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An Uphill Battle: Incorporating cooperative learning using a largely individualized curriculum

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Math in the Middle Institute Partnership

Action Research Project Report

in partial fulfillment of the MAT Degree

Department of Mathematics

University of Nebraska-Lincoln

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An Uphill Battle: Incorporating cooperative learning with a largely individualized curriculum

Abstract

In this action research study of my classroom of 8th grade mathematics, I investigated if cooperative learning could be an effective teaching method with the Saxon curriculum. Saxon curriculum is largely individualized in that most lessons could be completed without much group interaction. I discovered that cooperative learning was very successful with the curriculum as long as it was structured. Ninety-five percent of the students in the study preferred to work in groups, and I observed mathematical communication grow with most of the students. As a result of this research, I plan to continue to incorporate cooperative learning into my mathematics classroom. I will use cooperative learning with all of my mathematics classes, even the ones that do not use the Saxon curriculum. I believe in the power of working together.

Introduction

The topic of my research is implementing cooperative learning with a curriculum that is focused on individual performance and understanding. The cooperative learning that I have used in the past was mostly group work and not real cooperative learning. Cooperative learning requires structure and work toward a common goal. I wanted to use cooperative learning with my new curriculum, Saxon curriculum is largely individualized. The lessons in Saxon begin with a Facts test known as Mental Math. After the students complete these individual timed tests, they are taught the lesson. The students are then asked to work on the Daily Practice which is about five to seven problems on the skill of the day. The period ends with assigning Written Practice, which is 30 problems to be completed as homework. These problems are varied from different lessons of the book with integrated instruction as a key. In my opinion, the students could teach themselves from this textbook (Saxon Course 3, Hake, 2007). The textbook is not very hands-on. There is not much technology integrated; in fact, the textbook does not come with any CD enhancement. The Course 3 textbook is a new version of the Saxon Middle School math curriculum, and has more problem solving in it than past books. It is still lacking, though, in mathematical communication and representation. I know that currently the textbook that has been chosen for me to use is just a tool. I do not know if I believe in the textbook's philosophy, but I believe in the math that is in it. When students have only a textbook and a pencil, it is not a guarantee that learning will take place. I teach students who are tied to their textbook: they cannot follow along with my teaching unless I give them a page number. I believe the textbook our district uses makes students "depend" on their book as it is very individualized. I want my students to fully understand the math they are doing and be able to communicate mathematically. Problem solving is also a way to facilitate mathematical understanding and communication. I

believe my curriculum was enhanced from the implementation of cooperative learning. I want to incorporate cooperative learning on a daily basis with the curriculum.

The cooperative learning involves both my teaching of the curriculum and the students learning this curriculum individually or in groups. Cooperative learning is something I feel very passionate about, as it has been incredibly helpful in my own graduate level coursework. I believe learning cooperatively is beneficial with the Saxon curriculum and with my students. I want to improve my students' understanding of math, their communication of math, and their confidence in math. Improvement in the area of problem solving would be especially important as my curriculum is weak in this area.

My ideal classroom would have students communicating mathematically and having mathematical discussions. They would be justifying their answers both verbally and in writing. Most importantly, they would be performing exceptionally on the state standard assessments because they understand the math. I want the discussions to be student-led, as I believe the students learn more by teaching others than by listening to me lecture. I want all teaching to be active with problem solving rather than a repetition of lecture and practice. I want my students to experience something new every day, rather than the same book day after day. I want cooperative learning to be a part of my classroom, and it could lead me closer to the ideal learning environment. By implementing cooperative learning with the Saxon curriculum, I am on my way to the ideal classroom.

Problem Statement

Just how do I implement cooperative learning with a curriculum focused on individual performance and understanding? Will it make a difference in my students' mathematical understanding? I, as well as many other teachers, am searching for the best way to teach math to

my students. I want to ensure every student can learn the math I am teaching, and I am not sure if the book I use is the best book for students to learn math. I want math to be cooperative and hands-on, but I also want to see if cooperative learning with my curriculum is the best way for students to learn. Researching this question benefits my own teaching greatly as I move forward with this curriculum in this teaching position.

I believe the answer to this question can help the teachers in my own middle school, as well as all teachers who teach using a highly structured book series. In my middle school, the Saxon math series is new to all of us. I worry that our books will lead us into a rut of doing the same thing every day. My research could be a benefit to the fifth, sixth, and seventh grade teachers in my building if cooperative learning has a higher impact with students than teaching with the textbook alone. Many teachers outside my building struggle with a curriculum their district has mandated. My research could benefit all teachers who struggle with the question of how to best teach students. Any teacher with the dilemma between working individually versus working cooperatively could be helped with my results. Any teacher that uses a primarily individualized curriculum could benefit from seeing a study that uses the curriculum cooperatively.

Do students learn more by themselves with rote practice, or do they learn more communicating cooperatively with that same practice? Do students problem solve more successfully on their own, or do they problem solve better in a cooperative setting? These questions could benefit anyone who teaches, and anyone who learns.

Literature Review

To discover how to use cooperative learning in my eighth grade math classroom, I read much literature related to its implementation. Sapon-Shavin (1994) stated, “an overly-rigid,

fixed curriculum may discourage teachers from taking full ownership of students' programs and their own teaching" (p. 187). This statement applies to the Saxon course 3 textbook that I am currently teaching within eighth grade Math. This is a rigid, fixed curriculum that does not lend itself easily to cooperative learning. My dilemma was to see if cooperative learning can indeed work with a fixed curriculum. As stated above, Sapon-Shavin thinks many teachers in my situation would not even try it. Sapon-Shavin is a professor of education at Syracuse University. Her research has identified some of the problems with cooperative learning strategies and their implementation.

I am in a dilemma, but Smith (2000) states, "Dilemmas are commonplace…and likely to arise when old practices and new pedagogy suggest different courses of action" (p. 352). Smith conducted a study examining the dilemmas an experienced teacher struggled with during her first year in a mathematics reform project. She conducted interviews and collected data of classroom observations to find that dilemmas are how teachers learn and improve their teaching. I hoped to improve my teaching and the students' learning of mathematics by using a cooperative learning approach with a fixed, rigid curriculum.

Cooperative learning follows many themes found in research literature; such as interdependence among the student learning teams. Another theme is that the students are empowered, rather than the teacher being in control of the students' learning (Stevens & Slavin, 1995). Structure is an essential theme to a cooperative learning classroom, "…simply placing students in groups to work together…does not ensure…positive interactions" (Battistich, Solomon, & Delucchi, 1993, p. 20). Another theme was the idea that problem solving and student attitudes can be improved in cooperative learning settings. These many themes were

found in the literature that I reviewed, but the most prevalent by far was the idea of Interdependence.

Interdependence

The idea of cooperative learning organizes the classroom instruction to involve students to work together to help one another learn (Sapon-Shevin, 1994). The definition of interdependence is to be mutually dependent, with the group members being dependent on each other. Cooperative groups are only as strong as their weakest members, with each member being equally responsible for the learning groups' successes or failures.

Stevens and Slavin (1995) conducted a two-year study of the use of different cooperative elementary school models. They used pre-tests, post-tests, and attitude surveys to determine the effect of different cooperative learning models on approximately 1,000 students in five different elementary schools. These students were from the second to the sixth grade level. The researchers found that even after the first year, students displayed higher achievement as well as better social relations. Stevens and Slavin state that to make cooperative learning increase student learning, the attainment of the group goals must depend on the individual learning of all group members. This promotes positive interdependence when the group's success depends on the successful learning of each and every member of the group. If that positive interdependence is created, then the students are taking more responsibility for their own learning. This frees the teacher for instruction with the students who need it.

Qin, Johnson D., and Johnson R. (1995) analyzed 46 research studies conducted between 1929 and 1993. They then conducted a meta-analysis comparing the effect of cooperative and comparative efforts on problem solving. Their method was to look at others' published research and compare and contrast the effect of the method used on problem solving. Based on their

results, members of cooperative teams outperformed individuals competing with each other on all four types of problem solving. These types were linguistic, non-linguistic, well-defined, and ill-defined. These researchers state positive interdependence is essential to cooperative learning.

The members of a cooperative learning team must work together to accomplish a group goal and the performance of each group member is assessed. The members are held responsible for their team reaching their goal (Antil, Jenkins, Wayne, & Vadasy, 1998). These four researchers from the University of Washington and Washington Research Institute examined the use of cooperative learning by six elementary schools in two districts. Ninety-three percent of the teachers indicated that they were using some form of cooperative learning on a regular basis. Of these teachers, many were randomly selected for interviews and observations. The researchers found that only a few teachers were using the recognized form of cooperative learning, as many lacked the individual accountability to group goals. Positive interdependence and individual accountability are the centerpieces of cooperative learning.

To promote interdependence, it is important the students think they can reach their goal if and only if the other members also reach their goals. D. Johnson and R. Johnson (1999) are professors of education and co-directors of the Cooperative Learning Center at the University of Minnesota. They have conducted much research in the area of cooperative learning and discuss in their article how to make cooperative learning work, as well as define the methods and types of cooperative learning that they recommend. They believe that positive interdependence is a basic element of cooperative learning. They even promote the idea of rewarding the entire group for the group members' performance, giving each group member pieces and parts of an assignment that must be joined together to complete the task, or using complementary roles to give each group member a goal or purpose.

Overall, numerous researchers agree cooperative learning is not cooperative without the idea of interdependence. Antil, Jenkins, Wayne, and Vadasy (1998) conducted a study examining the idea of cooperative learning and if teachers really knew what it was that they were using in their classrooms. The researchers created a definition of cooperative learning for their study, and this definition relies on interdependence and individual accountability. The researchers' efforts were similar to Qin, D. Johnson, and R. Johnson (1995), as neither group of authors researched actual students. Antil, et al. interviewed and questioned teachers, while Qin, D. Johnson, and R. Johnson researched former published cooperative learning research studies. Qin, D. Johnson, and R. Johnson also created a definition of cooperative learning for their study: "the presence of joint goals, mutual rewards, shared resources, and complementary roles among members of a group" (p. 131). The researchers shared definitions of cooperative learning relying on interdependence, even though they didn't research actual students in a cooperative learning setting. The only authors to actually research student performance with students were Stevens and Slavin (1995). Using a cooperative learning model for two years with 1,012 students, the researchers stressed that the model's group goals and individual accountability would promote positive interdependence among the group members.

The research I reviewed in this section was conducted in different ways. Antil, et al. (1998) relied on teacher interviews and teacher observations. Qin, D. Johnson, and R. Johnson (1995) studied 46 different research studies and analyzed the effectiveness of cooperation on problem solving ability. Stevens and Slavin (1995) researched cooperative learning using treatment and comparison schools. The teachers were trained in a cooperative learning model that was gradually phased in to the treatment schools. Measurement was obtained using pre-tests, post-tests, and attitude surveys. Stevens and Slavin spent years preparing and administering their

research. All three studies were conducted in very different ways, but shared the idea of interdependence.

Interdependence is the key to successful cooperative learning in the classroom, and this is seen with all three research studies. Learning is not cooperative without interdependence. Whether the research is administered with students, teachers, or with the researchers themselves, the theme of interdependence makes the learning cooperative.

Increased Achievement

Qin, D. Johnson, and R. Johnson (1995) found that members of cooperative teams outperformed individuals competing with each other on all types of problem solving. They first defined problem solving as linguistic, non-linguistic, well-defined, and ill-defined. They analyzed 46 studies on cooperative learning published between 1929 and 1993. This meta-analysis showed an increase in math achievement using cooperation.

Leikin and Zaslavsky (1997) studied the different interactions of students in a cooperative learning setting of low-level ninth-grade students. They took one problem and studied four classes divided into two pairs. The first pair studied problems using a cooperative learning method and the second pair learned the material in a conventional way. The students were observed and filled out questionnaires. The researchers found that small-group cooperative learning facilitates a higher level of learning activities.

Stevens and Slavin (1995) found that gifted students in heterogeneous cooperative learning classes had significantly higher achievement than their peers in enrichment programs without cooperative learning. They used mainstreaming and peer coaching as well as parent involvement. After one year, achievement was seen in reading vocabulary and after 2 years, math computation was higher than similar students in comparison schools. D. Johnson, and R.

Johnson (1999) stress that a student's extraordinary achievement comes from a cooperative group, not from the competitive efforts of an isolated individual. The authors state that cooperative learning results in process gain, more time on task, and can ensure that students are performing to their potential allowing for high student achievement.

Leikin and Zaslavsky (1997), as well as Stevens and Slavin (1995), found definite increased achievement in the students of their studies. Both research studies used attitude surveys, observations, and a form of assessment. The Leikin and Zaslavsky study used mostly observation as the assessment while the Stevens study used both pre and post-tests. Qin, D. Johnson, and R. Johnson (1995) relied solely on results of many different research studies. All three studies found performance being increased and enhanced by working cooperatively. Even though the different studies measured achievement in a different way, they all three identified that cooperative learning can increase achievement.

Empowering Learners

To empower means to give the ability or power to the student. They are in control of their own learning. Smith (2000) studied the dilemmas faced by an experienced math teacher trying to reform her mathematics curriculum. She found that giving the students control can be one of the hardest things for a teacher to do, but one of the most beneficial for students' learning. Students work together for longer periods and question each other, allowing the teacher to sit back and listen rather than lecture. By controlling her students' learning she was ensuring their success, but limiting their growth in problem-solving skills. She stated that

> How to challenge students in ways that empower them as learners of mathematics, and yet provide sufficient support for them to meet the challenges in complex tasks without

> reducing the demand of the tasks, is the dilemma at the heart of educational reform. (p. 373)

As a teacher, I am trying to let the students discover and learn on their own, but I need to give them enough support to get there. Cooperative learning can empower them to discover and learn on their own, with the teacher acting as the supporter and not the sole provider of information.

Stevens and Slavin (1995) state that the cooperative learning structure helps students to manage the classroom. When the students take more responsibility, it frees teachers from time on managerial tasks to giving more individualized instruction to the students that need it. Antil, et al. (1998) encourage the empowerment to continue to see students who are excited, active and engaged with cooperative learning. To empower the students is to give them goals to achieve together and roles to help them along the way. The students are in charge of their own learning. D. Johnson, and R. Johnson (1999) state the purpose of cooperative learning groups is to make each member a stronger individual. Students are held individually accountable to do their share of the work. They are in control. They have the power. The teacher is the encourager rather than the lecturer.

Smith (2000) relied solely on one teacher and her dilemmas in teaching. She used teacher interviews and observations to measure her research. Teachers want to empower students to think for themselves. Many teachers will change the way they teach to increase the students' ability to think and reason for themselves. She wanted to study how teachers deal with this change, and what the student result can be. Students achieve more when they are empowered to think for themselves. The Antil, et. al(1998) study focused on many different teachers: eighty-five teachers completed surveys with seventy-nine saying that they used cooperative learning. Many of the teachers chose to use any model of cooperative learning to empower their students.

The only problem was that if they did not use the model correctly, the students would not be empowered. Authors of all three studies agree that cooperative learning can empower students, and lead to a more successful classroom.

Structure

One of the most important themes in cooperative learning is structure. Battistich, Solomon, and Delucchi (1993) state, "…simply placing students in groups to work together, even under a cooperative incentive does not ensure that they will engage in positive interactions" (p. 20). The researchers saw the importance of teachers relying on structure with cooperative learning. There were more positive results with trained teachers using a cooperative learning method with the students. The study included eighteen fourth through sixth grade classrooms and measured students attitudes and skills using small-group learning experiences. The effect of the cooperative learning on students depended on the group interaction. The outcome of the group will be more positive with more structure to begin with. Smith's (2000) idea of structure was the conflict between structuring her students for success, and structuring for developing of skills. She almost structured too much and did not let the students control their own learning. There has to be a balance. Antil, et al. (1998) say that if it is individual, it is probably not cooperative learning. D. Johnson, and R. Johnson (1999) and Sapon-Shevin (1994) agree that students must be explicitly taught the leadership, decision-making, trust-building, communication, and conflict-management skills just as purposefully as academic skills. Students need a structure of how to work together, rather than just forcing students to sit by each other and expecting good things to take place.

Battistich, Solomon, and Delucchi (1993) state that most teachers have little or no training in managing small groups effectively, with the result of students being placed in groups without adequate preparation for working together. Just putting students together in a group does not make it cooperative learning. Leikin and Zaslavsky (1997) state that implementing any cooperative small-group setting does not automatically ensure cooperative work. Sapon-Shevin (1994) states "…simply placing them in cooperative groups and instructing them to 'cooperate' is not likely to be sufficient" (p. 184). Issues of race, class, and typical middle school frustrations will not be resolved just by sitting the students together in a team. Teachers and students need to be better prepared for cooperative learning. There should be better models of cooperative learning as well as a deeper understanding of the principles and changes of these models.

Structure is essential to the successful cooperative learning classroom. Battistich, Solomon, and Delucchi (1993) studied teachers and students from 18 different classrooms. They trained their subjects for 40 hours on small-group interaction. This training solidifies the fact that one cannot just walk into a classroom and group students together to call it cooperative learning. A positive group experience comes from structure. Johnson and Johnson (1999) also emphasized the importance of structure in their study. The Antil (1998) study saw that structure was one of the key things that was lacking in many untrained teachers' classrooms. Both the Antil and the Battistich studies saw that with no structure there could be a negative group experience. Structure is a major theme in cooperative learning, as learning cooperatively relies on it.

Improved Problem Solving

Problem solving is characterized by its emphasis on students' thinking, reasoning, and communication. Students construct their understanding of these concepts through interactions with their peers and teacher according to Smith (2000). When students work together and

question each other, their problem solving ability can grow. D. Johnson and R. Johnson (1999), through their many years of research in the area of cooperative learning, have found that the more conceptual the task, the more problem solving is required. The more high-level reasoning and critical thinking that are expected, the more creativity required. The greater the application required of what is being learned to the real world, the greater the superiority of cooperative over competitive or individualistic efforts.

Qin, D. Johnson, and R. Johnson (1995) found that cooperative groups are better able to deal with complex problems than competitors working alone. They analyzed 63 relevant findings of cooperation being used to solve problems. These findings were from 46 research studies published between 1929 and 1993. In 55 of these studies, cooperation outperformed competition. Qin, D. Johnson, and R. Johnson define cooperation as the presence of joint goals, mutual rewards, shared resources, and complementary roles among members of a group. Competition was defined as the presence of a goal or reward that only one or a few group members could achieve by outperforming the others. In only eight findings were competitors more successful than cooperators. Qin, D. Johnson, and R. Johnson found that possible reasons why cooperation increased problem solving success was: the exchange of information and insights among the cooperators, the variety of strategies shared to solve the problem, the increased ability to translate the problem into the students' own language, and the development of shared response to the problem.

Smith (2000) and Qin, D. Johnson, and R. Johnson (1995) agree that cooperative learning can enhance and support mathematical problem solving ability. Overall, problem solving can be more successful for many students in a cooperative learning setting. Whether the result was from data recorded in former research studies (Qin, D. Johnson, and R. Johnson, 1995), or from

teacher interviews and observations (Smith, 2000), both research studies observed the enhancement that cooperative learning can give to solving complex mathematical problems. The ability to share different perspectives, relate the problem to “kid-talk”, and share ideas for solutions makes problem solving benefit from cooperative learning (Antil, Jenkins, Wayne, & Vadasy, 1998). D. Johnson, and R. Johnson (1999) stress that extraordinary achievement comes from a cooperative group. One of the areas that they have observed this positive achievement in was the higher-level reasoning and thinking required in problem solving. These researchers agree that problems can be attacked successfully with a cooperative effort.

Conclusion

After reading many articles on cooperative learning, I have found some repeating themes. Interdependence is essential to productive cooperative learning. All articles agreed on the importance of interdependence in a cooperative learning setting. Structure can ensure better achievement and the students will be empowered with controlling their own learning for success. Smith (2000), D. Johnson, and R. Johnson (1999), Sapon-Shevin (1994), Antil, et al (1998), and Battistich, Solomon, and Delucchi (1993) all agree on using structure in cooperative learning. These articles all agreed that just putting the desks together in pods does not make a successful cooperative learning classroom.

Problem solving is one particular area in which cooperative learning can be very beneficial. Overall, the research solidifies in my mind that cooperative learning is a valid classroom tool.

My research focus is using cooperative learning with the Saxon Course 3 book as it is an individualized textbook. Can cooperative learning benefit the Mental Math, Daily Practice, and Problem Solving in the Saxon book? Research could not answer this question for me. There were a few research articles on the Saxon curriculum itself, but I could not find a single article

on using cooperative learning with the Saxon curriculum. Research has proved that cooperative learning can increase math performance and confidence in problem solving, but problem solving hold a different meaning for different people. It would be helpful to see research in all areas of mathematics with cooperative learning, even in areas other than problem solving.

Purpose Statement

The purpose of my action research project is to determine how cooperative learning changes students' understanding of mathematics with an individual based curriculum. The textbook I use is primarily individualized (Hake, 2007). Will working cooperatively allow students to understand the curriculum more? Could working in groups on their math assignments and problem solving allow students to gain a knowledge that they would not have gained if they worked alone at their desk? I have too many questions to answer about this problem so I narrowed it down to four research questions:

Question 1: What will happen to students' abilities to complete mental math when asked to work cooperatively?

Question 2: What will happen to students' abilities to complete their daily math assignments (written practice) when asked to work cooperatively?

Question 3: What will happen to students' confidence in themselves as problem solvers when asked to work cooperatively?

Question 4: What happens to my teaching when I try to incorporate cooperative learning into my classroom?

Method

I began my research in January by putting the students into their cooperative learning teams. Before the Christmas break, the students were given a chance to indicate who they

"wanted" to work with. I hypothesized this would minimize the clashing of student personalities. I wanted to use the model that D. Johnson, and R. Johnson highlighted in their book *Learning Together and Alone* (1975). This model uses cooperative learning to emphasize both academic and interpersonal skills. Johnson and Johnson have a five-element standard that encourages a goal, reward, resource, role, or task. They also encourage assigning specific roles to the group members. D. Johnson, and R. Johnson (1999) emphasize five elements: positive interdependence, individual accountability, face-to-face promotive interaction, social skills, and group processing. My Pre-Algebra classes and I studied what was important about these elements and working cooperatively. The students knew that just sitting together does not make the team cooperative. I planned my lessons according to the structure and advice of Johnson and Johnson (1999). We worked toward group goals, stressing interdependence as one of the main goals. The students are required by the Saxon curriculum to complete daily mental math activities. I asked the individuals to complete a Mental Math survey (Appendix A) in January that would be followed up in April with another survey (Appendix B) to measure growth (if any). After the pre-survey, we began our daily mental math lessons. The students were given a job to complete such as recorder, reader, or leader. They had three minutes to complete their mental math problems by working together. Each day the jobs changed. I kept a daily journal (see Appendix D for journal prompts) on observations I made during the mental math work time. I also kept all individual student scores on mental math, and I selected a few students to interview about their mental math experience (see Appendix C for interview questions). The students completed every mental math activity in their cooperative learning teams.

The daily assignments were also completed in teams using different cooperative learning strategies. One strategy I used was to have the groups complete their assignment by "complete

and pass." They would work a problem then pass the assignment to the next person in their group. If that person thought he or she could not complete it, he or she could ask the group for help or pass it to another person. Another strategy used was to assign certain problems to certain members of the group. They would then complete their problems then they were in charge of checking their group members' work. I kept examples of their daily assignment work as well as interviewed select students about their cooperative learning experiences (see Appendix E for interview questions). After the completion of each daily assignment, I wrote an entry in my journal (see Appendix D for journal prompts).

Every Friday, we would work select problem solving activities in our cooperative learning groups. Many of the problems were from the Saxon curriculum (Hake, 2007) while some problems were Habits of Mind problems. A Habits of Mind problem is a multiple step problem that requires the student to persevere and try many approaches to the problem to arrive at a possible solution. These problems require higher-order thinking skills and are quite beneficial to students. For Friday problem solving, the students were given jobs such as writer, reader, and leader. They used their allotted time to attempt the problem solving activities and recorded their work and answers on a small marker board. Everyone was asked to participate as the jobs changed after every problem solving activity. The more problem solving activities they completed on Friday, the more points their group would receive. These points for group work were redeemable for prizes such as pop, candy, free assignments, and more. Before our Friday problem solving challenges began in January, I had the students complete individual pre-surveys (Appendix H) about their problem solving abilities. The individuals completed a post-survey in April (Appendix I). I also had the students journal about their cooperative learning teams when

problem solving on Fridays. They would record their group's abilities to work together as well as the journal questions (Appendix F) that I developed.

I gave all pre-project surveys in January and gave both post-project surveys in April. I made sure to journal weekly on my teaching practice (see Appendix J for journal prompts) in the classroom as well as journal daily on my cooperative learning observations (see Appendix D for journal prompts). The most difficult thing was balancing the researching with the teaching. I could easily collect the student work and make my observations. The hard part was finding time to interview students, as our schedules were so busy. I did have to make a few adjustments on my calendar to collect the data that I needed, but these challenges were worth the effort.

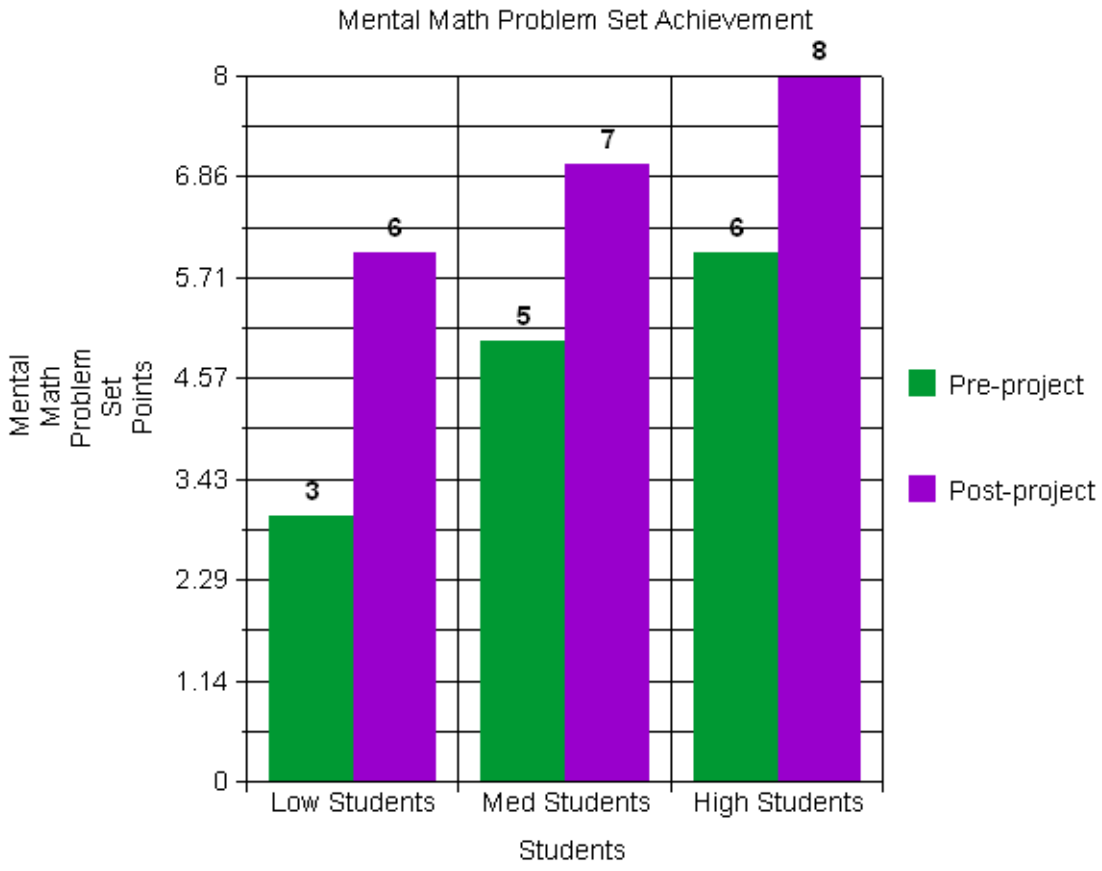
Findings

A typical day in my classroom with the Saxon Course 3 textbook (Hake, 2007) before the action research project involved the first two minutes as Mental Math timed facts test. The students then had about three minutes to complete a Mental Math set of eight problems that reviewed various mathematical skills. These were all completed individually then checked aloud in class by the students. The lesson of the day was then taught, usually with some type of supplemental hands-on activity, and the problem set was practiced by the students individually. Finally, the Written Practice daily problem set was assigned with the students finishing their thirty problems as homework.

During the research project, the classroom became much more animated. The Mental Math problems were completed in the learning teams as described in the Methods section. The lessons were still taught with supplemental hands on activities, but there were more opportunities for discussion with the cooperative learning teams. Finally, all assignments were completed in the cooperative learning teams using one of the methods described in the Methods section.

Assignments were full of discussion, and students were discussing more and more among their learning teams rather than only with me.

The first research question that I investigated was “What will happen to students’ abilities to complete mental math when asked to work cooperatively?” I found that students correctly completed more mental math problems correctly when working cooperatively. I kept a daily record of correct responses on mental math problems. These mental math problems are eight problems at the beginning of each Saxon lesson. The problems are to be worked without calculators, and students can earn up to eight points a day. The average response in November before working cooperatively was a little more than five points per assignment. After working cooperatively, students’ average in April increased to around seven points per assignment. This indicates that working in a group helps students earn more points on their mental math assignments. I also saw particular students’ point totals increase while participating in a team. This was especially true of the lower ability students grouped with students of higher ability. One particular student had averaged one to two points per mental math problem set in the fall. After joining his group, he is averaged five to six points per mental math problem set. I think his improvement was a result of working cooperatively as I noticed his team members encouraging him to finish his work, as well as correcting his frequent mistakes. The graph below shows the relationship of Mental Math performance before and during cooperative learning.

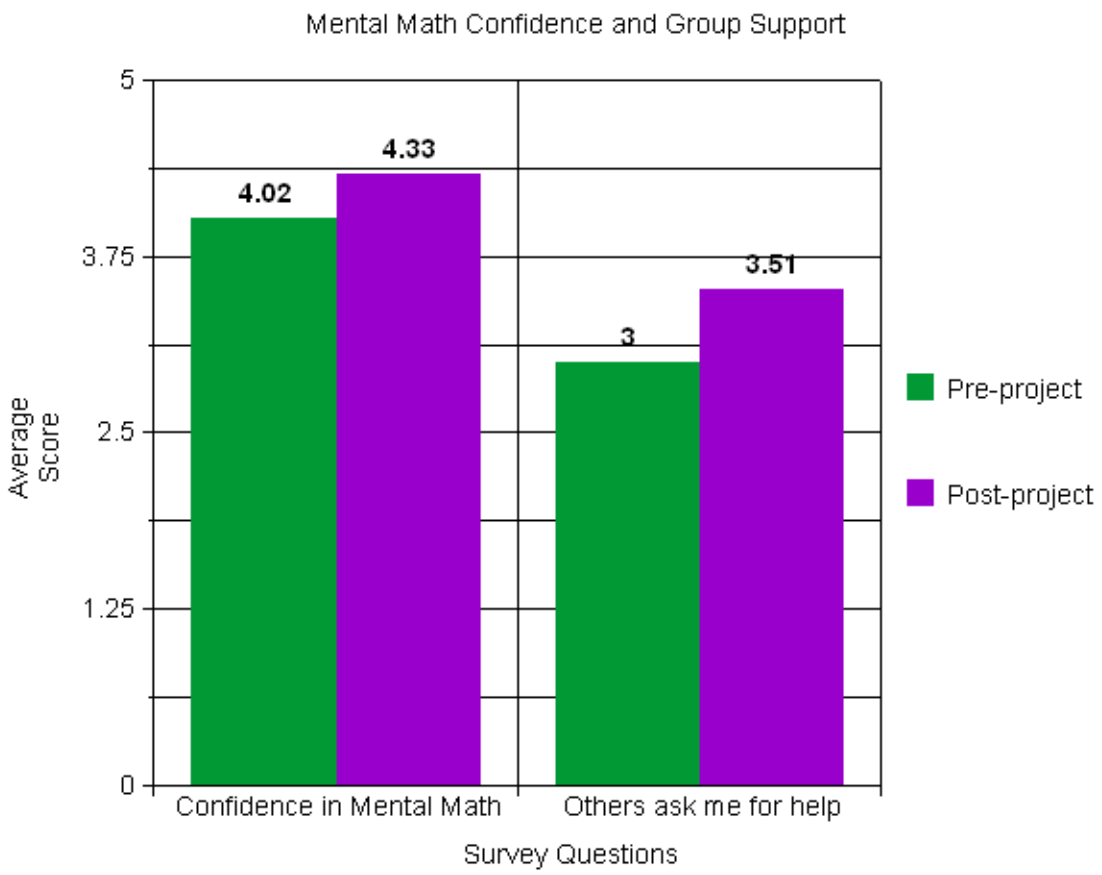


In my observations of students, I noticed that more than half of each class worked harder on the mental math problems than they did before the project began. I stated in my observation journal: “I saw the students trying to complete all the mental math problems that they could” (Personal Journal, February 18, 2008). This is a contrast from how some of the students worked on mental math before January. I can not say that every student was engaged and trying to do all the problems that they could before January. I know I was not looking specifically at this, but I do have a record of some students who would not complete any problems at all. These students are now completing all they can because of their groups.

I interviewed five students on their mental math experiences. Question number five in my interview was, “What helps you get involved in mental math?” All five students indicated that

their groups help them get involved in the mental math. Two even stated that they enjoy working on the mental math problems in groups because they finish the problems faster. All five interviews indicated that they work hard on doing their part on the mental math, and one emphasized that she encourages others in the group to complete their problems as well.

I also saw improvement on the surveys that were given before and after the cooperative learning research began. Before the project, students indicated with an average score of 4.02 with a Standard Deviation of 0.8 that they felt confident when completing mental math in their cooperative learning groups. This is on a 1-5 scale with 1 being Strongly Disagree and 5 being Strongly Agree. This score became an average of 4.33 after the project with a Standard Deviation of 0.64. I believe that this shows that of the 63 students surveyed, most felt their confidence grow. The students also indicated that more students ask them for help on the mental math problems now that they are learning cooperatively. This score went from an average of 3 with a Standard Deviation of 1.06 before the project to an average of 3.51 with a Standard Deviation of 0.7 after the project. The graph on the next page displays this growth in confidence and in group support which helps achievement on Mental Math.



It seems that using cooperative learning in the classroom helps students to complete more mental math problems correctly than working on the mental math individually. They have group members to encourage them to get problems done, and to motivate them to work. They still complete their timed facts test individually, and I can attest to growth in their math facts. I am actively engaged in observing the students while they work, and they each have a specific job they must complete for their team or they won't receive any credit. By doing their jobs for their team, they are ensuring that each member succeeds on their daily Mental Math problems.

My second research question was, "What will happen to students' abilities to complete their daily math assignments, also known as Written Practice?" when working cooperatively. I found that students' understanding increases on the daily assignments when working cooperatively. Understanding can be defined and measured in many different ways. I believe

that students understand a concept when they can work without my prodding them every step of the way. Students' understanding can display itself when they explain a concept to another student.

I noticed this trend first in my daily assignment journal. Before the project began, many students would ask me questions. I could not always answer all of the students' questions due to the limited class time. Also some students would put their hands down after waiting awhile, and I never knew if this was because they got tired of waiting or they had their question answered. After the project began, the students were asking each other math questions before they asked me. I saw this first on February 6, 2008 not long after the project began. Their frustration on waiting with their hand up was getting better, and they began to ask others in their group before they asked me. This was noted in my observation journal with this entry: "…the trust in themselves seems to be growing though, but my only evidence of that is they go to each other now more than they go directly to me" (Personal Journal, February 6, 2008). As a teacher, I was ecstatic because I was free to help groups one-on-one rather than focusing on the class as a whole.

I also shared in my journal on February 12th that students were working together more and relying on each other more. This is evident when they asked each other for help before they ask me. I made the following entry on March 10th:

> My students are becoming more confident with each other as their communication with each other has grown. I see them going to each other more often than going to me with their questions. This week I answered no questions at all during the problem solving on Friday. (Personal Journal, March 10, 2008)

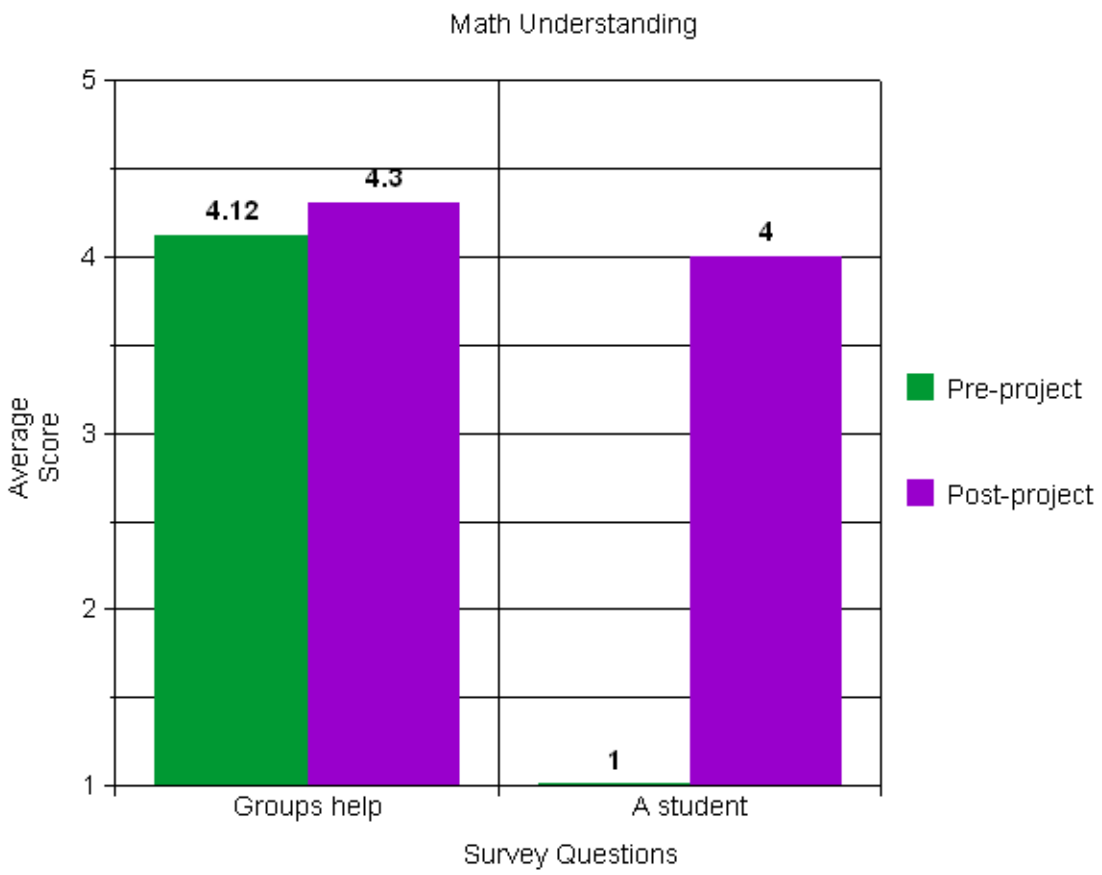
Obviously, understanding was a work in progress, and I had to structure classes sometimes to force the students to communicate if they were understanding a concept or not. Yet the understanding was happening.

I also found this trend in the student interviews. Two of the students I interviewed told me that, “I get to ask my group questions before I have to ask the teacher.” The first student believed that her group members were so confident and understood the material so well that all she had to do was ask them and they would explain it to her. The other student stated: “If I have a question I get the chance to ask my teammate from their perspective first before I ask the teacher.” I trust that this is beneficial because peers can sometimes explain concepts to each other better than I can explain it to them.

Before I began the project I knew that students understood certain concepts by looking at their grades on the daily assignments, but rarely was I able to discuss the math with them. By requiring the students to do a certain amount of problems and discuss their answers to these problems to their teammates, the students were communicating mathematically more than they were before. These students were also checking for understanding of the math concepts, and not only their own understanding but the understanding of the group as a whole. There have even been some instances in which students ask there team members, “How did you get that?”, and the students have to communicate methods as well as answers. I know from experience that I must truly understand a concept before I can explain it to another person. One student stated, “My group helps to keep me on task so I know what is going on.” This person will know more about math because her group helped her to focus on the math rather than other things going on in the room. Before the cooperative groups, students would only have had feedback on their understanding from their homework or answers to questions in class. Now, through the

organization of the cooperative learning, the students were checking for understanding on every single daily math problem. Every student on the team was required at some time during the lesson to prove their understanding, yet the group was there to coach them through it if they needed help. They were there for each other.

They students were questioned on pre-surveys and post-surveys about whether working in groups helped them to understand math concepts better. Students stated before the project an average score of 4.12 with a Standard Deviation of 0.93, and after the project an average score of 4.3 with a Standard Deviation of 0.67. This tells me that their opinion didn't change much from beginning to end, but many students indicated that they actually used their groups to help them understand math concepts. About half also believed that their math groups could help them to understand math better, one student even progressed from a score of 1 (Strongly Disagree) before the project to a score of 4 (Agree) after the project. She felt her group helped her understand math concepts more than working alone. The graph on the next page shows this slight growth for the class total and the large growth for my second period student.



I also wondered about students' confidence in problem solving individually versus in a cooperative learning team. Confidence can be measured in many different ways, but I defined confidence with my students as the ability to attempt a problem solving problem. I was not looking at accuracy of solutions, just the chance to try to answer each problem solving problem on every Friday. My research question was, "What will happen to students' confidence in themselves as problem solvers when asked to work cooperatively?" Students were more confident working in a cooperative learning team than working on problem solving by themselves.

I had the students keep problem solving journals. Fifty-six of the sixty-two students who have written in their journals about problem solving in their cooperative learning team have indicated that working in a team allows them to help each other and check each other's work.

One student wrote, "…it is fun to see what we all get (for answers as well as methods to get the answers)…." Many students indicated the same feeling that cooperative teams were a place to share. This tells me that students can help each other to solve problems as well as help them to see different ways to solve problems. Another student journal entry stated, "We can discuss the answers in our group, and we can ask each other for help." This is further evidence to me that the students are helping each other on problem solving while working in cooperative learning teams. Another student explained that, "If we don't understand the problem, we can ask someone in our group to explain what the problem is asking." Students help each other in many ways while working on problem solving in their cooperative learning teams--ways that were not experienced while working on their own.

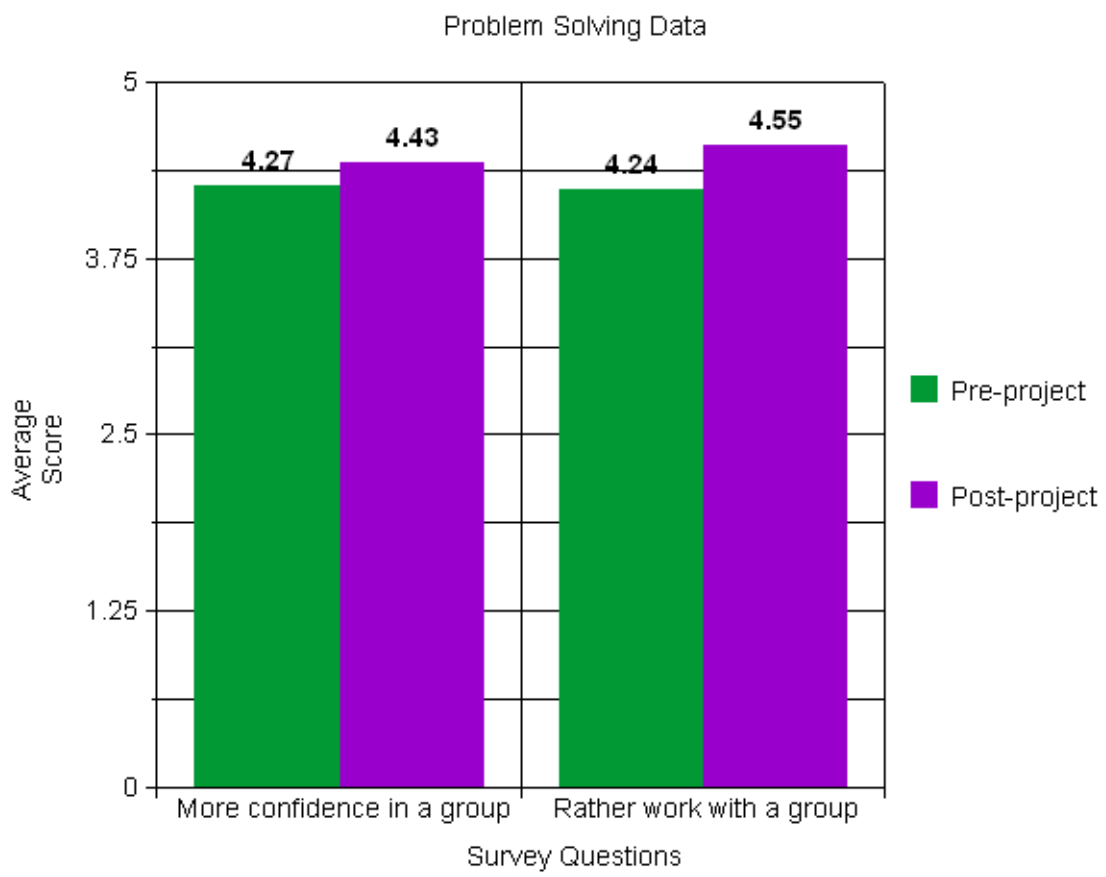
In student interviews, I focused questions on using cooperative learning to solve problems in math. We completed problem solving in our groups every Friday and I interviewed seven students about their experiences with cooperative learning while problem solving. One student stated, "I would rather do problem solving in a group because we can learn from each other more." This tells me that she would prefer to work on problem solving with her team because of the help that her team gives her. Another student said, "Working in my team helps me to get a new perspective on math."

There is more than one way to solve any problem, and when students work together with a team they can see other ways to solve the same problem. Students become better problem solvers and begin to see many different methods to solve problems. A cooperative learning team allows students to help each other experience different ways to solve problems.

The students completed a pre and post-survey to determine their opinion of how cooperative learning would affect their problem solving confidence. One question that I

addressed in the survey was the fact that the students have more confidence to try problems when they work in their cooperative learning groups. Before the project, they indicated an average score of 4.27 with a Standard Deviation of 0.89 on a 1-5 scale when 1 means Strongly Disagree and 5 means Strongly Agree. After the project their score went up a small amount to 4.43 with a Standard Deviation of 0.8. This is not a significant jump for the sixty-two students, but I did see an increase in many of the scores when it came to confidence in working together.

The last question I asked them on their problem solving survey was "Would you rather work with a group on problem solving than by yourself, and Why or Why not? The class average score before the project was 4.24 with a Standard Deviation of 1.22. The average score after the project was 4.55 with a Standard Deviation of 0.92. This may not be a statistically significant change, but it does tell me that many students would rather work in their groups on problem solving than work on their own. Some students did state on their surveys that the best thing about working in a group is that, "…we help each other…." Working on problem solving in cooperative learning teams allows students to help each other understand math problems as well as find the many different ways to solve these problems. The graph on the next page displays the improvement from the survey questions on problem solving.



The last research question that I investigated was: “What happens to my teaching when I try to incorporate cooperative learning in my classroom?” Saxon Course 3 textbook is known for its ability to be an individualized method of repeated practice. Many teachers use Saxon in the way that it promotes; ten minutes on the Facts Test and Mental Math, a twenty-five minute Lesson, and the Written Practice problems start in class and finish at home as homework. Teaching this way in a middle school situation does not leave much time for cooperative activities. The Saxon textbook recommends a certain amount of time spent on each part of the lesson. Moving to cooperative learning would mean that as a teacher I would have to restructure the lessons in order to fit them in the fifty-four minutes that I am given with each class period. I would have to change the way that I was teaching from the Saxon book.

I found that when I use cooperative learning, the classroom becomes centered on the students and not the teacher. I started the year with standing at the front of the room, being the "timekeeper", and being the instructor of the lesson. I began using the structure of cooperative learning teams to complete the Mental Math, and each student was given a certain job to complete each day. I followed with cooperative activities on each daily assignment in their teams, and I also moved the problem solving from the daily lessons to a special day just for problem solving. I began to notice that I was no longer the instructor of learning, but I became the facilitator of learning.

In my personal journal, I found an example of when I first realized that the classroom environment was no longer centered on me at the board or standing in front of the classroom. My entry read:

> I am changing from a teacher that primarily worked their examples on the board and stressed seatwork, to a teacher that forces students to work together and be more independent while working on their own. I just need to make sure that I am more structured and I take more risks with my project as they can't be successful if I don't give them the chance to be. (Personal Journal, March 10, 2008)

I struggled with this change in that I had to manage the classroom differently and put faith and trust in the students that they could meet their objectives.

By taking me out of the equation, the students go to each other for answers to their mathematical questions. When I am in front of the class at the board, I only get a chance to answer a few questions. I see what a disservice this could be to students as there may not be time to answer all of their questions. It has been quite amazing to see them start to go from relying on me for answers to relying on each other. I first noticed the students relying on each other when I

read the third entry in my journal. I wrote, "…the trust in themselves and their groups seems to be growing though, but my only evidence of that is they go to each other now more than they go directly to me" (Personal Journal, Feb. 11, 2008) This entry confirms that I observed answering fewer questions, and I saw the students going to each other more after not much time with cooperative learning incorporated into the classroom. I again noticed a few weeks later something totally amazing about their problem solving.

> My students are becoming more confident with each other in their groups as their communication with each other has grown. I see them going to each other more often than going to me. This week I answered no questions at all during the problem solving on Friday. (Personal Journal, March 10, 2008)

I did not answer a single question during their problem solving on Friday. That has never happened before in my teaching. The students asked their group members every question that they had on the problem solving activity. They were definitely focused on the math lesson and not on me.

The students' learning was definitely more focused on themselves when they were not just sitting at their desks listening to the teacher lecture. When they were actively involved in the mathematics; whether at the front board, at their desks with white boards, or in their cooperative learning groups, they were in control of their own learning. This was included in one of my personal journal entries, "I want them to be more actively involved in every single problem. I tried to make this happen by asking them first to work on the marker boards. They then had to be responsible for every single problem together" (Personal Journal, February 25, 2008). I see the evidence of the students group work when I use another tool besides lecturing at the front of the room. By making the students actively involved in the learning, they can gain more from each

other than I could give them with strictly demonstration at the front of the room. Later in my journal I made the following entry:

> The cooperative learning overall is going well, with the groups using their time wisely and actively learning from each other. I have seen this on the group journals that I had them complete. They like to work together and learn from each other. I know how structured it needs to be, and now I notice that we are seeing the benefit of that structure. (Personal Journal, March 24, 2008)

By reorganizing my classroom and my teaching, the students can benefit greatly from each other. By focusing the classroom only on myself at the front of the room, I could be hindering their learning of math. Although the Saxon Course 3 textbook is primarily individually instructed, the students are empowered when the instruction comes from each other in their cooperative learning teams rather than from me.

Conclusions

When implementing cooperative learning into an individualized curriculum such as Saxon, I found that the student performance on Mental Math increased. I also found that the Written Practice daily assignments were enhanced and student understanding improved with cooperative learning teams. Problem solving has often been an area in which students are not confident in their math abilities, but I did see students become more confident working with their groups rather than solving problems on their own. Finally, my teaching was changed as a result of the cooperative learning. The students were now in charge of their own learning.

My findings prove to me that cooperative learning is a valuable tool for any classroom teacher. The fundamental theme of interdependence states that cooperative groups are only as strong as their weakest members, with each member being equally responsible for the learning

groups' successes or failures. This idea of interdependence was observed with the cooperative groups working out of the Saxon Course 3 textbook. The textbook focuses on the individual, yet the group focused on each other. Cooperative learning can indeed be implemented with an individualized curriculum like Saxon. I believe the students have successfully completed the requirements of our eighth grade curriculum with cooperative learning enhancing their journey. Just as Antil et al. (1998) say, that if it is individual, it is probably not cooperative learning. Cooperative learning can not just be implemented by sticking students together. D. Johnson, and R. Johnson (1999) and Sapon-Shevin (1994) agree that students must be taught how to work cooperatively. I taught them how to work cooperatively, but the students took it from there. The students grabbed on to the leadership, decision-making, and math skills that they needed to help each other accomplish the goals set out for them. They worked together to reach every goal they set for themselves. Smith (2000) found that giving the students control can be one of the hardest things for a teacher to do, but one of the most beneficial for students' learning. I saw my control over the students' thinking change when they were empowered to think for themselves. I assert that learning cooperatively is a valuable tool for learning in any classroom, but especially in my mathematics classroom using the Saxon math curriculum.

Implications

The school year has ended, but I have never been more excited to begin the next year. I know that I want cooperative learning to be an integral part of my classroom teaching practice. I do not want to wait until next January to implement another research project; I want to begin as soon as I can to incorporate cooperative learning as a tool in my classroom. Whatever book is chosen for my district, I know that I can incorporate cooperative learning as a tool for my students' success. With the Saxon Course 3 textbook, the students will most likely complete

more mental math problems working in teams. Their understanding of the written practice may be enhanced. They may even choose to work in teams during their problem solving rather than work by themselves. Based on my findings, I know that my students can be even more successful mathematics by working together.

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Student Interviews. (February 2008 to April 2008)

Appendix A

Research Question 1: What will happen to students' abilities to complete mental math when asked to work cooperatively?

Pre-Project Survey:

Please give your honest response to each statement
SA-Strongly Agree A-Agree N-Neutral D-Disagree SD-Strongly Disagree

	SA	A	N	D	SD
1. I feel confident when I complete mental math	5	4	3	2	1
2. Mental math helps me understand math better	5	4	3	2	1
3. Other students ask me for help on mental math	5	4	3	2	1
4. I enjoy working on mental math	5	4	3	2	1
5. I do the best I can on mental math	5	4	3	2	1

Please answer the following questions:
6. What is the best thing about mental math?

7. What is the worst thing about mental math?

8. What would make working on mental math better?

Appendix B

Research Question 1: What will happen to students' abilities to complete mental math when asked to work cooperatively?

Post-survey

Please give your honest response to each statement
SA-Strongly Agree A-Agree N-Neutral D-Disagree SD-Strongly Disagree

	SA	A	N	D	SD
1. I feel confident when I complete mental math in my group	5	4	3	2	1
2. Mental math helps me understand math better	5	4	3	2	1
3. Other students ask me for help on mental math	5	4	3	2	1
4. I enjoy working on mental math	5	4	3	2	1
5. I do the best I can on mental math	5	4	3	2	1

Please answer the following questions:

6. What is the best thing about mental math?

7. What is the worst thing about mental math?

8. How did your teamwork change your mental math experience?

Appendix C

Research Question 1: What will happen to students' abilities to complete mental math when asked to work cooperatively?

Student Interview Questions

Student: Class: Date:

1. What do you like best about Mental Math?

2. What do you like least about Mental Math?

3. What makes Mental Math easy or difficult for you?

4. How would you rate being involved in Mental Math on average? 1 is NOT involved and 4 is VERY involved. Why?

5. What helps you get involved in Mental Math?

6. Does working in your team help you get involved in Mental Math?

7. How do you participate in your learning team?

8. What do you think about doing Mental Math in your learning teams?

9. What do you like/dislike about working with your team on Mental Math?

10. How confident are you in your Mental Math ability?

11. Are you more confident working on Mental Math alone or with your team?

12. As I am planning for my math class next year, what advice would you give me about doing Mental Math?

13. As I am planning for my math class next year, what advice would you give me about having my students work in teams?

14. Is there anything else I should know about your Mental Math experience?

Appendix D

Research Question 1: What will happen to students' abilities to complete mental math when asked to work cooperatively?

Teacher Journal Prompts

1. What changes have I seen today in my students' Mental Math ability?

2. What surprised me about their Mental Math today?

3. What went really well today?

4. What did not go as well as planned? What tensions do I feel?

Research Question 2: What will happen to students' abilities to complete their daily math assignments (written practice) when asked to work cooperatively?

Teacher Journal Prompts:

1. What changes have I seen today in my students' ability to complete their daily assignments?

2. What surprised me about their ability to work on their math today?

3. What went really well today?

4. What did not go as well as planned?

5. What tensions do I feel between being teacher and researcher?

Research Question 3: What will happen to students' confidence in themselves as problem solvers when asked to work cooperatively?

Teacher Journal Prompts:

1. What changes have I seen this week in my students' problem solving ability?

2. What changes have I seen this week in my students' ability to work in their teams?

3. What surprised me most about their ability to work in their teams this week on problem solving?

4. What went really well this week?

5. What did not go as well as planned this week?

6. What tensions do I feel between being teacher and researcher?

Appendix E

Research Question 2: What will happen to students' abilities to complete their daily math assignments (written practice) when asked to work cooperatively?

Student Interview Questions:

Students: Classes: Date:

1. How has working in your teams affected your ability to complete your daily assignments?

2. What helps you work better with your team?

3. What is your role as a team member in completing your daily assignments?

4. How does the cooperative learning team help you learn math?

5. How has working in the team affected your knowledge of math?

6. What could make the daily math assignments better?

7. Is there anything else you want to know from me?

8. Is there anything else I should know about you to better understand how your cooperative learning team affected your ability to complete your daily assignments?

Appendix F

Research Question 3: What will happen to students' confidence in themselves as problem solvers when asked to work cooperatively?

Student Journal Prompts:

1. What is good about doing the problem solving in your teams?

2. What can make the problem solving better in your teams?

3. What do you like about working in a team?

4. What needs to be changed to make your team work better?

5. What is your role in your cooperative learning team?

Appendix G

Research Question 3: What will happen to students' confidence in themselves as problem solvers when asked to work cooperatively?

Student Interview Questions:

Student: Class: Date:

1. What is your attitude toward cooperative learning in the math class?

2. How has your attitude toward cooperative learning changed since you began working as a team?

3. What is it important to work together on a cooperative learning team?

4. What helped you work better as a team?

5. What could your teacher have done to help your team work better?

6. How has the cooperative learning team helped you learn math?

7. How does your team approach a story problem?

8. Is there anything you want to know from me?

9. Is there anything else I should know to understand how your teamwork has affected your ability to solve problems?

Appendix H

Research Question 3: What will happen to students' confidence in themselves as problem solvers when asked to work cooperatively?

Problem Solving/Confidence Survey (pre-project)

Please give your honest response to each statement
SA-Strongly Agree A-Agree N-Neutral D-Disagree SD-Strongly Disagree

	SA	A	N	D	SD
1. I like to work in groups in my math class	5	4	3	2	1
2. I ask questions of others when I work in a math group	5	4	3	2	1
3. Other students in the group ask me questions	5	4	3	2	1
4. I have more confidence to try problems when I work in a group	5	4	3	2	1
5. Working in a group helps me understand the Math concepts better	5	4	3	2	1
6. I would rather work with a group on problem Solving than by myself	5	4	3	2	1
7. I am a better problem solver with a group	5	4	3	2	1

Please answer the following questions:

8. What is the best thing about working together in groups?

9. What is the worst thing about working together in groups?

10. When do you prefer to work in a group? When do you prefer to work by yourself?

Appendix I

Research Question 3: What will happen to students' confidence in themselves as problem solvers when asked to work cooperatively?

Problem Solving/Confidence Survey (post-project)

Please give your honest response to each statement
SA-Strongly Agree A-Agree N-Neutral D-Disagree SD-Strongly Disagree

	SA	A	N	D	SD
1. I like to work in groups in my math class	5	4	3	2	1
2. I ask questions of others when I work in a math group	5	4	3	2	1
3. Other students in my team ask me questions	5	4	3	2	1
4. I have more confidence to try problems when I work in a team	5	4	3	2	1
5. Working in a group helps me understand the Math concepts better	5	4	3	2	1
6. I would rather work with a my team on problem Solving than by myself	5	4	3	2	1
7. I am a better problem solver with my team	5	4	3	2	1

Please answer the following questions:

8. What is the best thing about working together in groups?

9. What is the worst thing about working together in groups?

10. When do you prefer to work in a group? When do you prefer to work by yourself?

Appendix J

Teaching Research Question: What happens to my teaching when I try to incorporate cooperative learning in my classroom?

Teaching Reflection Questions

1. What did my teaching look like in my classroom this week?

2. What am I keeping the same?

3. What am I changing as a result of my research questions? Why?

4. What does the change in my classroom look like?

5. What went well with my teaching this week?

6. What challenges did I face in my teaching this week?

7. What is going well with cooperative learning this week in my classes?

8. What do I need to think further about in my teaching, related to my action research project?