1992

Cooperative learning: Its many effective uses in the mathematics classroom

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Abstract

Most middle school educators agree that a major challenge for middle school teachers is to seek ways to create classroom environments and school learning climates that promote school success while reducing the disappointment and futility that saps students of their drive to engage in the learning process. One proven route to meeting this challenge is the use of cooperative learning in the classroom (Tyrrell, 1990). Many studies have shown that students in cooperative learning groups learn more than do students in traditional programs (Slavin, 1987).

COOPERATIVE LEARNING: ITS MANY EFFECTIVE USES IN THE MATHEMATICS CLASSROOM

A Graduate Project

Submitted to the

Department of Curriculum and Instruction

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts in Education

UNIVERSITY OF NORTHERN IOWA

by

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July, 1992

This Research Paper by: David H. Michels

Entitled: Cooperative Learning: Its Many Effective Uses in the Mathematics Classroom

has been approved as meeting the research paper requirements for the Degree of Master of Arts in Education.

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CHAPTER 1

Introduction

> A teacher of a sixth grade class finishes the unit on health and nutrition and breaks the students into groups for the cooperative learning activity. As the students are getting into groups, the assignment is given. The assignment is to develop a plan to change students' eating habits. The teacher suggests ideas and different approaches to the assignment and tells students to begin. Chaos ensues-- students socialize, noise increases, questions persist, the bell rings with no results. The students go to the next class leaving the teacher frustrated, tired, and determined to never use cooperative learning again. Bosch (1991, p.34.)

Most middle school educators agree that a major challenge for middle school teachers is to seek ways to create classroom environments and school learning climates that promote school success while reducing the disappointment and futility that saps students of their drive to engage in the learning process. One proven route to meeting this challenge is the use of cooperative learning in the classroom (Tyrrell, 1990). Many studies have shown that students in cooperative learning groups learn more than do students in traditional programs (Slavin, 1987).

Today, educators are preparing students for life in the twenty-first century. Students of both genders and

all races and socioeconomic levels need an education that will open doors to opportunity, an education that will prepare the United States for international economic competition (Taylor, 1989).

In mathematics classrooms, more effective instruction for all students is needed. This is because of the use of mathematics in almost all United States job areas. Mathematics is essential to meet the demands of the modern work world. Small-group instruction is suitable for a problem-solving-oriented curriculum that stresses understanding. When students participate in small groups, they can work together to solve more difficult problems. In small groups, the opportunity to express ideas in words helps students improve their understanding of mathematical concepts (Taylor, 1989).

Cooperative learning is a procedure which fosters relationship skills and team building. There is evidence that cooperative learning in small heterogeneous groups has great potential for raising achievement for all students on higher level skills and for reducing inequities.

The implemention of cooperative learning is a

significant change that requires extensive staff development, leadership by the principal, and "ownership" by the teachers (Taylor, 1989). The potential benefits of work-groups (enhanced motivation and enthusiasm, positive peer interaction, and advanced mathematical thinking) warrant further trials of the format in classrooms, as well as the development of more appropriate materials (Good, Reys, Grouws & Mulryan, 1990).

Statement of the Problem

The purpose of this study is to synthesize and analyze the research literature relating to the relationship between cooperative learning and its effects on achievement in the mathematics classroom. The following questions will be addressed in the study.

1. What is cooperative learning?
2. How are cooperative learning techniques executed effectively in the classroom?
3. What is the relationship between cooperative

learning and mathematics achievement in the classroom?

Significance of the Study

As the United States nears the twenty-first century, one fact stands clear in education: United States mathematics test scores are inferior when compared to other industrialized nations. It is obvious that the school systems in the United States must take measures to narrow the gap in mathematics competency with these countries to compete for international economic status (Taylor, 1989). Schools must make learning in mathematics meaningful and interesting to students, as well as, provide opportunities to experience success. To achieve this, students must have more input into their classes and their learning. The cooperative learning technique gives students the chance to be a part of a team with valuable input into team activities. The students must also learn how to work in a group setting. Dissatisfaction with students' performance in mathematics in the United States has led to various efforts toward improvement (Good, Reys, Grouws, & Mulryan, 1990). This paper will examine one of these efforts toward

improvement, cooperative learning.

Definitions

For the purpose of this study, important terms are defined as follows:

Cooperative Learning: An instructional technique that generally assumes a classroom of one teacher with students organized into heterogeneous ability groups of four students each who work together to learn academic material. They work together to be rewarded as a team, as well as for their individual achievement and improvement (Tyrrell, 1990).

Traditional Instruction: Classroom instruction that includes large group lecture, working independently, and competition in various forms (Slavin, 1980).

Student-Team Learning or STL: Another name for cooperative learning (Mevarech, 1985).

Individualized Instruction: Offering instruction appropriate to each student's needs (Slavin, 1987).

Student Teams Achievement Divisions or STAD: Classroom instruction technique where the teacher provides traditional instruction; then teams of four or five students study together and each person takes an individual quiz. Each student's score is compared to his or her own previously determined average and points are given for improvement. The team that achieves the most improvement points is considered the winning team (Slavin, 1978).

Teams-Games-Tournament or TGT: Classroom instruction technique where the teacher provides traditional instruction; then students are arranged in academic tournaments with students from other teams. The points earned during the tournament contribute to each team's score. The team with the highest score is considered the winner (Slavin, 1978).

Jigsaw Classroom: Instruction technique where each student on a cooperative learning team is assigned a section of the material or unit and becomes an expert on the section. Each student has a chance to meet and study with students from other teams who are also studying to be experts on their topics. The experts then return to their teams and report their findings (Aronson, Stephan, Sikes,

Blaney, & Shapp, 1978).

Student-Team Mastery Learning (STML): Instructional technique where students first study cooperatively in small heterogenous groups where task completion is contingent on mutual cooperation. These students are then individually tested to diagnose strengths and weaknesses in their learning. Finally, corrective activities are supplemented to teams whereby higher-achieving students help others to master the tasks (Mevarech, 1985).

Team Assisted Instruction (TAI): Cooperative learning technique where students themselves take care of the checking and management of lessons, help each other with problems and encourage one another to achieve (Slavin, 1987).

CHAPTER II

Review of Literature

The wealth of published information found in research of cooperative learning and its benefits in the classroom justifies continued study so that the education field can more fully benefit from this positive educational technique. This chapter will examine the basic features and types of cooperative learning and the benefits of cooperative learning in the middle school mathematics classroom.

Features of Cooperative Learning

Cooperative learning is a relatively new term in education. If a literature review were to be conducted by using older teaching manuals or professional journals using the term cooperative learning, there might be difficulty locating any information on the topic. This is because even though some educators have been using this teaching method

in classrooms for years, it is only recently that the name, cooperative learning, has been coined. Johnson and Johnson (1988, p.16) stated:

> Cooperative learning is not a new idea--it is as old as humankind. The capacity to work cooperatively has been a major contributor to the survival of our species. Throughout human history it has been those individuals who could organize and coordinate their efforts to achieve a common purpose who have been most successful in virtually any human endeavor. This is true of joining with one's fellows to hunt or to raise a barn as it is of space exploration.

Cooperative learning includes dividing the class into groups of two to six. Four is the optimum size for most cooperative learning situations. If the class is not divisible by four, then the remaining students should be assigned to create groups of five rather than three. If groups are too small, then there is not enough dialogue and someone is left out. If there are too many in a group, then there is too much happening and managing group cooperation becomes very difficult. If students are going to do drill or computer work, then pairs work fine. Each group member

plays a role in the group. The thinker must generate ideas, the supporter must ensure that ideas keep flowing, the questioner must look at ideas carefully, and the unifier must combine or synthesize ideas (Serra, 1989).

Even though this is only a new term and not a new concept, all the true benefits or weaknesses are not known until it is tested and modified in the classroom. Serra (1989, p.2) stated:

> There are many benefits when students work in cooperative groups. Researchers have found that working in cooperative small groups has a positive effect on student achievement and interpersonal relationships. Cooperative small groups increase contact and improve attitudes of students toward different racial and ethnic groups. Some studies have found that low-achieving students spend less time off task in cooperative small groups than in traditionally structured classrooms. Research has shown that conceptually oriented cooperative small groups (groups designed for long range projects, brainstorming, and the discovery of new information) promote the learning of abstract processes such as

critical thinking skills and problem solving better than traditionally structured classrooms.

Ronald Tyrrell agreed that there are many benefits to cooperative learning. After interviewing several Ohio teachers, Tyrrell found that cooperative learning should be made up of carefully structured groups to include high and low achieving students, whites and minorities, and males and females. They should all work together to be rewarded as a team, as well as for their individual achievement and improvement. Tyrrell (1990, p.16) stated:

> Being a part of a cooperative learning team provides the initial impetus for students to work. As they begin to achieve academic success, students who were not working previously began to work harder. Stronger students find working with and helping weaker students intellectually stimulating and enriching. Their academic achievement continues to increase as they engage in the process of explaining the material to their teammates. The weaker students find, for a change, that their classroom exertion is important. They discover that whatever they contribute can help the team effort. This is in contrast to situations

in the past when working individually has only led to failure. Furthermore, students learn that they need to not depend entirely on the teacher. In fact, they are encouraged to draw upon their own creativity and the strengths of teammates. In this way, cooperative learning teams provide the structure that helps students take greater responsibility for their own learning and for the learning of others. They learn that four heads are better than one.

Cooperative learning strategies also address the concerns identified by the Carnegie Task Force by providing students with an opportunity to move around, discuss ideas, and be a part of a familiar supportive group of other students (Jones, 1990).

Another benefit of cooperative learning seems to be that students really like working in groups. Tyrrell (1990, p.18) stated:

> The students really liked working on cooperative learning teams. They liked being able to work and talk together. One teacher said that working together was their favorite part. They enjoyed being able to talk to each other and to accomplish a goal together. It

was nice to see them smiling.

Tyrrell (1990) took part in an Ohio study of nineteen teachers trained in the uses of Student Team Learning (STL). This training was in the form of a weekend workshop. The nineteen teachers were exposed to STAD, TGT, and Jigsaw II. The initial six hour workshop training was followed by a series of five evening classes. By the end of the spring quarter, all nineteen teachers had implemented some form of STL in their classrooms. Many of the teachers were surprised they had fewer behavior problems when their students were working in cooperative learning groups. They reported that their students were more cooperative, listened better, were more concerned with the feelings of classmates, and showed greater tolerance for the weaknesses of others. They reported far fewer put-downs and much more encouragement of each other. Tyrrell also found improvements in self esteem in the classroom. The teachers used words such as happier, successful, confident, capable, positive, and proud, to describe the noticeably different affect of their students (Tyrrell, 1990).

The teacher must take on the task of teaching appropriate cooperative learning group behavior. They must

explain clearly to their students that the appropriate behavior involves the responsibility to listen carefully, the responsibility and right to contribute to the group, the right to ask for help, the responsibility to help others, and the right to their own opinion (Serra, 1990).

Although there are many benefits to cooperative learning, there are also those who have found difficulties in using the procedure. The Ohio teachers had concerns centering around finding the time and energy to try something new. The major complaint was that it took considerable initial preparation to transform traditional lessons to cooperative lessons. It also took time to teach students the procedures and skills needed to work in groups (Tyrrell, 1990).

Finally, the positive effects of cooperative learning on a variety of student outcomes are not found in every study. However, the overall conclusion to be drawn from research is that when the classroom is structured in a way that allows students to work cooperatively on learning tasks, students benefit academically as well as socially (Slavin, 1982).

Research on Cooperative Learning and Mathematics

Cooperative learning can be used successfully as the primary instructional method in reading, writing and mathematics (Slavin, Madden, & Stevens, 1990). The positive effects of cooperative learning in the mathematics classroom will be examined in this section.

Slavin and Karweit (1984) conducted a study with 588 ninth grade students in general mathematics classes. This was a longitudinal study, and sample attrition resulted from changes in class assignments after pretesting, student absenteeism, and mobility within the system. The achievement measure used in the study was level 2, form S, of a shortened version of the Mathematics Computations and Concepts and Applications subscales of the Comprehensive Test of Basic Skills (CTBS). The experimental design was a 2 X 2 factorial design, with Mastery (formative test, corrective instruction, summative test) and Teams (team work, team incentive) as factors. The four treatments were 1) Mastery; 2) Teams; 3) Teams and Mastery; 4) Focused Instruction. All four experimental treatments used the same curriculum materials and schedule of instruction. The

math book, Mathematics for Today was used in all treatment groups. The Two mastery treatments also received sets of enrichment activities, to be used by those students who had attained the mastery criterion on the formative test. The cycle of instruction usually took about one week to complete.

The results indicated those students that used teams, an identical approach to Student Teams Achievement Divisions (Slavin, 1978), achieved significantly higher scores than those that did not. There were no effects of the Mastery component or of the Mastery by Teams interaction. Slavin & Karweit (1984, p.372) stated:

> The results of this study do not support the effectiveness of the principal component of group-paced mastery learning. They do, however, support the instructional effectiveness of team work and team rewards characteristic of Student Teams Learning over and above the effects of a regular schedule of teaching, worksheet work, and quiz common to all four treatments.

Mevarech (1985) conducted a study that investigated the effects of student-teams using mastery learning

strategies (STML) on mathematics achievement of fifth-grade children (N=134). All the students received the same curriculum material and schedule of instruction. The four treatments used were 1) student-teams using mastery learning strategy; 2) student-teams without mastery learning; 3) mastery learning; 4) a conventional teaching setting. The test used in the study consisted of 35 computation problems and 13 word problems.

Slavin, Leavey, and Madden (1984) conducted a study that investigated the effects of students using team assisted instruction (TAI) on mathematics achievement. Students ranging from grades three to sixth took part in six carefully controlled studies. It was found that students exposed to team assisted instruction gained an average of twice as many grade equivalents as control classes. This gain was measured on standardized tests of mathematics computations. The same results were found in a study by Slavin and Karweit (1985). Students participating in team assisted instruction gained 1.63 grade equivalents in computations in only eighteen weeks, while control classes gained only 0.61.

Good, Reys, Grouws, & Mulryan (1990) conducted a study

by interviewing more than 400 teachers and their attitudes toward cooperative learning and mathematics. A majority of the teachers agreed that students in work-groups are more active learners and more motivated and enthusiastic about mathematics than students who worked in achievement-groups. Further, most lessons used in the work groups focused on higher-order thinking skills rather than on rote practice, and many provided students an opportunity to write or verbalize thoughts.

The results of Mevarech's study, and previous studies examined in this paper, indicate a higher achievement gain for students exposed to STML and cooperative learning than students exposed to traditional instruction.

CHAPTER III

Conclusion

The purpose of this study was to examine cooperative learning and its effects in the mathematics classroom. The review of literature attempted to answer three questions. First, what is cooperative learning? A study of the literature shows that cooperative learning is a classroom instructional technique that consists of small learning groups, of usually four students, that work together helping each other to solve problems. These cooperative groups usually receive awards when they meet previously set goals. Cooperative learning may be a relatively new term in education but it is an old concept in and out of the school setting. Studies have found that being a part of a cooperative learning team not only provides the student with the initial impetus to work, but also teaches the student to be more concerned with the feelings of classmates and teaches tolerance for the weaknesses of others.

Second, how are cooperative learning techniques executed effectively in the classroom? The literature

tells us that teachers must be willing to break away from the traditional modes of instruction and try something new when attempting to effectively incorporate cooperative learning in the classroom. The teacher must take into consideration the considerable initial preparation to transform traditional lessons to cooperative lessons. To use cooperative learning effectively in the classroom, the teacher must also be willing to take time to teach students the procedures and skills needed to work in groups.

Cooperative learning techniques are also executed effectively in the classroom by instructing the students to follow simple rules and guidelines. These rules and guidelines are 1) each group member plays a role in the group; 2) each group has a designated "thinker" who must generate ideas; 3) each group has a designated "supporter" who must ensure that ideas keep flowing; 4) each group has a designated "questioner" who must look at ideas carefully and question their validity; 5) each group has a "unifier" who must combine or synthesize ideas; 6) each group member has the responsibility to listen carefully; 7) each group member has the responsibility and the right to contribute to the group; 8) each group member has the right to ask for help;

9) each group member has the responsibility to help others in his/her group; 10) each group member has the right to his/her own opinion (Serra, 1990).

The use of effective cooperative learning in the classroom is enhanced by support from colleagues, principals, and parents. If fellow colleagues are using cooperative learning in their classrooms, the process can flow smoothly throughout the year, without interruption, from classroom to classroom.

Finally, what is the relationship between cooperative learning and mathematics achievement? The research shows that there are many positive outcomes when using cooperative learning in the mathematics classroom. Student cooperative learning teams, combined with mastery learning, produced higher achievement gains for students than those students that only received traditional instruction (Mevarech, 1985). Using team assisted instruction in the mathematics classroom also produced student gains on mathematics outcomes (Slavin, Leavey, & Madden). When using cooperative learning techniques. the students also learn how to work together in the mathematics classroom to achieve as a team. There are many positive applications of this group work in

the mathematics classroom to the real world.

There is a need for future research in the area of cooperative learning and high school achievement. A majority of existing research deals with studies in the elementary and middle school settings, and more is needed for high school aged students. The amount of class time to devote to the use of cooperative learning is another area that needs to be researched. Finally, which areas of mathematics are the most appropriate for cooperative learning groups needs to be further researched.

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