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Effects of Cooperative Learning Versus Direct Instruction and Independent Practice in a First Grade Mathematics Classroom

Andrea Wieringa

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Document Type
Thesis

Degree Name
Master of Education (MEd)

Department
Graduate Education

First Advisor
Dennis Vander Plaats

Keywords
Master of Education, thesis, Christian education, Sioux Center Christian School, elementary education, direct instruction, cooperative groups

Subject Categories
Curriculum and Instruction | Education

Comments
Action Research Report Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Education
The Effects of Cooperative Learning Versus Direct Instruction and Independent Practice in a First Grade Mathematics Classroom

by

Andrea Wieringa

B.A. Dordt College, 1993

Action Research Report
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Department of Education
Dordt College
Sioux Center, Iowa
March, 1998
The Effects of Cooperative Learning
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Acknowledgments

I would like to thank Dennis VanderPlaats for his assistance as my faculty advisor and to Ken Bussema for teaching me the research process. Thank you also to Jack Fennema for his work as Director of Graduate Education at Dordt College and for his input on this research project. A special thank you to Rick Eigenbrood for spending many hours helping me to analyze data and revise this paper. Each of you has been very helpful, and I appreciate your time and expertise.

Finally, thank you to Rebecca VanderWerf who helped perform the study, to the parents of the students who took part in the study, and to my husband, Harold, for encouraging me throughout this project.
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Abstract

This study investigated the effectiveness of cooperative learning versus direct instruction and individual practice in a first grade classroom when learning concepts about time. One classroom of 21 was divided into groups of three and worked and learned in cooperative groups. The other class of 21 was taught using direct instruction, and students completed assignments independently. An analysis of the post-test suggested that the cooperative group scored higher than the direct instruction group, although only two of the five sections of the test were significantly higher.
The issue of effective schools and teaching is of great concern in the United States today. During the past twenty years educators and researchers have been investigating a variety of curricular and instructional approaches. Much of this research indicates that cooperative learning methods using small groups of students contribute significantly to student achievement at all grade levels, in different geographical locations, and in different subject areas. (Slavin, 1981, 1983, 1991; Jones & Steinbrink, 1989; Stevens, Slavin, Farnish & Maddin, 1993; Kagan, 1994; Nattive, 1994; Baris-Sanders, 1997; Shaw, Chambless, Chessin, Price, & Beardin, 1997).

However, most research in cooperative learning has focused on certain limited concepts, subjects, and grade levels.

Cooperative learning refers to a set of instructional methods that include over 80 strategies in which students work in small, mixed-ability learning groups toward a mutual goal (Slavin, 1987, 1989/1990, 1991; Behounek, Rosenbaum, Brown & Burcalow, 1988; Jones & Steinbrink, 1989: Manning &Lucking, 1991; Nattive, 1994). The students in each group are individually responsible not only for learning the material being taught in class, but also for helping their groupmates learn. Several studies have indicated that cooperative learning motivates students to help one another learn (Slavin, 1982, 1987; Buckmaster, 1994, Cavalier, Klein, & Cavalier, 1995; Mulryan, 1995). Slavin (1987) states that students are often able to translate the teacher's language into "kid language" for one another, thus helping students who did not grasp fully a concept the teacher has presented. Cooperative learning also is beneficial for the students who are explaining concepts to their peers, because they have to organize their thoughts which enhances their own understanding of a concept (Dansereau, 1985; Slavin, 1987; Yackel, Cobb and Wood, 1991; Mulryan, 1992; Shaw
et al., 1997). Although studies such as those above have found that cooperative learning has positive effects on achievement, other research studies have also suggested that achievement effects do not result from all forms of cooperative learning (Slavin, 1988, 1989/1990; Manning and Lucking, 1991). Cooperative learning methods that produce positive academic achievement share two features. First, the cooperative groups have group goals and must work interdependently to earn teacher recognition or other forms of success. The second feature is individual accountability, which means that group success depends on individual learning and contributions of all group members (Slavin, 1988, 1989/1990, 1991; Manning & Lucking, 1991). Individual practice generally refers to students completing assignments and learning concepts independently with help solely from the teacher.

As was mentioned above, cooperative learning has proven to be a beneficial instructional procedure in many different subject areas. Much research has been done on the effectiveness of cooperative learning in the subject area of mathematics. In particular, studies have been conducted on cooperative learning concerning problem solving skills, such as word or story problems, in mathematics (Rosenbaum, Behovnek, Brown, & Burcalow, 1989; McGlinn, 1991; Duren & Cherryiton, 1992; Shaw et al., 1997). Word problems require higher-level thinking skills than computational skills; therefore, cooperative problem solving enables students to work together in learning and applying these higher-level thinking skills, which leads to greater achievement in solving mathematical word problems (Rosenbaum et al., 1989; Taylor, 1989; McGlinn, 1991). Parker (1984) found that small-group cooperative learning emphasized the development of thinking and problem-solving skills. Duren and
Cherrington (1992) conducted a study in which junior high students practiced problem-solving strategies either cooperatively or independently. Their results concluded that the students who were in cooperative practice groups retained problem-solving strategies better and were more willing to tackle a problem longer than those in individual practice groups. The National Council of Teachers of Mathematics has also called for small-group learning (NCTM, 1990). However, not much research has been done in other content areas of mathematics. Other than higher level thinking concepts such as word problems, can cooperative learning strategies benefit the learning of other concepts in mathematics?

Cooperative learning groups have proven to be effective in all subject areas including mathematics; however, most studies on cooperative learning have focused on the middle to upper grade levels (Behounek, et al., 1988; Rosenbaum, et al., 1988; Mulryan, 1995; Ross, 1995). Robert Slavin (1989/1990) states, "there is ample evidence that cooperative methods are instructionally effective in grades 2-9, but relatively few studies examine grades 10-12" (pg. 53). Another way of interpreting Slavin's comment is that kindergarten and first grade have also been neglected in research comparing the effectiveness of cooperative learning to other instructional strategies. The question arises: Why not? Don't primary grade students already tend to think cooperatively? From the author's observations, most primary grade students have not been exposed to competitive learning and generally enjoy helping their classmates learn. Behounek (1988) emphasizes that primary age students are capable of successfully using the concept of cooperative learning, although the maturity level requires a slightly different approach. Behounek also states that teachers need to use different types of grouping for this age level. Large-group instruction is
very effective when basic knowledge is being taught or when the teacher is modeling a strategy for students. Alternatively, working in cooperative groups enables students to practice new or difficult skills in a low-risk environment. Although students eventually will need to demonstrate knowledge and skills in an individual setting, we should not rush to this stage. Behounek cautions that children need many opportunities in the primary grades to practice skills cooperatively before they are expected to work independently. Kohler, Ezell, Hoel and Strain (1994) investigated the effects of peer practice versus individual practice for low-achieving students in a first grade classroom. Their research concluded that peer practice was an effective and efficient strategy for enhancing low-achieving students' mastery of mathematical concepts. Kohler et al. encouraged future research to examine a greater number and range of students.

In conclusion, cooperative learning has proven to be an effective instructional procedure. However, there are few studies that investigate whether cooperative learning is beneficial when learning about concepts in mathematics other than problem solving skills such as word problems. There are also few studies that examine whether cooperative learning is effective in the lower primary grades.

The author has primarily taught mathematics to her first graders by using direct instruction, followed by the students working on assignments independently with little cooperative group work. However, the author wanted to determine if using direct instruction and individual practice was the best way to teach her first graders. The research question in this study is to determine if cooperative learning is more or as effective as direct instruction and independent practice when teaching concepts of time to first
graders. The purpose of this experiment is to compare these two instructional strategies to determine the answer to this question.

**Method**

**Participants**

This study used 42 students from two first grade classrooms in a Christian school located in a small, midwest community. This school is affiliated with the Christian Reformed Church and is a member of Christian Schools International.

**Materials**

The curriculum unit for this study consisted of Chapter 11 from the Addison-Wesley 1995 mathematics series on time. The unit consisted of ten lessons which took ten days (see Appendix A). A teacher-made pre-test and post-test consisting of 12 questions were made using sample questions from Addison-Wesley student workbooks (see Appendix B). There were also daily assignments given from the Addison-Wesley student workbooks. These assignments were evaluated every day, although the scores will not be reported in the results of this study.

**Procedure**

A consent form was signed by each child's parent/s to participate in this study (see Appendix C). At the beginning of this study the students from both classes were individually given an oral pre-test. From the pre-test scores, the students' pre-existing knowledge on these mathematical concepts was determined. Matching was used to ensure that groups were equivalent. The overall mean pre-test score for the cooperative group was 4.05 correct
answers, and for the direct instruction group the mean was 5.05 correct answers. The analysis of the pre-test revealed that, although group two scored higher, the groups were equivalent (See Table 1).

Because the cooperative group size was 21 students, the students were equally divided into groups of three by placing a high-ability, medium ability, and low-ability student in each group based on the results of the pre-test. Students in the cooperative learning group classroom received instruction on helping behaviors for three weeks, as Webb (1988) recommends, including the concept that only giving answers is not considered help and is discouraged.

At the beginning of each class period, both teachers taught a concept relating to time to the entire class for 15-20 minutes. The teachers reviewed the major points of the previous lesson, introduced new material by explaining the concept to the entire class, gave examples of how to apply the new concept, and assigned short problem sets for the entire class to work on (i.e. "controlled practice"). At the end of each lesson, the students in the independent practice classroom worked with manipulatives or on assignments individually for approximately 20 minutes. The teacher monitored the work of individual students and provided help as needed. The students in the cooperative group classroom discussed the problems and solutions to questions within their own groups for approximately 20 minutes. They took turns recording their groups' answers on a collective assignment. Students in the groups were instructed to ask for help from other group members in understanding concepts before asking the teacher for assistance. The teacher monitored the work of the cooperative groups and provided help only when none of the students in the group could work out the problem or answer the student's question and before the group
dissolved in frustration. Daily assignments were given and collected every day. These assignments were used when the two teachers consulted on which concepts needed reviewing or reteaching in the next day's lesson.

A post-test on all concepts covered in the two weeks was given after the field experiment was finished. Regardless of the treatment received, each student took the post-test independently.

Results

Independent t-tests for means were calculated for several comparisons. These included the entire test as well as the four separate sections which were: writing time, estimating time, identifying time and problem solving using knowledge about time.

Independent t-tests for means of post-test scores revealed that the subtest on writing time and the scores of the entire test were significantly higher for the cooperative group. All other comparisons were not significant (see Table 2).

In conclusion, although the cooperative learning group began with lower scores, they finished scoring higher on all four individual sections. However, three of the four averages were not statistically significant, independent of the other sections. The cooperative learning group did score significantly higher on the section concerning writing time. When a t-test was conducted on the scores of the entire test rather than individual sections, the results were significant in that the cooperative group scored higher. There were no significant differences between the scores of boys and girls. In answer to the research question, it was proven in this study that the cooperative learning group of first graders did as well and even slightly better than the group receiving direct instruction and doing assignments independently when learning about time concepts.
Discussion

It was interesting that the cooperative learning group scored lower than the control group on all four sections of the pre-test, but scored higher on all four sections of the post-test. Although the results were only significant on one section and the test in its entirety, the cooperative learning group actually made greater gains than the direct instruction/independent practice group.

It would have been interesting to have given some sort of evaluation on how much students enjoyed this unit. The students in the cooperative learning group did an excellent job of helping and encouraging one another, and it was observed that especially the lower achieving students were feeling good about their contributions to their peers. The author was encouraged to see that her students were not only concerned about their individual achievement, but they also were concerned whether the other students in their group understood and did well.

This unit and study also changed the author's perspective on cooperative learning in lower grades. Before this study it was thought that cooperative learning was not very effective or time-efficient in lower grades. Mathematical concepts were generally taught using direct instruction with some manipulative work or other activities done now and then. After seeing the results of this study, the author saw the need to reevaluate her instructional strategies and be willing to implement more teaching styles that are as effective as direct instruction but have added benefits.

It is important to note that the teacher in the cooperative group needed much more time to plan her lessons than the teacher using direct instruction and individual practice. This could have been a factor for the
cooperative group scoring higher on the post-test. It would be interesting to do a study to determine whether the time the teachers spend on planning lessons significantly affects student achievement. Because cooperative learning is time-consuming to plan, this might be the reason the author previously relied heavily on direct instruction.

However, perhaps the most important finding from this study is that it made the author think more deeply about how to teach math from a Christian perspective. Because of its objectivity, math can be a difficult subject to teach from a distinctively Christian perspective. The orderliness of creation is often discussed, but after doing this field experiment it was realized that a teacher's instructional strategy sometimes speaks louder to her students about Christian perspective than the actual concepts being taught. This unit taught students not only how to tell time, but also how to treat and serve each other, which is part of the mission of this particular Christian school.

There are serious limiting factors to this experiment. Obviously, the generalizability will be limited because of the number of participants and the in-tact classroom. Randomly placing 42 students into two groups was not feasible in this particular study. Also, the findings are limited to this small-town, Iowan, Christian school.

The results of these two learning groups in other settings or mathematical content areas might result in different findings. The author would suggest that this experiment be done in other mathematical content areas such as money, measurement, or whole numbers. Also, the dynamics of the class is a limiting factor, as some classes work better together than others. In addition, this study involves two teachers. The teachers'
experience and attitudes towards cooperative learning or individual practice might be a limiting factor as well as their teaching styles.

Finally, a two week study is not long enough to see any long-term effects of direct instruction and individual practice versus cooperative learning. This study could be replicated over several years or units to find more substantial results.

Despite limitations, these results have implications for teachers and the instructional strategies they use. Because cooperative learning was as and even more effective than direct instruction and individual practice, it should be used more in the lower grades. Although cooperative learning is a more time-consuming instructional strategy, its benefits on students' learning, attitude, and servanthood make it a beneficial and effective way to teach first graders.
References


Appendixes
Appendix A

Timeline for Action Research

Prior to Lessons: Pretest given individually to each First Grader by para-professional.

Day One: Writing Time on the Hour
Day Two: Time on the Half Hour
Day Three: Practice point
Day Four: Problem Solving Skills: Critical Thinking about Time Estimates
          Think Tank: Reasoning
Day Five: Midchapter Review
Day Six: Analyzing Data about Time
Day Seven: Calendar
Day Eight: Problem Solving Skill: Finding Missing Data
Day Nine: Review game
Day Ten: Chapter Test

After the two week lessons are completed, a post-test will be administered to each student individually by a para-professional.
Write the time.

1. 

2. 

3. 

4. 

5. 

About how long would it take? Ring the better answer.

6. to blow up a balloon
   1 minute 1 hour

7. to paint your room
   5 hours 5 weeks
8. Which clock face shows 2:00?

9. Which clock face shows 7:30?

10. Which clock face shows 5:30?
11. Sal slept from

How long did he sleep? ___ hours

Read the problem. Write the time.

Amy leaves home at 7:30. She gets to school one half hour later. When does Amy get to school?
POST-TEST QUESTIONS

Write the time

1. [Clock Image]
2. [Clock Image]
3. [Clock Image]
4. [Clock Image]
5. [Clock Image]

About how long would it take? Ring the better answer.

6. to play a baseball game
   2 minutes   2 hours
7. to walk around the block
   10 minutes  10 hours
8. Which clock face shows \[ \text{7:00} \]?

9. Which clock face shows \[ \text{3:30} \]?

10. Which clock face shows \[ \text{9:30} \]?
11. Jody played ball from

How long did she play? ____ hours

12. Ari started to eat lunch at 12:00. He finished eating one half hour later. When did Ari finish eating lunch?
Tables
Appendix C

Dear First Grade Parents,

I am currently enrolled in Dordt College's Masters Program. A requirement for one of my classes, Introduction to Graduate Research, is to write a research proposal and, after it is accepted, conduct this research project before I can graduate. My project is comparing the effectiveness between individual practice and cooperative learning when learning about the concepts of time and measurement in math. In both First Grade classrooms, a lesson will be taught by myself and Mrs. VanderWerf and then in one classroom, assignments will be done individually whereas in the other classroom, assignments will be completed in cooperative groups. Both groups will be given tests at the end of each of the three weeks of this experiment to check for comprehension. Regardless of which group your child is in, they will learn these math concepts after the experiment is finished. (Hopefully they will all learn these concepts during the experiment as well!!) It is mandatory that I receive permission from you to conduct this research project. Thank You!

Please check and sign below:

[ ] Yes, we give our permission for _____________ to be a participant in this research project. _____________

[ ] No, we do not give our permission for _____________ to be a participant in this research project. _____________

Signed: _____________

parent

______________

parent
### Table 1
Independent t-test for means of pre-test scores

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<th>Number</th>
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* significant results
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