teachers often give math problems that are unreasonably hard.

15. There is a direct connection between how hard I study math and the grades I get.

16. If I work hard enough I can usually make the grade I want in a math class.

17. Many times math exam questions tend to be so unrelated to course work that studying is really useless.

18. I really prefer to work math problems before I look at the answers.

19. When I learn something quickly in math class it is usually because I paid close attention.

20. If I encounter an especially difficult math problem my first impulse is to ask for help.

21. I usually know how to start working my math assignments.

22. If I encounter a math problem that I can't work quickly I don't want anyone telling me how to work it until I've tried several times to do it myself.

23. If a student is really well prepared there is rarely if ever any such thing as an unfair math test.

24. When a question is left unanswered in a math class, I usually think about it afterward.

25. The challenge of math problems does not appeal to me.*

26. Once I start trying to work on a math puzzle, I think about it off and on until I get the solution.

27. If I have trouble understanding something in math class it is usually because the teacher didn't explain it very well.

* This item is form Effectance Motivation in Mathematics Scale, FennemaSherman Mathematics Attitudes Scales.

ATTITUDE SURVEY

Select one of the response choices given at the right of each question. The response should describe how you agree with the statement.

SA Strongly Agree
A Agree
N Neutral
D Disagree
SD Strongly Disagree

		SA	A	N	D	SD
1.	I have a lot of self-confidence when it comes to math.	___	___	___	___	___
2.	Most subjects I can handle O.K., but I have a knack for flubbing up math.	___	___	___	___	___
3.	For some reason, even though I study, math seems unusually hard for me.	___	___	___	___	___
4.	Math has been my worst subject.	___	___	___	___	___
5.	Generally I have felt secure	___	___	___	___	___
6.	I'm no good at math.	___	___	___	___	___
7.	I'm sure I could do advanced work in math.	___	___	___	___	___
8.	I'm not the type to do well in math.	___	___	___	___	___
9.	I think I could handle more difficult mathematics.	___	___	___	___	___
10.	I don't think I could do advanced math.	___	___	___	___	___
11.	I can get good grades in math.	___	___	___	___	___
12.	I am sure that I can learn math.	___	___	___	___	___

APPENDIX E

RAW DATA

RAW DATA

Subject No.	Group No.	Achievement in Mathematics Scores (TABS)		Methods of Teaching Mathematics Scores		Locus of Control Scores		Attitude Toward Mathematics Scores	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	C	47	48	15	18	057	059	49	55
2	C	46	51	12	18	077	072	38	40
3	C	26	16	13	14	098	073	30	43
4	C	27	20	09	17	073	077	38	31
5	C	42	51	15	18	086	084	20	24
6	C	47	51	14	22	091	095	25	26
7	C	50	41	10	20	089	090	29	30
8	C	34	50	09	19	080	086	32	34
9	C	46	52	10	17	084	072	28	46
10	C	54	58	16	24	097	098	32	27
11	C	49	57	15	17	066	062	44	46
12	C	59	59	12	17	069	066	49	50
13	C	50	43	10	16	072	067	31	34
14	C	33	41	14	14	071	082	28	29
15	C	48	47	11	20	082	074	33	36
16	C	44	51	19	22	046	056	58	53
17	C	41	42	10	18	064	068	50	53
18	C	49	52	15	20	064	072	35	39
19	C	47	51	13	23	065	061	50	49
20	C	54	50	09	12	062	066	50	51
21	C	40	51	14	16	080	082	35	30
22	C	39	31	13	15	088	089	32	36
23	C	54	50	13	21	058	082	43	35
24	C	26	42	11	20	083	084	26	27

RAW DATA (continued)

Subject No.	Group No.	Achievement in Mathematics Scores (TABS)		Methods of Teaching Mathematics Scores		Locus of Control Scores		Attitude Toward Mathematics Scores	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post
25	E	53	55	06	20	060	057	49	38
26	E	40	40	08	21	072	067	44	53
27	E	34	35	10	20	092	090	25	26
28	E	47	55	08	20	093	086	23	35
29	E	41	48	14	19	069	079	33	39
30	E	52	52	15	22	069	077	31	28
31	E	47	53	13	18	047	036	52	53
32	E	50	52	08	18	067	059	48	46
33	E	39	50	12	23	075	073	44	44
34	E	31	43	19	23	091	076	30	37
35	E	30	41	11	19	070	074	37	44
36	E	46	50	17	18	071	050	39	44
37	E	23	33	22	25	106	100	30	30
38	E	33	54	13	21	091	086	27	29
39	E	47	59	15	25	077	047	44	53
40	E	58	58	18	20	048	052	54	55
41	E	52	54	10	20	080	078	37	39
42	E	50	56	15	23	077	078	36	37
43	E	31	41	11	18	077	088	28	28
44	E	39	45	12	20	081	073	27	32
45	E	37	44	17	22	060	065	39	41
46	E	53	57	15	21	059	057	45	45
47	E	50	54	11	18	081	088	27	27
48	E	42	49	16	20	081	081	38	32
49	E	40	47	14	19	056	074	53	47

VITA

Lorraine Day Jimison

Candidate for the Degree of

Doctor of Education

Thesis: A STUDY TO INVESTIGATE THE EFFECT OF COOPERATIVE GROUP LEARNING ON SELECTED COGNITIVE AND AFFECTIVE OUTCOMES FOR PRESERVICE ELEMENTARY TEACHERS IN A MATHEMATICS METHODS CLASS

Major Field: Curriculum and Instruction

Minor Field: Elementary Education

Biographical:

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