An Analysis of the Effects of Cooperative Learning Vs. Individual Learning in Dealing with High Risk Learners

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LOYOLA UNIVERSITY CHICAGO

AN ANALYSIS OF THE EFFECTS OF COOPERATIVE LEARNING VS. INDIVIDUAL LEARNING IN DEALING WITH HIGH RISK LEARNERS

A THESIS SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL IN CANDIDACY FOR THE DEGREE OF MASTER OF ARTS DEPARTMENT OF CURRICULUM, INSTRUCTION, AND EDUCATIONAL PSYCHOLOGY

BY ROBBY R. SINGER

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A large portion of the research that has taken place over the last fifteen to twenty years in American education has centered around cooperative learning. Cooperative learning is a teaching strategy in which students are generally separated into heterogeneous, mixed ability groups of four to six students each. In this type of setting, students are expected to help one another learn. After the initial discussion on a topic, the teacher is no longer the primary focal point of the class; that is, the teacher becomes a facilitator of knowledge, assisting each of the groups as needed (Artzt, 1990, p.448). Educational researchers, such as Robert Slavin of the Center of Social Organization of Schools, John Hopkins University, have shown that there are many tangible benefits to using cooperative learning in the classroom. Slavin has found that cooperative learning methods have had an important impact on many aspects of student success, including the academic achievement scores of students, race relations, self-esteem, ability to work with others, and increasingly positive attitudes towards academically handicapped students (Slavin, Sharan, Kagan, Lazarowitz, Webb, and Schmuck, 1985, p.13). Other well known educational researchers, such as David and Roger Johnson of the University of Minnesota, have come to similar conclusions (Johnson and Johnson, 1983, p.323).

Most educational researchers agree that there are two necessary conditions if cooperative learning is to be successful in the classroom. First, students that are working in groups must somehow feel that they are individually accountable
to the group. They have to understand that they will either have a positive or a negative impact on the group in which they are working, depending on their actions. One of the most common ways for teachers to provide for individual accountability in group settings is to assign specific roles to be performed by each member of the group (Boyd and Tompkins, 1992, p.203). Second, there must be a feeling of positive interdependence among the students. Group members must know that they will either sink or swim together. Students must be aware that they will only be rewarded for team success; therefore, it is each group member's responsibility to make sure that everyone else in their group understands the topic at hand (Johnson, Johnson, and Holubec, 1994, p.9). Teachers that use cooperative learning techniques in their classroom can greatly improve the chances that they will be successful by making sure that each student is held individually accountable to the group and that only as a group will the individuals receive rewards.

In the United States recently, it has been said over and over again that students are not reaching the academic standards that they need to. This is especially true in the Chicago Public Schools, where it seems that student achievement has consistently declined over the last few years. It becomes more and more obvious with each passing year that traditional methods of teaching are simply not meeting the needs of today's students. Students today find traditional methods of teaching, such as lecture or practice and drill, extremely boring and uninteresting. Any good teacher knows that once students have lost interest, students will not learn, no matter how creative the method of instruction. The key then is to capture the students' interests before they become bored.

Cooperative learning may just be the answer to this problem. Students tend
to enjoy themselves when they are working cooperatively with their peers. It gives them a chance to meet and get to know other people. It teaches them to work together with their peers to complete a task. This aspect of cooperative learning is especially important, as students will most likely be expected to work with peers in the workplace. Cooperative learning gives students a chance to develop their social skills. In most traditional methods of teaching, little or no emphasis is placed on developing interpersonal skills in students. In addition, allowing students to work cooperatively gives them opportunity to grow in other areas, such as leadership, decision making, and conflict management (Black, 1992, p.18) In general, students that are to work in cooperative learning settings seem to enjoy school more than students who are not allowed to do so.

With these ideas in mind, the investigator attempted to implement cooperative learning into the classroom. The study was conducted in an inner city Chicago Public High School on the South side. Generally, the average Freshmen entering this school possess very low T.A.P. test scores, ranging somewhere around the twentieth percentile nationally. It is common to see five hundred students start at this school as Freshmen, only to find that about two hundred of them graduate four years later. That is, approximately forty percent of the students that start as Freshmen graduate as Seniors four years later. These types of students are commonly referred to as "high-risk" learners, as many are in danger of dropping out of school. Like any good teacher, the investigator is always looking for new ways to improve the academic achievement of students. For this reason, the researcher wanted to see if he could duplicate the positive findings of other researchers; that is, he wanted to determine whether or not cooperative learning could help improve the academic achievement scores of his students.
Problem Statement

The purpose of this study was to analyze the achievement effects of cooperative learning methods versus individual learning methods in dealing with the "high-risk" learners, or students who are typically in danger of dropping out of school. Two Algebra classes were studied over approximately four weeks of time. One class was taught using only traditional methods of teaching, such as lecture, question-response, and drill and practice. This was considered to be the control group. The other class was taught using a cooperative learning method developed at John Hopkins University known as Student Team Achievement Divisions (Slavin, 1983, p.432). This group was considered to be the experimental group.

The students in both classes covered a unit that dealt with solving equations. The equations in these four chapters could easily be categorized into four major types. First, there were equations that could be solved by either adding or subtracting something from both sides of the equation. Second, there were equations that could be solved by either multiplying or dividing something on both sides of the equation. Third, there were equations that could be solved using two or more steps, similar to those previously described. Finally, there were problems in which there were variables on both sides of the equal sign. For each of the four types of equations listed, students were also given several word problems that could be solved using the same procedures as the straightforward math problems. These problems were included in an effort to give the students a form of real life application of the skills they had learned.

The cooperative learning group and the individual learning group used exactly the same worksheets, quizzes, and tests throughout the study. The only difference between the control and experimental groups was that the control
group completed their worksheets individually while the experimental group completed theirs cooperatively. To assess whether or not there was a significant difference in achievement scores across the two groups, both groups were given a pretest before the study as well as a post test after the study was completed. The same 50 question test was used for both the pretest and the post test.

Significance of Study

In places such as the Chicago Public Schools, it is quite obvious that there needs to a dramatic improvement in the achievement scores of students. Each year it becomes more apparent that traditional methods of teaching are not working well enough; that is, students are not achieving as much as they need to academically. For example, the Chicago Board of Education recently placed 38 high schools on probation because less than 15 percent of those school’s Freshmen and Juniors could read at the national average level. It is therefore the job of teachers to implement new, innovate ways to teach that not only challenge students academically, but motivate them as well.

Cooperative learning just may be the answer that teachers are searching for. There have been large numbers of field studies conducted over the last century that have concluded that cooperative learning is more effective than individual learning in improving achievement scores (Johnson, Johnson, and Holubec, 1994, p. 11). While the results of these research projects have been quite convincing, one particular aspect of many of the studies is a personal cause for concern. It seems that many of the studies published about cooperative learning were either directly performed or indirectly supervised by an expert in the field. It is not surprising that achievement scores would improve if an expert in the field of cooperative learning were supervising a
particular study, whether directly or indirectly. Is it fair to assume that an average teacher with only theoretical knowledge in cooperative learning can produce the same kinds of results that an expert would? If not, might students learn more from a teacher who is experienced in using individualized methods than a teacher who is a relative novice in using cooperative learning methods?

In addition, many of the students entering the school system these days have not only poor academic and social skills, but strong gang affiliations as well. It would not be outrageous to guess that approximately 80% of the boys and 30% of the girls at my school have strong gang affiliations. Many of these gangs follow codes of conduct that will not even allow them to be in the same room with members of another gang, let alone sitting down working with them. This is where the true significance of this study is found. This study seeks to answer the question, "Is it realistic for teachers at the high school level, especially teachers who work in inner city schools, to assume that cooperative learning can be highly beneficial to their students?" If cooperative learning can be as successful for teachers who will become experts only through research, trial and error, and hard work as it is for experts in the field of cooperative learning, it could be the answer to many of the academic problems found in the Chicago Public Schools as well as other struggling school districts.
Cooperative learning is by no means a new concept. Since the late 1800’s, educators have suspected that group learning could improve student performance in school (Johnson and Johnson, 1994, p.47). The development of cooperative learning as a teaching method was substantially delayed over the years though, as there have been quite a few changes in educational priorities at the national level. Group learning, individual learning, competitive learning, and a return to the basics have all taken turns being the focal point of American education over the last century. In the late 1970’s and early 1980’s, many educators began to call once again for a change in the educational system in an attempt to improve student achievement. It was at this time that the amount of published research regarding cooperative learning began to increase dramatically. Researchers began to look at group learning more closely. Many educators soon realized that if group learning is to be successful, two things must happen. First, individuals must be held accountable for the success of the group. Second, individual students can only gain rewards through accomplishing team goals.

It was recognition of these two basic premises of cooperative learning that led researchers, most notably at John Hopkins University, to create team learning structures such as Student Team Achievement Divisions (STAD), Team Assisted Individualization (TAI), and Team- Games-Tournaments (TGT),
each of which takes individual accountability and group rewards into account (Slavin, Sharan, Kagan, Lazarowitz, Webb, and Schmuck, 1985, p.7). At this point, a large majority of the studies that have been conducted concerning cooperative learning suggest that cooperative learning is far more effective than traditional, individualized teaching methods when it comes to improving student achievement (Johnson, Johnson, and Holubec, 1994, p. 11).

History of Cooperative Learning, 1875 - 1930

Group learning has been investigated by educators for some time. As early as 1889, Turner conducted studies in England concerning the factors associated with competitive performance. A short time after this, Triplett (1898) and Mayer (1903), in the United States and Germany respectively, conducted similar studies. (Johnson and Johnson, 1994, p.41) One of the most famous of all early pioneers in the field of cooperative learning was Colonel Francis Parker. In the last decades of the nineteenth century, Colonel Francis Parker used cooperative learning to create a relaxed, democratic atmosphere in which students could learn. In the years 1875 - 1880, it is estimated that approximately 30,000 people per year came to Quincy, Massachusetts where Parker was superintendent of public schools, to investigate his use of cooperative learning in the classroom (Johnson and Johnson, 1994, p. 47). Parker's philosophy of grouping students cooperatively remained the dominant model of teaching until after the turn of the century.

Shortly after Parker, John Dewey used cooperative learning to stimulate learning in students. In fact, Dewey used cooperative groups as a part of his famous project method of instruction (Johnson and Johnson, 1992, p. 173). Until the early 1930's, cooperative learning was the dominant educational
strategy used to instruct students.

History of Cooperative Learning, 1930-1960

In the early 1930's, the emphasis in educational strategies was no longer focused on cooperative learning. At this time, competitive learning was the primary instructional tool being used (Johnson and Johnson, 1992, p. 173). Teachers attempted to motivate students by putting them into competition with each other. In retrospect, competitive learning was beneficial to some students while it was detrimental to others. Many students find direct competition to be threatening to their self-esteem. Students that lack all of the necessary prerequisite skills to be successful in the classroom are often well aware of their own shortcomings. In a competitive setting, it is only natural that there will be winners and losers. In general, it seemed that only the best and brightest students seemed to realize their full potential as students while working in a competitive environment (Johnson and Johnson, 1992, p. 173). For this reason, educators realized that another change in teaching style was necessary. The emphasis in American education shifted again, this time favoring individualistic teaching methods.

History of Cooperative Learning, 1960 - 1970

During this period, cooperative learning once again took a back seat to another method of instruction. At this time, individualized instruction, with an emphasis on the basics, was considered the practical choice for educators. To truly understand the nature of American education around 1960, one must take into account the political events of the period. Although this portion of the history of cooperative learning begins with 1960, it is necessary to go back to 1957 to find the root of concern. In 1957, the Soviet Union launched Sputnik I,
defeating the United States in the race to put the first humans into space. This was very alarming to the citizens of the United States. They were upset and insecure about the fact that they were losing the space race against Russia. Members of the military began to question the stability of the national defense. The fears of the American people as a whole were put into words when Hyman Rickover, an Admiral in the U.S. Navy, questioned why Johnny could not read while Ivan could and did (Hunkins and Ornstein, 1993, p.165). Feelings such as these led to a complete overhaul of the curriculum being used at this time. Here, the average curriculum switched from a competitive philosophy to a back to the basics, individualized approach (Hunkins and Ornstein, 1993, p.165). Subjects such as math, science, history, English, and foreign languages were now being stressed more than at any time before. Little or no emphasis was placed on helping all students to achieve the newly created standards. In fact, the curriculum attempted to give extra attention to academically gifted and talented students, as they were seen as the only hope of helping the United States regain its position at the pinnacle of the technological world (Tanner and Tanner, 1990, p.316). Finally, in 1969, the United States put the first men on the moon with the Apollo space mission. For many Americans, this was a great relief, as it signaled the fact that the Americans were once again at the top of the technological world. Once the fears of Soviet domination in the space program were calmed, Americans began to once again scrutinize the educational system. It was becoming obvious that a high price had been paid to make the United States number one again in the technological world. The effort that was placed on increasing the achievement of a few students directly caused the educational neglect of many others. Many educational researchers once again began looking for teaching techniques that would allow all students to reach
their maximum potential. It was at this time that two well known experts in the field of cooperative learning, David Johnson and Roger Johnson, began teaching professors at the University of Minnesota how to implement cooperative learning in their classrooms (Johnson and Johnson, 1994, p. 47). Once again, cooperative learning was being investigated as a means of increasing overall student achievement.

History of Cooperative Learning, 1970- Present

The 1970's were really the true beginning of cooperative learning as we understand it today. Educational researchers that believed cooperative learning was a useful teaching method began to study the subject intently. This led to a sudden influx of new information and theories in the field of cooperative learning.

In 1974, David DeVries and Keith Edwards of John Hopkins University created a student team learning method known as the Teams-Games-Tournaments (TGT) (Johnson and Johnson, 1994, p. 47). In this method, the teacher begins by presenting a lesson to the entire class. Once the initial presentation has been given, students are divided into groups of four to six students each. These groups should contain mixed ability students, such as low, average, and high achievers. Groups should be constructed in such a way that each group represents the race and gender makeup of the class as closely as possible. Students will then work in groups to complete worksheets that are related to the lesson that was taught. Once students complete the worksheets, they will take turns representing their teams in academic games. Students compete with others from other groups that are of a similar achievement level. Students gain a different number of points for their teams depending on the amount of improvement they show over their average scores.
Individual student grades are usually based on each student's individual performance. Team-Games-Tournaments has built a solid reputation over the years for increasing student achievement while allowing them to have fun as well.

In 1978, a team of teachers, administrators, and researchers, led by E. Aronson, published the results of a six year study conducted in Austin, Texas. The study was designed to eliminate the competitive, individualized nature of traditional learning in which some students "won" and others "lost" (Sharan, 1994, p.35). The team decided that two steps would be necessary to create a new atmosphere for learning. The first step was to create an atmosphere where individual competition was not compatible with success in the classroom. The second step was to develop an atmosphere in which success could only be obtained by students after they cooperated with each other. The cooperative learning method the team devised is now commonly known as the Jigsaw approach (Sharan, 1994, p.35). In the Jigsaw approach, students work in small groups in which each student has a specialized role or task. For the group to be successful, students must be sure that they have completed the task they were assigned. In general, there are four basic steps one must follow to implement Jigsaw in the classroom (Sharan, 1994, p.36). First, the students should be divided into groups of four to five students each. These are considered the students' "home groups". The teacher then introduces the lesson to all students, placing special emphasis on the reason the topic is important. Second, students from each group team with students who are studying similar topics from other groups to form what is called a "focus group". Each focus group would study a different aspect of the overall project to be completed by
the "home groups". Third, students would return to the "home groups" to share the information they have learned while working in the "focus groups". Finally, the home group would complete a task, such as an oral or written presentation, to show that an integration of topic learned has taken place (Sharan, 1994, p.37). It is obvious that this type of approach creates inter-dependence among the members of the group. Cooperation and trust among the members of the group are crucial if achievement is to occur.

In 1980, another educational researcher from John Hopkins University, Robert Slavin, modified Teams-Games-Tournaments to form a new cooperative learning method known as Student Team Achievement Divisions (STAD). Slavin was especially familiar with the methods and theory behind TGT, as he was a doctoral student of David DeVries, one of the creators of Team-Game-Tournaments (Johnson and Johnson, 1994, p.113). The methodology involved in Student Team Achievement Divisions is very similar to those used in the TGT approach. Students are divided into mixed ability, heterogeneous groups of four to six students each. Students work together in groups to complete worksheets. They have a high accountability level to their group, as students contribute points to their teams based on improvement points, or the degree to which they have improved over each of their normal averages (Slavin, Sharan, Kagan, Lazarowitz, Webb, and Schmuck, 1985, p.7). The major difference between the two methods is that in STAD, students take individual quizzes to determine achievement rather than playing academic games as in TGT. Research has shown that Student Team Achievement Divisions are also very useful in improving student academic achievement in comparison to traditional methods.

At virtually the same time, Shlomo and Yael Sharan created what is known as the Group-Investigation method of cooperative learning (Slavin, Sharan,
Kagan, Lazarowitz, Webb, and Schmuck, 1985, p.8) In this method, the teacher presents the class with a complex problem that has many correct solutions. To investigate the problem, the teacher and students work together to formulate questions that are critical to understanding the topic. These questions are divided into categories, or subtopics. Students then decide which of the subtopics they are most interested in, as they will team up with others who have a similar interest to form a cooperative learning group. Once a group has decided on a strategy to complete a task, the work is divided into parts, with each member of the group becoming responsible for a certain aspect of the project. Many of the topics given to Group-Investigation teams culminate with a group presentation or report to the class (Sharan, 1994, p. 108). Most cooperative learning experts consider this one of the most complex of all the learning group methods, as it greatly increases the student's role in deciding what will be learned and how it will be accomplished (Slavin, Sharan, Kagan, Lazarowitz, Webb, and Schmuck, 1985, p.8). Students often find it very difficult to take such an active role in planning their own educational activities.

In addition to all of the other learning group methods created in the 1970's, Roger and David Johnson created what is known as “Learning Together”. This is one of the simplest methods of group learning. In this method, a great deal of emphasis is placed on teaching students the five elements that are essential if they are to be productive members of a group. These five essential elements needed for a successful cooperative learning environment are: positive interdependence, face to face interaction, individual accountability, social skills, and group processing skills (Sharan, 1994, p.58). Positive interdependence is the idea that students must understand they sink or swim together. Individuals can only receive rewards through group participation. Face to face interaction
addresses the need for students to practice communicating with each other. Individual accountability refers to an individual's understanding that he or she has a direct positive or negative influence on the group, depending on the quality of work performed. Social skills, such as leadership, decision-making, communication, and conflict management skills are all necessary to function in the group setting. Finally, group processing skills involve the continual evaluation of the group's progress by members of the group (Sharan, 1994, p.58).

These skills are very important, as many of the jobs in today's workplace require people to not only work together, but to evaluate their own progress as well. In the Learning Together model, students work together to complete assignments that the group will receive praise for (Slavin, Sharan, Kagan, Lazarowitz, Webb, and Schmuck, 1985, p. 8).

Yet another cooperative learning method was devised in 1983, as Robert Slavin extended the idea of computer assisted instruction to create Team Assisted Instruction (TAI). Unlike the other cooperative learning methods discussed, TAI was created specifically for students studying mathematics in grades three through six (Sharan, 1994, p.22). To implement TAI, educators must begin by separating the students into mixed ability groups of four to six students each. Students are then given a placement test to determine each student's particular academic level. Once a student's academic level has been identified, a curriculum package is designed to meet the student's special needs. It is important to note that in TAI, students in the mixed ability groups are not necessarily learning from each other. In these groups, each student works individually on his or her own curriculum materials. Students in the mixed ability groups assist each other by checking each others papers and by asking
each other questions for self-quizzes. In TAI, students who are at the same point in the curriculum are combined in small groups to receive direct instruction from the teacher. At the end of each week, team scores are computed based on the average number of units each member of the group completed (Sharan, 1994, p.24).

While it was created primarily for elementary school students, TAI has been used at higher levels as well. When used at higher levels, TAI has been used with students that are not ready for a regular level Algebra course.

In the years 1970 to 1985, the primary emphasis of cooperative learning research was devoted to creating new, innovative methods of group learning. Since that time, researchers have attempted to evaluate the effectiveness of each of the cooperative learning methods that have been discussed.

Effectiveness of Cooperative Learning Methods,
A Review of Research

For about the last ten years, researchers have primarily focused on evaluating the effectiveness of the cooperative learning methods developed in the 1970's and early 1980's. An enormous number of studies have been conducted during this time. It is important to note that there were several different types of studies that were conducted. One type of study simply compared a certain cooperative learning method, such as STAD, TGT, or TAI to traditional, individualistic methods. The second type of study that was sometimes conducted was an analysis of all the studies that had taken place in cooperative learning until that time. These types of studies were conducted to determine whether or not various researchers conducting similar experiments were reaching similar conclusions.
In 1981, Robert Slavin and Eileen Oickle conducted a study to determine the effects of cooperative learning teams on student achievement and race relations. In this particular study, the subjects were 230 students that were either in sixth, seventh, or eight grades in a rural middle school. The 230 students were taken from ten different English classes. Seventy-eight of the students were black. The remainder of the students were white. The students received one of two treatment conditions. Some students were placed in the experimental group which used Student Team Achievement Divisions (STAD). The control group used the exact curriculum materials as the experimental group, except members worked individually rather than in groups (Slavin and Oickle, 1981, p. 176). The study began with all students, in both the experimental and control divisions, taking a pretest. Several things were noticed in the pretest results. First, the mean scores for students in the control groups (74.65 and 68.18 for whites and blacks, respectively) were higher than the mean scores for both white (71.78) and black (64.35) students in the experimental groups. In addition, the mean scores of white students (71.78 - experimental group and 74.65 - control group) were significantly higher than those of black students (64.35 - experimental group and 68.18 - control group) in both the cooperative and traditional groups. After the experiment was completed, researchers gave both groups a post test that was identical to the pretest they had been given earlier. The results of the post test were very interesting indeed. The most notable result was that black students gained significantly more than white students as a result of cooperative learning. White students in Student Team Achievement divisions improved their mean scores by 3.26 to a score of 75.04 points on the post test. On the other hand, black students working in Student Team Achievement Divisions improved their mean
scores by 9.77 points to 74.12 points on the post test. While white students still had the higher mean score on the post test (75.04 for whites and 74.12 for blacks), it is obvious that the variance in their mean scores was drastically reduced (Slavin and Oickle, 1981, p.177). This is truly a very significant difference. Another significant observation was made when viewing the post test results for the control groups. Although whites' mean scores (76.32) were higher than blacks' mean scores (69.53) on the post test, the average amount of improvement since the pretest for the two groups was virtually the same. On the average, whites in the control group improved by about 1.67 on the post test while blacks in the control group improved by about 1.35 points on the post test. This can be interpreted to mean that in at least this study, traditional methods of teaching produced no significant improvements in achievement scores. At the same time, there were significant gains in achievement scores for students working in cooperative groups. As in earlier studies, all students' achievement scores improved more by working in cooperative groups than learning through traditional methods. The difference is that blacks' achievement scores rose dramatically more after using cooperative methods than whites' had (Slavin and Oickle, 1981, p. 179). This particular study provides strong evidence that Student Team Achievement Divisions can improve student achievement scores.

In 1981, David Johnson, Geoffrey Maruyama, Roger Johnson, Deborah Nelson, and Linda Skon used meta-analysis techniques to evaluate the effects of cooperative, competitive, and individualistic goal structures on achievement. There were two main procedures used to conduct the meta analysis. The first procedure used was the voting method. If a study was believed to be credible, the researchers would count the findings of the original authors and place them
into one of three categories as either positive, negative, or insignificant in comparing different learning methods. The second procedure used to analyze the studies is called the effect-size method. The effect size method allows for the examination of the strengths of the relations between the independent and dependent variables.

In this study, several significant findings were made. First, using the voting method, a conclusion was reached that cooperation is superior to competition in promoting achievement and productivity (Johnson, Maruyama, Johnson, Nelson, and Skon, 1981, p.57). In reviewing 108 different studies, 65 of them favored cooperation over competition, while only 8 showed competition to be more useful. There were also 36 studies that found no significant differences between the two methods. Using the effect-size method to compare cooperation to competition, an effect size of .78 was found favoring cooperation. This means that the person working in the cooperative setting performed at about .75 of a standard deviation above the average person in the competitive setting (Johnson, Maruyama, Johnson, Nelson, and Skon, 1981, p.51). The effect size of .78 could also be interpreted as saying that the average person working in a cooperative setting would be at the 78 percentile of those people working in the competitive setting.

Another significant finding was that cooperation was far superior to individualistic methods in promoting achievement and productivity (Johnson, Maruyama, Johnson, Nelson, and Skon, 1981, p.57). Using the voting method, researchers found that cooperation produced higher achievement than individual methods by a margin of 108 to 6. In addition, there were 42 studies that found no significant difference between the two methods (Johnson, Maruyama, Johnson, Nelson, Skon, 1981, p.51). Using the effect-size method, a
.78 effect size favoring cooperative methods was found. Again, this finding indicates that the average students working in a cooperative setting would fall at the 78 percentile of those students that worked in individualistic settings (Johnson, Maruyama, Johnson, Nelson, Skon, 1981, p.51).

A third result of the meta-analysis was that there was no significant difference between interpersonal, competitive and individualistic goal structures on achievement and productivity (Johnson, Maruyama, Johnson, Nelson, Skon, 1981,p. 57). Out of a total of 59 studies analyzed by the voting method, nine showed favorable results in achievement for competitively structured tasks. Twelve studies favored individualistic goal structures over competitive structures. There were also 38 studies that showed no difference between methods in producing significant achievement or productivity results (Johnson, Maruyama, Johnson, Nelson, 1981, p.51). Using the effect-size method, an effect size of .03 was found in favor of competitive methods. This can be interpreted as meaning that an average student in a competitive learning group would only perform .03 of a standard deviation better than an average student in a class being taught using individual methods.

In this particular meta-analysis, there were not enough published studies available to accurately compare cooperative groups without intergroup competition to cooperation with intergroup competition. The overall finding of this study was very clear. Group learning tended to produce better academic achievement and productivity than did either competitive or individualistic learning methods.

In 1983, Robert Slavin conducted a meta-analysis in an attempt to determine when cooperative learning increases student achievement (Slavin, 1983, p.429). In all, Slavin analyzed 46 recent studies that were deemed credible,
due to factors such as duration of study, setting used for experiment, and methodological adequacy. Out of the 46 studies analyzed, 29 of them (63%) showed cooperative learning to have significantly positive effects on student achievement. There were 15 studies (33%) which found no differences between treatment conditions. There were also 2 groups (4%) that reported results showing the control group had obtained higher achievement levels than the experimental group (Slavin, 1983, 434). While not always effective, cooperative learning seems to be effective the majority of the time in increasing student achievement levels.

In 1984, Robert Slavin, Marshall Leavey, and Nancy Madden published the results of two large studies that directly compared Team Assisted Instruction (TAI) with traditional teaching methods. In the first study, the subjects were 504 third, fourth, and fifth graders in a Maryland school district. An analysis of the racial components of the class showed that eighty percent of the students were white, fifteen percent were black, and five percent were Asian-American (primarily Korean). These students were from a total of 18 different classes from six different schools. Each of the schools was either assigned to the experimental group (TAI) or to the control group (traditional methods). In the second study, the subjects were 375 third, fourth, and fifth grade students from another Maryland school district. In this study, fifty-five percent of the students were white, forty-three percent were black, and two percent were Asian-American (Slavin, Leavey, and Madden, 1984, p. 415).

In both studies, the experimental groups (TAI) had significantly higher achievement gains than did the control groups using individualized teaching methods. In both studies, the Team Assisted Instruction groups gained twice as many grade equivalents as the control group (Slavin, Leavey, Madden, 1984,
In 1986, a study was conducted by William Allen and Ronald VanSickle to determine whether or not cooperative learning methods, such as Student Team Achievement Divisions, could be useful in increasing achievement levels for low-achieving students in history classes (Allen and VanSickle, 1986, p.61). The study consisted of approximately 1,000 students in grades 9 through 12 in a rural high school in Georgia. The exact topic being taught was basic world geography. Upon completion of the study, the researchers found a statistically significant difference between the post test achievement scores of the experimental (cooperative learning) and control (individual learning) groups. That is, the post test achievement scores for the students in the experimental group (mean score of 51.5) were found to be significantly higher than the post test achievement scores for students in the control group (mean score of 39.8). Once again, another study had been conducted that appeared to show cooperative learning to be more successful than individual learning in promoting student achievement.

In 1986, Lawrence Sherman and Mary Thomas conducted a study that was designed to test the theory that cooperative learning strategies, such as Student Team Achievement Divisions, promote higher academic achievement among students that traditional methods do (Sherman and Thomas, 1986, p. 170). Two general, high school mathematics courses in an Ohio high school were taught a unit in percentages. One group was the control group. This group studied and worked individually. The second group was the experimental group. This group worked cooperatively, employing Student Team Achievement Divisions as the primary cooperative learning method. The study was conducted over a duration of 25 days. At the end of the study, students in both the control and the
experimental group had shown significant gains in achievement based on their pretest scores; however, the experimental group demonstrated achievement scores that were even significantly higher than the achievement scores earned by members of the control group (Sherman and Thomas, 1986, p.169). As indicated by the authors, the results compiled in this study also seem to support the notion that cooperative learning is more effective than individual learning in promoting student achievement.

David Johnson, Roger Johnson, and Edythe Holubec note that since 1898, over 600 experimental studies and 100 correlational studies have been conducted in regards to cooperative learning and its effects on students in relation to traditional methods (Johnson, Johnson, and Holubec, 1994, p.11). From a meta-analysis of all of this research, the authors claim to have found three constantly recurring themes. First, students that learn in a cooperative setting achieve more and retain it longer than students that learn in either competitive or individualistic settings. Second, students working in a cooperative setting build more positive relationships than students working in other settings. That is, students become more friendly in dealing with their peers, including ones that are handicapped. Third, students working in a cooperative setting tend to maintain better psychological health. This means that students used to working in cooperative settings tend to have higher self-esteem and more advanced social skill development than students who work in non-cooperative settings. This meta-analysis seems to confirm the results that many other researchers have come to. Cooperative learning is very successful not only in improving student achievement, but in promoting social skill development as well.
CHAPTER 3
METHODOLOGY

This study analyzed the effects of cooperative learning on student achievement in comparison to traditional, individualized instruction. More specifically, this study was designed to answer the following research question. Is cooperative learning more efficient than individual learning in promoting student academic achievement, especially when dealing with "high-risk" learners? The null hypothesis of this study was that there would be no difference in student achievement scores across treatment groups. That is, there would be no apparent advantage in improving student achievement scores by using cooperative learning rather than using individual learning methods. The ninth grade Algebra students involved in the study worked on a unit dealing with solving equations for the missing variable. In an effort to test the effectiveness of cooperative learning, the following methods and procedures were employed.

Subjects

This study was conducted using two groups of Algebra I students at a Chicago Public high school in Chicago, Illinois. These students were all part of what is known as the SAM program, which is a small school within a school that prepares students for careers involving science, architecture, and mathematics. All of the students in the SAM program are relatively similar to each other academically, as the schools within a school tend to separate students into academically heterogeneous groups. For instance, new Freshmen with very
high T.A.P. test scores entering the school usually enter into the Principal's Scholar program. Freshmen that enter the school with the lowest T.A.P. test scores are encouraged to enter programs such as the Academy of Travel and Tourism or the Academy of Spanish and English. Students that enter the SAM program generally have T.A.P. test scores ranging from the twenty-fifth to forty-fifth percentiles. Despite their average T.A.P. scores, many of these students are considered to be "high risk" learners. At this high school, Freshmen classes usually begin with about 500 students. Four years later, it is not uncommon to see only about 200 of them graduate. These 200 students are primarily the best and brightest the school has to offer.

One of the Algebra I classes was chosen to be the control group. This group was chosen to be the control group simply by the flip of a coin. In the control group, students would be instructed using traditional methods, such as lecture, question-response, and practice and drill sessions. This group contained 20 students. Of these 20 students, 13 were females and 7 were males. In addition, 13 of the students were Hispanic while 7 were black. The other Algebra I class was chosen to be the experimental group. This class was taught using a cooperative learning method known as Student Team Achievement Divisions. In the experimental group, there were a total of 21 students. Of these 21 students, 12 were females and 9 were males. In addition, 13 of the students were black while 8 were Hispanic. Neither group had any behavior disordered students that would be detrimental to the study. Since both groups were very similar in number of students, gender, and racial makeup, the second group was chosen at random to be the experimental group.
Procedures

This study began on March 7, 1996 with both groups completing the pretest and concluded on April 9, 1996 when they concluded the post test. Throughout the four and a half week duration of the study, students would attend class every day of the week for 50 minutes each day. The control and experimental groups were both taught by the same instructor, the investigator. The curriculum being used was a unit on equations. Over the course of four weeks, students learned to solve four basic types of problems involving equations. First, there were equations that could be solved by adding or subtracting on both sides of the equation. Second, there were equations that could be solved by multiplying or dividing on both sides of the equation. Third, there were equations that could only be solved by using several steps, such as adding or subtracting on both sides first and then multiplying or dividing on both sides afterwards. Fourth, there were equations that had a variable on both sides of the equal sign. For each of the four categories described, there were also problems that required students to apply their newly acquired skills in solving equations to real-life problems.

In the experimental group, students worked cooperatively following the procedures used in Robert Slavin's Student Team Achievement Divisions (STAD). The students were divided into mixed ability groups that included low, middle, and high achievers as classified by the instructor. Once this was accomplished, the teacher would begin the process by presenting a lesson to the entire class. After this initial presentation, students were to work together in their mixed ability groups to complete worksheets related to the topic at hand. Each group was given a copy of the answers to the worksheet so that students could not only check their work together, but practice for the quizzes as well.
During this time, the teacher would monitor the progress of each group. If a particular group's progress appeared to be stagnant and they could not find a solution to their problem, the investigator would attempt to briefly address the topic so that the students could once again continue working. It is important to note here that many times, one question from a student working in a group can spark an avalanche of what the investigator refers to as "silly" questions. Students often feel that if someone else is asking a question, they must ask one too. These "silly" questions would include whether or not to put headings on a paper, put the date on a paper, whether to write in pen or pencil, whether or not the teacher will collect this assignment, etc. In turn, these questions would often cause students to lose focus on the task at hand unless they were quickly answered. For this reason, the investigator tried to present an initial lesson on each topic that was so thorough, very few questions would need to be asked or answered. If a major problem were discovered, such as noticing that many groups were having an inordinate amount of trouble with a particular topic or problem, the teacher would address this by making another presentation to the entire class. This approach to handling questions in a cooperative learning situation such as Student Team Achievement divisions is very important, as all of the groups are in direct competition with each other. One group might have an unfair advantage over another group if the teacher were to provide particular groups with more assistance than others. After completing the worksheets, students were required to take quizzes individually based on what they had learned.

The next step in the process was to calculate a base score for each of the students so that relative improvement in achievement on future assignments could be evaluated. Since this study was conducted in March and April of
1996, the investigator already had seven months to learn the strengths and weaknesses of each student. A base score was calculated for each student based on the academic achievement they had displayed throughout the year. If the student’s score on the quiz was more than 10 points below their estimated base score, they would receive zero improvement points (See table 1).

**TABLE 1: IMPROVEMENT POINT SCALE (STAD)**

<table>
<thead>
<tr>
<th>Quiz Score as Compared to Base Score</th>
<th>Improvement Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 10 points below base score</td>
<td>0</td>
</tr>
<tr>
<td>10 points below base score to base score</td>
<td>10</td>
</tr>
<tr>
<td>1 point above base score to 10 points above base score</td>
<td>20</td>
</tr>
<tr>
<td>11 points above base score to 20 points above base score</td>
<td>30</td>
</tr>
<tr>
<td>Perfect quiz score, no matter what base score</td>
<td>30</td>
</tr>
</tbody>
</table>

If their actual scores were between 10 points below up to their base score, they would receive 10 improvement points. If a student’s actual score was one point above the base score to 10 points above the base score, the student would earn 20 improvement points. If a student’s actual score was between 11 and 20 points above the base score, the student would earn 30 improvement points. If a student earned a 100 on any quiz, that student would receive 30 improvement points, regardless of their base score. To determine the success of each group, the individual improvement scores of members of the group would be averaged together.
A certain set of criteria was also used to determine team success (See table 2). If the average improvement scores for a team totaled less than 15 points, that team was recognized as "hard workers". When using Student Team Achievement Divisions, there is usually no recognition given to a team that averages less than 15 improvement points. In the investigator's opinion, all students deserve some form of recognition. The students themselves that were recognized as "hard workers" are aware that they did not achieve the level that other groups had. The investigator's opinion was simply based on the fact that no group wants to feel that they have not accomplished anything. If the average improvement points were between 15 and 19 points, the team would be recognized as a "Good Team". Similarly, if a group averaged improvement points in the 20 to 24 point range, they were praised as a "Great Team". Finally, any team that averaged 25 or more improvement points was hailed as a "Super Team". Team success was recognized each week by placing a sign on the classroom bulletin board listing the achievement of
each team as well as the names of the students each group was comprised of.

All students were graded on an individual basis in reference to their report card grades. Although the post test used in this study was very important to the results of the study, it was simply considered as just another unit test in determining student’s third quarter grades. Unit tests, quizzes, worksheets, class participation, and a homework journal were all considered in determining a student’s report card grade.

In the control group, everything was done exactly as it was in the experimental group, with the exception that students in the control group completed their worksheets individually. In addition, the control group used traditional methods of teaching, such as lecture, question-response, and drill and practice. These methods were not used in the experimental group, except in the initial presentation of the topic to the class as a whole.

Instruments Used in Study

The pretests and post tests used to measure the students’ achievement in solving equations for the missing variable were identical to each other. They were arranged into their given format by the investigator. The problems were all adapted from the textbook *Algebra, Structure and Method*, written by Brown. This is the textbook that was normally used by both of the Algebra classes. The purpose of the pretest and post test was to determine whether or not students in the cooperative learning groups achieved more or less than the students that were working in individualized settings. Since the tests were made by the investigator, their reliability and validity are not known.
Methods of Analyzing Data

All student scores from the pretest and post test were recorded for data analysis. There were several ways the data was analyzed. First, the mean and standard deviation were calculated for the data in both the pretest and the post test. This was one way that the data could be compared. In order to identify if any significant changes had occurred in achievement between the two groups, a t-test was used to analyze the data. The t-test was calculated using an alpha level of .05. The formula for the t-ratio used is shown in Table 3 (Center for the Study of Evaluation, 1975, p.54).

TABLE 3 : FORMULA FOR T - RATIO

\[
t = \frac{X_1 - X_2}{s_E^2 \left(\frac{n_E - 1}{n_E} \right) + s_C^2 \left(\frac{n_C - 1}{n_C} \right)} \quad \frac{1}{n_E + n_C - 2} \quad \frac{1}{n_E} + \frac{1}{n_C}
\]

where \( t \) = t-ratio, \( X_1 \) = the mean of experimental group, \( X_2 \) = the mean of control group, \( s_E^2 \) = squared standard deviation of experimental group, \( s_C^2 \) = squared standard deviation of control group, \( n_E \) = number of students in experimental group, \( n_C \) = number of students in control group.
Once a t value was obtained for the given data, it was compared to a critical value of t that was given in a statistical table assuming an alpha level of .05 and 30 degrees of freedom. If the obtained value of t exceeded the critical value of t, the null hypothesis stating that the mean achievement scores across the two groups are equal would be rejected. If the obtained value of t did not exceed the critical value of t, the null hypothesis stating that the mean achievement scores across the two groups are equal would be accepted.
CHAPTER 4

SUMMARY OF THE FINDINGS

Pretests and post tests were given before and after the study to evaluate student achievement in cooperative learning and individual settings. Means, standard deviations, and t-ratios were computed for the data collected in both the experimental and control groups on the pretests and post tests. The results related to the pretest are summarized in table 4. As you can see, the mean

**TABLE 4: SUMMARY OF DATA: PRETEST**

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>20</td>
<td>15.80</td>
<td>12.46</td>
<td>-.708 *</td>
</tr>
<tr>
<td>Experimental</td>
<td>21</td>
<td>13.42</td>
<td>8.88</td>
<td></td>
</tr>
</tbody>
</table>

* The obtained value of t was not significant at the .05 level. The critical value was 2.04.
of the control group (15.80) was slightly higher than the mean for the experimental group (13.42) on the 50 question pretest. In addition, the obtained t-value of -.708 was not statistically significant at the .05 alpha level allowing 30 degrees of freedom, as it did not meet or exceed the critical value of 2.04.

Table 5 shown below summarizes the data collected from the control and experimental groups on the post test. As you can see, the obtained t-value of

TABLE 5: SUMMARY OF DATA: POST TEST

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>20</td>
<td>63.60</td>
<td>19.73</td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>21</td>
<td>67.14</td>
<td>17.80</td>
<td></td>
</tr>
</tbody>
</table>

*The obtained value of t was not significant at the .05 level. The critical value was 2.04.

.60 was not statistically significant at the .05 alpha level, allowing 30 degrees of freedom, as it did not meet or exceed the critical value of 2.04. Despite this fact, the post test results contained some significant information. For instance, the post test revealed that the mean score for the experimental group (67.14) was now higher than the mean score for the control group (63.60) by an average of
3.54 points. This is very different than the results of the pretest. The pretest showed mean scores of the control group to be higher than those of the experimental group by an average of 2.38 points (15.8 for the control group as compared to 13.42 for the experimental group). A closer look at the data shows that the mean scores for students in the control group went from 15.80 on the pretest to 63.60 on the post test, an average gain of 47.80 points per student. The mean scores for students in the experimental, or cooperative learning group, went from 13.42 to 67.14, an average gain of 53.72 points per student.

The research question for this study explored whether or not cooperative learning was more effective than individual learning in improving student achievement when dealing with high risk learners. The results of the study showed that statistically, there was not a significant difference in achievement between the experimental and control groups.
CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to determine if cooperative learning was more effective than individual learning in increasing student achievement when dealing with “high risk” learners. Research in the field has consistently shown that cooperative learning not only improves student achievement, but race relations, self-esteem, ability to work with others, and attitudes towards academically handicapped students as well (Slavin, 1983). Based on the t-ratios calculated, the data collected in this study was statistically insignificant. This would seem to indicate that cooperative learning was not more effective than individual learning in increasing student achievement. Despite this assumption, the data did reveal that the students in the experimental group (Student Team Achievement Divisions) did achieve higher mean scores on the post test than did students who were in the control group (individualized learning). In addition, the experimental group’s improvement on the post test in relation to pretest scores was significantly higher than the control group’s improvement on the post test, based on their pretest scores. This seems to support the notion that students working in a cooperative setting did achieve more than students who were working in individualized settings.
Throughout the duration of the study, the investigator noticed a distinct difference between the two groups in relation to pure happiness, fun, and enjoyment. The students in the experimental group that worked cooperatively seemed to enjoy themselves a great deal. There were many times that students who were actively engaged, working together in groups were surprised by the bell that would signal the end of the period. This was a clear sign to the investigator that the students were enjoying themselves. Students working in the control group who learned individually seemed to be bored quite often. Many of the students would be attentive for the first 10 or 15 minutes of the period, only to lose attentiveness as the period progressed. Unlike students working in the cooperative groups, students in the control groups were often seen watching the clock, as they were ready to run out of the room as soon as the bell rang. To the investigator, these were sure signs that students working in the cooperative learning groups enjoyed themselves a great deal more than students who worked individually.

In addition, low-achieving students seemed to be much more comfortable working in cooperative groups than those that worked individually. As the days and the weeks passed, low-achieving students became more outgoing. Many of these students began to ask their classmates questions without hesitation. This was very different from what occurred at the beginning of the study. When the study began, many of the low-achieving students seemed to be very apprehensive and timid. It seemed as though they were afraid to ask their
classmates anything, as they were afraid of possibly being embarrassed. This fear seemed to virtually disappear by the end of the study. Low-achieving students seemed to enjoy themselves working in cooperative groups just as much as other students did.

Limitations of Study

While there were no major problems encountered throughout the duration of the study, the investigator admits that several changes could have been made that would have improved the study. The teacher could have modeled appropriate group behavior for the students so that they would have had a better understanding of what was expected of them. The students could have been surveyed before and after the study to determine their attitudes towards mathematics. This would have been far more scientific than simply saying that some students appeared to enjoy themselves more than others. In addition, the investigator could have been more creative in the ways the available data was analyzed in an attempt to find results that were statistically significant.

Students must possess the prerequisite social skills that are necessary for group work if one desires to implement cooperative learning successfully in the classroom. The investigator made an attempt to work on each student’s social skills before the beginning of the study. Students were encouraged to speak freely in the classroom at all times, as long as they raised their hand first. Students were required to participate in math research projects in which
students would work together in groups of two with an oral presentation to the class at the conclusion of their work. This was done to give students practice in speaking to their peers. The groups of two students each were changed with each project so that students could learn to deal with as many other students as possible. Students were also encouraged to write as much as possible, despite the fact that this was a math class. Once students became more comfortable working in groups of two, the investigator combined groups of two to make groups of four. The idea here was that students must show first that they could work with one other person before they could reasonably be expected to work with three or four other students.

While this procedure for improving student's social skills seemed to be a good start, the investigator admits that it could have been improved. One way to improve this would have been for the investigator to model appropriate group behavior for the rest of the class. This could have been done using one cooperative learning group containing three students and the teacher acting as a student. In this setting, the teacher could have shown the other students how students were really expected to help each other. That is, the investigator could have shown students acceptable ways for students to speak to each other, including aspects such as tone of voice, elevation level of voice, and talking in turn with other students. In regard to each student's role in the group, the investigator could have shown students how they were expected to work together. This would include assisting each other on worksheets, quizzesing each
other on worksheet answers to prepare for upcoming quizzes, assisting each other when a group member was not able to complete an assigned problem, and providing positive feedback for all members of the group so that everyone felt comfortable working cooperatively.

This improvement in the study would have made a great deal of sense. It is often not enough to tell students what they are expected to do. It is sometimes necessary to show them exactly what is expected of them. Modeling appropriate student group behavior would have been very beneficial to the children and to the study.

It would have also made a great deal of sense to survey student attitudes towards mathematics before and after the study. One of the investigator's observations during the study was that students in the cooperative learning setting appeared to enjoy math more than students working in the individualized settings. While this may have been the case, the investigator cannot say with any certainty that this attitude was a result of the use of cooperative learning. All students have subjects that they enjoy more than other subjects. It is possible that these students simply enjoyed math more than those students that were working in an individualized setting. It is possible that cooperative learning did not play any role in determining the students that enjoyed math. The math attitude survey would have been very useful in determining whether or not working in a cooperative setting made math more enjoyable for students than working individually.
Finally, the investigator could have been more creative in the ways the available data was analyzed in an attempt to find results that were statistically significant. For example, instead of simply comparing the entire group of twenty-one students in the experimental group with the twenty students in the control group, the investigator could have simply compared the pretest and posttest scores of the six or seven lowest ranking students in each class to check for any possible statistical significance the use of cooperative learning might have had on these students. This would make a great deal of sense, as this particular study focused on the effects of cooperative learning on the achievement of high risk learners. It is obvious that of the students in the study, none of them are at "higher risk" of dropping out than those that are at the bottom of the achievement ladder.

Recommendations

There are several recommendations that can be made to assist educators in implementing cooperative learning in the classroom. First, students should be rotated into different groups every four to five weeks. This will help to keep the cooperative learning atmosphere interesting for all students, as they will get a chance to make new friends and work with different people. As long as they are interested, students will learn. Second, teachers must prepare students for the cooperative learning experience by helping them to develop the social skills that are necessary for successful group work. It is unfair to simply tell students
to work together in groups. They must be prepared to meet the challenges that group work will present them with. Third, teachers must constantly reevaluate the effectiveness of the cooperative learning groups. For instance, a teacher might need to restructure groups if a particular group has several members that are chronically absent.
APPENDIX A

SIMPLIFYING EQUATIONS PRE/POST TEST
APPENDIX A
SIMPLIFYING EQUATIONS PRE/POST TEST
Use addition or subtraction to solve each of the following equations.

1) y - 9 = 13
2) x + 15 = 27
3) -49 + n = 63

4) x - 26 = 18
5) y + 32 = -45
6) 0 = z - 14

7) -32 + b = 82
8) x - 8 = 25
9) g - 6 = 14 - 8

10) x - 97 = -105
11) -1.8 + h = -3.8
12) -x + 6 = 4

Use multiplication or division to solve each of the following equations.

13) 5y = 65
14) 3t = -27
15) -6p = 42

16) -9z = -63
17) 1/3y = 18
18) c/4 = -9

19) -1/5t = 17
20) 5/2y = 10
21) 5/8c = -20

22) -2/11p = 14
23) -324 = -18c
24) 252 = -14y
Use the two-step method to solve each of the following equations.

25) $3y - 8 = 16$  
26) $5c + 7 = -28$  
27) $-8y - 11 = 13$

28) $\frac{2}{3}p - 7 = 17$  
29) $\frac{4y}{5} = 28$  
30) $z - 5/4 = 8$

31) $5 - \frac{n}{3} = 4$  
32) $3y - 7y = 28$  
33) $2a - 11a = -27$

34) $2x + 5 - 7x = 15$  
35) $0 = 6p + 18$  
36) $3(y - 7) = 27$

Solve each of the following equations for the missing variable. If the solution is an identity or no solution, say so.

37) $8a = 2a + 30$  
38) $2b = 80 - 8b$  
39) $3x = 27 - 15x$

40) $51 = 9 - 3x$  
41) $39c + 78 = 33c$  
42) $-7a = -12a - 65$
Write an equation based on the facts of the problem. Then solve the equation and answer the question asked in the problem.

46) A lion can run 18 miles/hour faster than a giraffe. If a lion can run 50 miles/hour, how fast can a giraffe run?

47) John paid $4.75 for a sandwich, a drink, and frozen yogurt. He remembered that the drink and the yogurt were each $1.15 and that the sandwich had too much mustard, but he forgot the price of the sandwich. How much did the sandwich cost?

48) The perimeter of a square parking lot is 784 meters. How long is each side of the lot?

49) How many apples, averaging 0.2 kg each, are included in a 50 kg shipment of apples?

50) Lynne took a taxicab from her office to the airport. She had to pay a flat fee of $2.05 plus $.90 per mile. The total cost was $5.65. How many miles was the trip?
APPENDIX B

GROUP THAT USED INDIVIDUALIZED LEARNING METHODS:

PRETEST AND POST TEST RESULTS
### APPENDIX B

**GROUPS THAT USED INDIVIDUALIZED LEARNING METHODS: PRETEST AND POST TEST RESULTS**

<table>
<thead>
<tr>
<th>Student</th>
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**totals**

|        | 316 | 1272 |

**Mean**

|        | 15.8 | 63.6 |
APPENDIX C

GROUP THAT USED COOPERATIVE LEARNING METHODS:

PRETEST AND POST TEST RESULTS
### APPENDIX C
GROUP THAT USED COOPERATIVE LEARNING METHODS:
PRETEST AND POST TEST RESULTS

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**totals**  
282  
1410

**Mean**  
13.42  
67.14
Use addition or subtraction to solve each of the following equations.

1) \( x - 7 = 13 \)  
2) \( z + 8 = 31 \)  
3) \( -52 + m = 84 \)

4) \( t - 25 = -18 \)  
5) \( p + 18 = -32 \)  
6) \( 0 = 38 + k \)

7) \( -19 + a = 23 \)  
8) \( c + 9 = 5 \)  
9) \( f + 7 = 9 - 2 \)

10) \( z - 57 = -67 \)  
11) \( -0.7 + k = -1.7 \)  
12) \( 4.5 = x + 1.6 \)

13) \( -y + 5 = 17 \)  
14) \( 21 - x = 28 \)  
15) \( 8 = -x + 18 \)

16) Jane ran the 400 meter dash in 56.8 seconds. This was 1.3 seconds less than her previous time. What was her previous time?

17) The temperature at the summit of Mt. Mansfield dropped 17 degrees F between 4 p.m. and 11 p.m. If the temperature at 11 p.m. was -11 degrees F, what was the temperature at 4 p.m.?

18) Bill had 45 sheets of graph paper. She gave five sheets to each of the six students she tutored and put the remaining sheets in her desk. How many did she put in her desk?
<table>
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<th>Question</th>
<th>Answer</th>
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<td>3)</td>
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<td>5)</td>
<td>P = -50</td>
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<tr>
<td>6)</td>
<td>k = -38</td>
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<tr>
<td>7)</td>
<td>A = 42</td>
</tr>
<tr>
<td>8)</td>
<td>c = -4</td>
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<td>9)</td>
<td>f = 0</td>
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<td>10)</td>
<td>z = -10</td>
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<td>k = -1</td>
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<td>12)</td>
<td>x = 2.9</td>
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<td>13)</td>
<td>y = -12</td>
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<td>14)</td>
<td>x = -7</td>
</tr>
<tr>
<td>15)</td>
<td>X = 10</td>
</tr>
<tr>
<td>16)</td>
<td>Let $p =$ previous time, then $56.8 = p - 1.3$, and $p = 58.1$ seconds</td>
</tr>
<tr>
<td>17)</td>
<td>Let $t =$ temperature at 4 p.m. Then $t - 17 = -11$. Therefore, $t = 6$ degrees F.</td>
</tr>
<tr>
<td>18)</td>
<td>Let $s =$ sheets in desk. Then $s + 5(6) = 45$, and $s = 15$ sheets.</td>
</tr>
</tbody>
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APPENDIX E

SAMPLE STAD QUIZ WITH ANSWERS
## APPENDIX E
SAMPLE STAD QUIZ WITH ANSWERS

Use addition or subtraction to solve each of the following equations.

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<thead>
<tr>
<th>Equation</th>
<th>Equation</th>
<th>Equation</th>
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<tbody>
<tr>
<td>1) $x - 23 = 3$</td>
<td>2) $y + 7 = 63$</td>
<td>3) $-12 + y = 18$</td>
</tr>
<tr>
<td>4) $b - 10 = 8$</td>
<td>5) $a + 8 = -4$</td>
<td>6) $0 = 19 + w$</td>
</tr>
<tr>
<td>7) $-3 = x - 8$</td>
<td>8) $y + 36 = 32$</td>
<td>9) $x - 5 = 11 - 2$</td>
</tr>
<tr>
<td>10) $x - 9 = -9$</td>
<td>11) $-5.2 = z - 0.9$</td>
<td>12) $0.6 + x = 1.4$</td>
</tr>
<tr>
<td>13) $-w + 7 = 19$</td>
<td>14) $15 - x = 32$</td>
<td>15) $12 = -h + 6$</td>
</tr>
</tbody>
</table>

16) The price of a radio decreased by $35 is the discount price of $85. Find the original price.

17) The desert temperature rose 25 degrees Celsius between 6 a.m. and noon. If the temperature at noon was 18 degrees Celsius, what was the temperature at 6 a.m.?

18) Mrs. Willoby had 52 candy canes. She gave two canes to each of the 19 second graders in her class. She placed the remaining canes on the Christmas tree. How many canes did she place on the tree?
APPENDIX E
SAMPLE STAD QUIZ WITH ANSWERS

1) $x = 26$
2) $y = 56$
3) $y = 30$
4) $b = 18$
5) $a = -12$
6) $w = -19$
7) $x = 5$
8) $y = -4$
9) $x = 14$
10) $x = 0$
11) $z = -4.3$
12) $x = 0.8$
13) $w = -12$
14) $x = -17$
15) $h = -6$
16) Let $p =$ original price. Then $p - 35 = 85$, and $p = $ 120
17) Let $t =$ temperature at 6 a.m. Then $t + 25 = 18$, and $t =$ -7 degrees Celsius at 6 a.m.
18) Let $c =$ canes on tree. Then $c + 2(19) = 52$, so $c + 38 = 52$, and $c =$ 14 canes on the tree.
SELECTED BIBLIOGRAPHY


VITA

Robby R. Singer conducted his undergraduate studies at Loyola University, where he was a mathematics major. He earned his Bachelor of Science (B.S.) degree from Loyola University of Chicago in January 1994. Since then, Mr. Singer has been working as a mathematics teacher at James H. Bowen High School, a Chicago Public School located in the South Chicago area. Mr. Singer is currently working on a Master of Arts degree at Loyola University of Chicago, where he is a graduate student in the department of Curriculum, Instruction, and Educational Psychology. He will receive his Master of Arts in January of 1997.
THESIS APPROVAL SHEET

The thesis submitted by Robby R. Singer has been read and approved by the following committee:

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Associate Professor, Curriculum, Instruction, and Educational Psychology
Loyola University Chicago

Pam Nesselrodt, Ph.D.
Assistant Professor, Curriculum, Instruction, and Educational Psychology
Loyola University Chicago

The final copies have been examined by the director of the thesis committee and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the committee with reference to content and form.

The thesis is, therefore, accepted in partial fulfillment of the requirements for the degree of Master of Arts (M.A.).

November 25, 1996
Date

Director's Signature