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Increasing Academic Achievement in High School Mathematics Students
Through Cooperative Learning Strategies

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Abstract

This qualitative teacher-action research study investigated the observed and reported experiences of high school students when cooperative learning strategies were implemented. The participants were 28 freshman and sophomore students in an honors geometry class. In the study, students first worked with a partner and then separated into groups of four.

Through observations, surveys, interviews, and the analysis of student work, it was determined that although cooperative learning had an insignificant direct effect on students' grades, it enhanced their engagement and motivation.

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Researcher Stance

When I was growing up in a family full of teachers, I should have known I would eventually gravitate toward that profession. But of course, like a lot of young boys, my dream was to become a professional athlete. My parents always told me that before I could become a pro I would have to go to college, and in order to go to college I had to study hard and get good grades in high school. It was sometime during my four years of high school when I realized I was not going to make it in the major leagues, NFL, or NBA, but those educational values instilled in me when I was smaller drove me to continue my education after high school, to go to college, and to get a good job.

I entered Temple University's business school with the idea that a career in actuarial science would make me rich and successful. After two years and a horrible internship experience in which I worked in the solitude of my own little cubicle, I knew this was not the right career path for me. I needed to work in a social setting, not only to be around other people, but also to work with other people and, more importantly, to help other people. Having loved math my entire life, coupled with my new recognition of what would best fit my personality, becoming a math teacher was the perfect fit.

I went into the teaching profession hoping to make an impact on students' lives and lead them towards the same opportunities that I had growing up. My high school education gave me the chance to learn a fair amount of information on a variety of topics. When I changed my major in college, I not only decided what I wanted to learn more about, but I also realized that learning how to learn was important. Being a lifelong learner was something I would not be able to avoid, and being a great communicator of information would be just as important, if not more important than just knowing the information. Those ideas are ingrained in my beliefs as a person and as an educator, and they have guided my teaching practices in my career thus far. However, I do not always see the students communicating with each other in my classroom. They are stuck in the pattern of coming into class, sitting at their desk, copying down the notes, then working on their homework. I feel that the lack of communication and interaction between students, as well as their disinterest in questioning and critically thinking about the subject matter, is preventing them from being fully engaged in the learning process. The thing that exemplifies this most is when it is clear from the blank stares or from the lack of chatter during class work exercises, that the students do not fully understand the material, yet will not ask questions to clarify their thoughts. Cooperative learning will force students to become more

engaged and take control of their own learning. It is one teaching strategy that positively affects student motivation, develops communication skills, raises students' problem solving ability, and fosters students' higher level thinking (Kagan, 1994).

Cooperative learning teaches students how to learn because it prevents the teacher from simply giving the information to the students. The teacher's job instead is to guide the students towards the answers to their questions. The students are forced to use other resources to help them, just like what is done in the real world. They can use their books, notes, other print and electronic tools, and most importantly, their partner or group mates. Learning how to learn and developing those problem solving skills are valuable tools students will use even after high school.

Being able to communicate is also vital to surviving in society. The skills, or lack thereof, that most students demonstrate while working with one another leave much to be desired. However, when students are forced to communicate with each other through different cooperative learning techniques, those skills get sharpened and allow them to discover the best ways to get their points across.

A final reason I feel that cooperative learning is important is because working collaboratively will not only improve students' grades, but also strengthen those skills they need later in life. Communicating and

learning how to learn are processes that people continually develop, even after high school and college, which lead them to becoming lifelong learners. All individuals must continue to learn and grow no matter what career path they choose. In order to increase their chances of success later in life, students must perfect those basic skills throughout their time in the classroom, and this study will allow them to do so. Therefore, I decided to study: What are the observed and reported experiences when cooperative learning is incorporated into a high school mathematics class?

Literature Review

Introduction

Cooperative learning is an instructional technique that puts the students in control of their own learning. It is no longer the teacher's responsibility to stand in front of the class and lecture the students while writing all of the pertinent information on the blackboard. The traditional way of teaching is being replaced by a more constructivist, 21st century model of the classroom where the students have more control over their own education (Cakici & Yavuz, 2010; Johnson, 2009). Cooperative learning will allow the students to discuss certain aspects of the lesson in detail and relate them to their own prior knowledge. Incorporating students' previous experiences into the lesson leads to more intimate contacts between the teacher and the students. Therefore, more guidance, from both the teacher and fellow classmates, is received. This is something that will lead to an increase in cooperative learning (Dewey, 1938).

Aside from the direct benefits of cooperative learning, the amount of collateral learning that takes place will benefit the students both inside and outside the classroom. The students are forced to work with others as part of a team, correctly communicate their thoughts and ideas to every member of the group, and develop the ability to see things from different

perspectives. All of these secondary benefits make cooperative learning a useful tool inside the classroom and also prepares students for success later on in life.

Peer Interaction

Cooperative learning is a very complex teaching strategy that has many different factors and byproducts. It has been a growing trend in the push toward 21st century education, but still many students are not accustomed to working with other students on a regular basis. Therefore, the benefits of cooperative learning may not be immediately apparent. Whicker, Bol, and Nunnery (1997) found this to be true in their study of cooperative learning. Although groups participating in the cooperative aspect of their study performed better on every test they administered than those who did not participate, it was not until six weeks after the cooperative learning techniques were administered that a significant gap between the two groups started to emerge.

Aside from time, which is a key factor in just about every part of education, the dynamics of a group or partnership goes a long way in determining the success of the students. McCurry's (2010) study of cooperative learning used peer tutoring as the mode of cooperation. She assigned certain students, whom she deemed to have strong mathematics skills, as the tutors, and arranged them to work with a small group of three

or four students who were not as capable. The majority of her struggling learners were able to increase their test scores consistently during the four weeks of tutoring that her study lasted. This idea of matching stronger students with weaker students was also utilized by Parsons, Marchand-Martella, Waldron-Soler, Martella, and Lignugaris/Kraft (2004). They found statistically significant differences between pretest and posttest scores of not only the struggling math learners, but also of the scores of the tutors themselves. So often the attention is focused on struggling learners and not on improving the ability of all students. "This study adds to the research on the use of peer tutors for remediation of mathematics skills" because of the significant improvement they showed on the tests given (p. 102).

The notion of grouping students with varying abilities in order to achieve the best outcomes is not the only way of grouping, however. Gijlers and de Jong (2005) found that it was best to group students with others who are near the same ability level. This is true because they have the same level of prior knowledge and normally complete tasks at a similar pace. Grouping students of similar abilities was helpful to both lower and higher achieving students because it was easier for them to work together to solve problems instead of one person waiting for the rest of the group to catch up.

Aside from ability levels, there is not a consensus in the number of students that should be working together. As mentioned above, Parsons et al. (2004) and McCurry (2010) used peer tutoring, which although it had a few instances of group work, was designed to create a more intimate, one-on-one setting for the students. However, Chiu (2008) discovered that having groups full of diverse thinkers and learners was beneficial in his study of micro-creativity. In his study, students were able to learn more from each other when disagreements arose during the problem solving process. This could only occur in a group full of students who think about math and solve problems differently. When another group member politely questioned the reasoning of another, it forced everyone to think harder about the process, and sometimes forced them to think of a more creative and clear way of explaining their thoughts, which led to a better understanding of the material. These peaceful and respectful disagreements kept all of the students engaged.

Another way to ensure every student's ability level increases is to ensure equity among the level of involvement of all group members. Esmonde (2009) studied the effects of equity among groups. She used cooperative learning during a variety of tasks in the classroom and noted that group presentations or any informal task was more helpful for all students involved. She found that group quizzes or tests were not a

reliable measure of each student's ability because of the emergence of a leader or expert among the group. "The expert students were likely to take on the bulk of the work and focus much of the interaction on explaining their own ideas, thus neglecting the understanding of their peers" (p. 274). This idea of one student taking control over the group is clearly something that needs to be avoided when conducting a study that aims to improve all students' levels of ability.

Cooperative learning, when applied and monitored appropriately, can be a valuable tool for keeping students of all ability levels engaged. As opposed to just listening to direct instruction from the teacher, "it is believed that students can relate better to one another, often using more simplistic terms to explain concepts" while using cooperative learning strategies (Ellis, Ellis, Huemann, & Stolarik, 2007, p. 80). Smith and Confrey (1991) agree that cooperative learning is a valuable tool in the classroom. They feel it succeeds because it allows a student to remain focused on the individual vision of the problem, while resolving the problem through communication with peers.

Whether students are working as partners or in groups, with students of similar abilities or of varying ability levels, positive interactions with their classmates is what fosters their understanding and allows them

to learn better. It is therefore the teacher's role to support and foster these interactions in a positive manner.

Teacher Facilitation Techniques

Although cooperative learning is a more student-driven form of learning, there is still a lot of work that needs to be done on the teacher's end. The first important task the teacher has is to make sure the students are put in the best possible situation to succeed during the cooperative learning process. The best way this is done is by understanding the students' prior knowledge entering the class and understanding which students will work best with each other. Walker (2007) found that teachers need to do more to understand their students' background in order to create a space where they can feel comfortable in their environment. When students feel comfortable they are more likely to actively participate in conversation, which is the foundation of cooperative learning. Staples (2007) also supported this idea of background knowledge being an important factor for cooperative learning to be successful. She related time to students' background knowledge, saying that it may take longer for some students to fully grasp the concept of cooperative learning because they are not used to being able to express their own thoughts and feelings. Some students, especially underprivileged children, are accustomed to simply doing what they are

told, both in school and during their home life, so talking about their own ideas is a new concept that will take time to get used to.

Teachers play a pivotal role during the cooperative learning process as well. Although they act more as a facilitator than an instructor, there are always items that teachers need to look for. Chiu (1997) states the three most common problems that could arise are students becoming entrenched in opposing others' views, simply dismissing the opinions of the other members of their group, and misinterpreting other students' comments. If teachers observe any of these situations taking place, it is their responsibility to intervene and get the members of the group back on track. Chiu thinks that the best way to do this is to ask students about their previous experiences and to make sure they elaborate on their thoughts in order to eliminate any confusion. Gillies and Boyle (2008) also discovered that it was important to challenge students' perspectives and make them defend their positions to every other member of the group.

Durand (2008) and Gillies and Khan (2008) also talked about the role of the teacher during cooperative learning. They discussed scaffolding techniques that the facilitators should use to promote greater communication. It is no longer the teacher's responsibility to provide answers to the students, but to give them subtle clues to foster the

discussion of the problem that will lead to the discovery of the solution on their own.

Other strategies to promote successful cooperative learning are making sure the students show their work to each other, explain their work to each other, criticize and analyze each other's work, and then reconstruct their work if necessary (Dekker & Elshout-Mohr, 2004). Chapman (2004) also listed specific tactics that teachers should use to facilitate peer interactions. She states that teachers should "listen and observe" to determine when and how to help the students, use "questions and prompts" to check for understanding among all members of the group, "support student thinking" by making sure they know all of the resources they have available to them, "model questioning" techniques during whole-class instruction so the students can do the same during their group work, and finally, "promote good peer relations" through shared questions and peer observations.

A final instructional strategy that is important for teachers to utilize during cooperative learning is to make sure the students have control of their own learning. The teachers should conduct interviews and take surveys to see what can be done to improve the experience for the students (Neal, 2004). Teachers should be able to adjust their plan as the study progresses. The main goal is not to force cooperative learning on

the class, but to use it as a tool to help students learn. Adjusting the groups, giving them more time for discussion, or doing anything else that may come out of the student interviews or surveys is something that should be taken seriously and should be implemented into the study.

Sometimes just collecting those data on the students is not enough. To really give the students more control, Kostopoulos (2010) suggests that the students can not only provide the information, but also be great interpreters and analyzers as well. The students might be able to see patterns or trends in the class that the teacher cannot see. They may also be able to give valuable suggestions to improve their own learning environments in the context of the cooperative learning study.

Outcomes

Despite all of the precautions that can be taken by the teacher and the variety of cooperative learning strategies that could be implemented, it still does not mean that cooperative learning is a fool proof teaching strategy. For that matter, there is no such thing as a strategy that works all of the time for every classroom because of the fact that every student learns differently, and every classroom has different dynamics that may or may not be conducive to cooperative learning.

The majority of the prior research indicates that cooperative learning is in fact a valuable technique that will improve student

achievement. Ifamuyiwa and Akinsola (2008) found that cooperative learning also has an impact on attitudes and engagement levels inside the classroom as well. Those are two factors that normally lead to increased achievement. Therefore, Ifamuyiwa and Akinsola give further evidence to support cooperative learning as a method to improve achievement.

Durand's study that supported scaffolding as a facilitation technique gave great insight into tools teachers can use, but the outcome of the study was less than desirable. The cooperative learning techniques used in this study "produced different effects, depending upon the individual students" (2008, p. 191). Some students were able to work effectively with one another and improve their grades, while others showed a tendency for off-task behavior due to a lack of control in the group. It is clear that an increase in off-task behavior could not have been beneficial for the students, so it is important for teachers to do the best they can to maintain control over every cooperative learning group in the classroom.

Di Fatta, Garcia, and Gorman (2009) had a rare instance of cooperative learning having a negative effect in the class. In this case, it was the students' homework that suffered, as students started failing to complete their assignments while the cooperative learning techniques were being implemented. Their study was not a failure, however, because they measured an increase in the students' attitudes as well as their

overall grades. The researchers felt “that the group work . . . helped their students improve their understand [*sic*] and retain mathematical content knowledge” (p. 35).

Conclusion

Cooperative learning is a very complex, yet integral part of education today. There are many intricate facets of this teaching strategy that require special attention from both the students involved and the teacher administering the strategy in order for it to be successful.

Students must realize that working with others will not only help them in the classroom, but also prepare them for life after high school.

Communicating effectively with other people is something that productive members of society must do on a daily basis, so teachers should strive to prepare students in this ability.

Teachers, on the other hand, must realize that this strategy is something that some students are not immediately comfortable with. It will take time and effort on the part of the teacher and the students to make cooperative learning a success. Every person involved must be willing to actively participate in the learning process and adapt the strategy as need be in order to benefit all parties involved.

Research Design and Methodology

Introduction

In my study of cooperative learning there were multiple modes through which data were collected as well as three separate time frames in which that data were collected. The class was able to seamlessly transition from working with a partner, to working with three individuals in a group, to finally switching again into a group with a different compilation of students. I was able to collect data using observations, student work, and surveys and interviews at all three phases of the study.

Setting

This study was done in a suburban high school in eastern Pennsylvania. The school consists of roughly 1,500 students in grades 9 through 12. Although there is not a lot of racial diversity at the school, a wide range of socioeconomic statuses exist. The majority of the population falls in the middle class, with some students on both the upper and lower end of the spectrum.

The classroom in which the study took place is located on the top floor of the school near other math classrooms. The front of the room is covered with chalkboards, while the back is covered with bulletin boards and a Promethean board. One side of the room is lined with closets and posters, and has a small bookshelf behind the teacher's desk. The side of

the room away from the door has a chalkboard in the middle of the wall, with windows on either side. There are 28 desks in the room, arranged in rows, with four desks in the first row, followed by the teacher's desk, and four rows of six desks beyond that. While working cooperatively, the students were able to move the desks around, so during the majority of the time, the desks were arranged in seven pods of four desks each.

Participants

All 28 students in my honors level geometry class participated in the study. The breakdown of the students was as follows: 14 white freshmen males, eight white freshmen females, four white sophomore males, one black freshman female, and one white sophomore female. None of the individuals had an Individualized Education Program (IEP), although three of the freshmen males were identified as being gifted.

Procedures

Before I was able to begin the study, consent had to be given from multiple sources. I first submitted a proposal of my study to the Human Subjects Internal Review Board (HSIRB) at Moravian College. Once the HSIRB permitted me to conduct my study (see Appendix A), I had to receive permission from my principal as well as the parents/guardians of my students. I submitted a letter to my principal explaining what my study consisted of and describing the measures I would take to ensure

confidentiality in the process (see Appendix B). Once he approved of the study, a similar letter was sent home to the parents of my students that had to be signed in order for me to collect data on their children (see Appendix C). When these three prerequisites were completed, I was finally able to begin my study of cooperative learning.

Partnering. I started my study by giving a pre-study survey (see Appendix D) to the students. Its intent was to give me insight into the students' attitudes towards math in general, as well as their attitudes towards working with others, and their tendencies during problem solving.

During the first week of the study I taught the students using direct instruction. After the students took notes, we worked on example problems together as a class. In the time that was left in the class period, usually around 20 minutes, the students were able to work with one partner of their own choosing to begin working on their homework assignment. During this time, some students chose to work individually instead of seeking the support of others. I used this time to observe both the partnerships that were formed as well as make note of the students who constantly decided to work alone. I also gave the first survey during this portion of the study.

First cooperative learning groups. The students were randomly placed in their first cooperative learning groups and stayed in those

groups for about five weeks. The first day that they were together was when the group building activity was implemented. For the next two weeks, the class was run the same as it was during partnering, except that the students were required to work with the three other members of their group instead of given the option to work with one member of their choosing. During the following two weeks, the groups were given a bit more freedom. I started the class with direct instruction, making sure the students identified the important definitions, properties, postulates, and theorems about each lesson. Then, each group gathered to discuss the new information, work together on the given example problems, and finally start their homework together if time permitted. During the final week of this portion of the study, while I was conducting the first round of interviews, the students were in charge of teaching each other a lesson. Each group member selected an upcoming lesson and taught that section to the other members of their group; then, they would all work together on example problems I gave them from that section.

Second cooperative learning groups. Over the final five weeks of the study, the students were rearranged into different groups of four students. I strategically placed the students together this time instead of randomly assigning them. I used my observations, as well as the students' responses to the first survey and interview, to group them in

such a way that would help the students learn even better. While the students were in these final groups, the class was structured the same as it was during the previous groupings. The first two weeks started with the group building activity and mainly direct instruction from myself. During the next two weeks, the students had more freedom in their groups. Finally, the last week consisted of the students teaching lessons to each other. My study then concluded with the second survey (see Appendix E) and final round of interviews.

Data Sources

Observations. The majority of my data came from observational data. During every class in which the students were not taking an assessment, I was either observing the class as a whole, or one specific group of students. To record my observations, I used a double-entry journal. In doing so, I wrote down my observations and student conversations on one side of the paper, and then after class, I would add my own commentary as to what conclusions I could make from what I observed. Recording my observational data in such a fashion allowed me to keep what actually happened in the classroom separate from my own thoughts and opinions.

Surveys and interviews. The data sources of surveys and interviews were intertwined throughout my study. The first survey, my pre-

study survey, allowed me to get a baseline of data on the students' feelings toward math in general, as well as cooperative learning. My first round of interviews, about halfway through the study, was used as a device to regroup the students into ones more beneficial to their learning styles. I was able to determine which groups were getting along with each other and which ones needed to be rearranged because those groupings simply were not putting the students in the most optimal setting for learning. Toward the end of the study, I gave the second survey to the class. This survey had similar questions on it, and allowed me to determine what aspects of math and cooperative learning were affected by the study. I then used the students' answers to conduct a final round of interviews. This allowed me to gain an even greater insight into their thoughts and feelings about the study and to determine if it changed their opinions on cooperative learning or on mathematics in general.

Written work. The final data source I used to gather information on my students was their written work. I analyzed the quiz and test scores for relevant topics of our curriculum. This enabled me to see what impact the study had specifically on their grades, instead of their feelings and motivation, which I received from my other methods of data collection. I was able to compare these results to grades they earned on the

assessments before the study started to see what impact the study had on them.

Summary

By conducting my study of cooperative learning, I tried to determine the effect it had on the achievement of my students. I was able to implement partnering strategies as well as cooperative grouping techniques over a period encompassing eight units of the curriculum. The length of my study, along with the large amount of data I recorded allowed me to fully analyze my study and be satisfied with the effect it had on me as a teacher.

Trustworthiness Statement

Throughout my study of cooperative learning, I implemented different tactics that allowed me to be a trustworthy researcher. The first was by following Hendricks's (2009) advice and establishing credibility through data triangulation, "a process in which multiple forms of data are collected and analyzed" (p. 80). The three sources I focused on to ensure corroboration were my double-entry journal, student surveys and interviews, and student work. My double-entry journal allowed me to record my observations of student interaction and allowed me to quote students during conversations. Then my reflections and interpretations on these data led me to the conclusion that the students were understanding and comprehending the material better than they would have been if they were working individually. The second piece of data, student surveys and interviews, allowed me to ask the students directly if they understood the material, if they felt more confident in their work, and if they were getting the opportunity to learn more through interacting with other classmates. Finally, the source that allowed me to see the most direct impact on improved student achievement was the students' written work. It was possible to see how their grades were affected by the increase in cooperative learning.

Aside from data triangulation, another way I proved trustworthiness was the extended amount of time that was used when gathering my data. The extended fieldwork enabled me to see patterns and trends, not just a small sample of information where coincidences might be likely to occur. My observations of student behavior and use of student interviews helped prove my trustworthiness also because it allowed me to include low inference descriptors. The direct quotations from my students told me exactly how they felt about their work, so I did not have to draw every conclusion on my own. Those interviews, as well as the surveys, also served as another method in ensuring trustworthiness, which was participant feedback. I had time to hear all of the participants' thoughts and concerns about the study to make sure they coincided with my own observations and interpretations of the data I gathered. This guaranteed that my students and I saw the same results.

I also took preventative measures to ensure the reliability of my research. The first thing I did when planning this study was look at prior research done on the topic of cooperative learning. I was able to see how similar studies were run and take into consideration all of their positive and negative aspects when designing my research. I also submitted the parameters of my research to the HSIRB. They confirmed that I was taking the necessary precautions to protect my students through the use

of pseudonyms and making sure all of my data remain secure and confidential.

A final important piece of information I referred to when gathering data was noting all of the negative aspects of the study, the things that did not go as planned. Documentation of these aspects was vital as a record of how I analyzed the data, because it is through these realizations that I established my trustworthiness as a researcher (Ely, Vinz, Anzul, & Downing, 1997). It is obvious that I love math and feel that cooperative learning is extremely important, but I am sure not all of my students felt the same way. I took everyone's thoughts into consideration and did not let my own biases prevent me from recording accurate data.

This Year's Story

A False Sense of Hope

I thought this would not be a difficult study to conduct. After all, this was an honors class, the best of the best. I imagined when I told the students to open up their books and get to work with a partner that they would all rush to find a friend, or at least someone they have known from a previous class, and begin teaching themselves. That was where I made my first mistake.

At the beginning of my study, before the students were formally put into groups, there were a few days of partner work while we were finishing up a topic in the curriculum. At this early stage, it was clear that some students were more familiar with cooperative learning than others, or even if they were familiar with it, wanted no part of it. When given the choice to work with whomever they wished during these first few days, eight of my students constantly chose to work individually. I did not know why they decided to work alone, but with more than a quarter of the class unmotivated to engage in cooperative learning, my study did not have the start I anticipated.

A Conversation to Calm My Nerves

On the third day of partner work, just as I was beginning to second guess my decision to study cooperative learning, my fears of this study

being a struggle were put to rest on the basis of one conversation. I observed two students, Alex and Jamie working together.

Alex: Wait, hold on. I don't understand. How did you get the exterior angles?

Jamie: Try figuring out this one first (as he points to a specific angle in the picture). If you solve for that one first, you'll be able to get the other angles.

Alex: (After a minute of pondering) But I don't get it. How do you find that first angle?

Jamie: You have to use the formula we just learned. Look back in your notes. (He watches as Alex pages through the packet.) There! Stop!

Alex: Oh, okay! All you do is plug in these numbers?

Jamie: Yup!

Alex: Wow, that was easier than I thought!

When Alex could not figure out the answer, he made sure Jamie stopped to help him out. Without knowing it, Jamie used a scaffolding technique to help answer the question. He told his partner to focus on the first step of the problem, instead of getting overwhelmed by the entire diagram. He also reminded him to use the formula that was in the notes. Jamie made sure that Alex was using all of his available resources to

figure out the answer on his own, instead of just supplying him with the answer.

Observing this one interaction was an encouraging sign for the remainder of the study. To my excitement, this proper form of communication seemed to be traveling fast, because on the other side of the room a similar conversation was taking place between two other students.

Mario: But how did you get that answer? Mine is different.

Billy: Well since they're asking for the sum of the angles you just take the number of sides times 180.

Mario: (As Billy points to a spot on his paper) Oh there it is . . . but wait! It can't be 10 times 180.

Billy: Yes it is!

Mario: No, the formula is n minus two times 180, not just n times 180. So, eight times 180 equals 1440, not 1800.

Me: (Billy looks at me in confusion, hoping for some clarification) He's right. Good job Mario!

This was another great example of the conversations I expected throughout the study. It was only through questioning and explanation that the two students were able to figure out the correct answer.

Pre-Study Survey

During this early part of my study was when I conducted my first survey of the class. My goal was to gather a baseline for my students' feelings toward math in general, and also toward their working habits and preferences inside the classroom. The number of responses I received from the students for selected questions are shown below.

Table 1

Selected Questions and Responses from Pre-study Survey

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoy math.	1	1	7	13	6
I think I am good at math.	0	0	4	19	5
I like math when it is challenging.	2	5	11	5	5
I think I can learn every math concept taught to me.	0	2	9	12	5
I try to participate during math class.	0	1	7	14	6
I pay attention during math class.	0	0	6	14	8
I think math concepts are important because I will use them in the future.	0	1	9	11	7
When struggling with a problem, I try to work it out on my own first.	0	0	7	9	12
When doing math, I am always focused on the material.	0	5	8	13	3
I feel nervous and pressured in math class.	10	11	4	2	1
I ask for help if I don't know how to solve a math problem.	1	3	7	15	2
I enjoy working with other people.	1	1	4	7	15

Most of the responses I received were what I expected from an honors level class. The majority of the class indicated that they have a positive affinity toward math, are confident in their abilities, and are calm

and relaxed in class. However, I was surprised to see that some students did not enjoy math, preferred it to be easy, and even felt anxious in math class. Something else that caught my attention were the students who indicated that they did not enjoy working with other people. It was no surprise though, that the six students on the lower end of the scale were six of the students who chose to work individually during the partner work in class.

Although I was aware of the students who continually worked alone and confirmed their preferences on the first survey, I did not use this information when creating the first cooperative learning groups. Those groups were simply a random combination of students.

Getting Everyone Involved

After putting the students into groups, about one full day was spent on group building activities. I asked the students to write down the answers to a few questions: What is your favorite color? What is your favorite food? What is your favorite type of music? From their answers to those questions, as well as any other interesting pieces of information about themselves they revealed, the students established a group name that incorporated some of the things they had in common. Some names were simple and concise, like “The Pigs.” Other groups, however, got more entrenched and came up with names like “The Swaggin’ Recycling

Food Lovers” and “The Taco-Eating Feet Haters from Target.” The purpose was to get the students more familiar with each other and develop a sense of camaraderie within each group. It seemed to work at the time because every group member was actively involved in the process. However, this sense of companionship waned in certain groups as the weeks went on.

I spent a few days observing the class as a whole, floating around from group to group. This immediately allowed me to see which groups were communicating effectively and which groups needed some extra support. One group acted as if they had been doing this for years. The majority of the groups, however, were a little slow to catch on to the concept, while one group really struggled with the idea of cooperative learning.

When we started the next topic in the curriculum, I began focusing my observations on specific groups. I directed my attention to two groups while working on this topic. These first two groups were randomly selected. During this chapter though, I found myself frequently leaving the groups I planned to observe in order to tend to the needs of “M.W.A.,” the one group that was really struggling with this new method of learning. After checking their surveys, it became clear why they were struggling. It was due to the fact that two of the members indicated that they prefer

working alone. The group rarely spoke to one another, and when they did, it was merely to check answers. Even when they did not agree, there was no discussion about the problem; the students just went back and reworked the problem on their own once again. I intervened rather quickly, and decided they would be a focal point of observation during the next topic.

So for the next week, I observed “M.W.A.”, as well as a random selection of one of the remaining four groups. While I was working with “M.W.A.”, the conversation increased slightly, but only because I kept prompting the group members to ask each other questions and to answer the ones I was giving them.

The other group I observed during this chapter, however, responded well to this new style of learning. Not every member of the group was moving at the same pace, but they did a good job of making sure everyone understood the material before moving on.

Robert: Wait, I’m not finished yet. Don’t turn the page. (He finishes the problem he is working on, then reaches over to turn James’s paper toward him.)

James: Don’t just copy my answers! Ask me what you don’t understand.

Ali: You're not going to do well on the test if you just copy down our answers.

Robert: But you guys are on the next page. I just want to get caught up.

James: So ask us to slow down and explain something if you don't understand.

I began to sense that most of my students were becoming fully engaged in the cooperative learning process. I began to hear more positive interactions taking place. As it turned out, it was only because those positive interactions stayed fresh in my mind as I was observing. At the end of the week when I was working on my coding and reflective memos, rereading my observations lead me to a different conclusion, especially during the next topic in our curriculum.

During this last chapter before the midpoint of my study, I spent most of the days observing the remaining three groups that I did not work with yet. I was able to observe some positive interactions taking place, but also an increase in the amount of off-task behavior. It was hard for me to focus on my observations when my attention was continually being drawn away by other groups, actually only a few individuals, who were misbehaving on a regular basis. To make matters even worse, I still constantly found myself gravitating towards "M.W.A.", encouraging them

to discuss the problems and work on the material together. By the time this week had concluded it seemed like all hope was lost.

Reflective Memo

I am almost halfway through my study, about to start my first round of interviews, and I can only imagine the types of responses I will receive from my students. Sure, there were some observations that I was pleased with, but too many students are getting involved in just the social aspect of working with others and not focusing on the material in class. Even the groups that are quiet, are quiet in a bad way! They have been “working together” for four weeks and M.W.A. is still acting like they are a group of strangers. They don’t even push their desks right next to each other, it’s like they want to see how far apart they can be before I say something to them. I hope to get some quality information out of my interviews so I can make the rest of this study more successful.

Figure 1: Reflective Memo toward the End of the First Groups

It was then that I decided that after the interviews would be a good time to switch around the groups and give the four members of “M.W.A.,” along with a lot of the class, a fresh start with other students.

Gathering Valuable Information

While the last round of observations was going on, I conducted my first round of interviews with the students. During these first interviews, I

gathered information specifically on what is and is not going well within their groups, for the purpose of rearranging the students. I asked the students specifically what they liked and did not like about their learning experience so far. I then used those responses to create two Wordle documents to better see the trends in their answers.

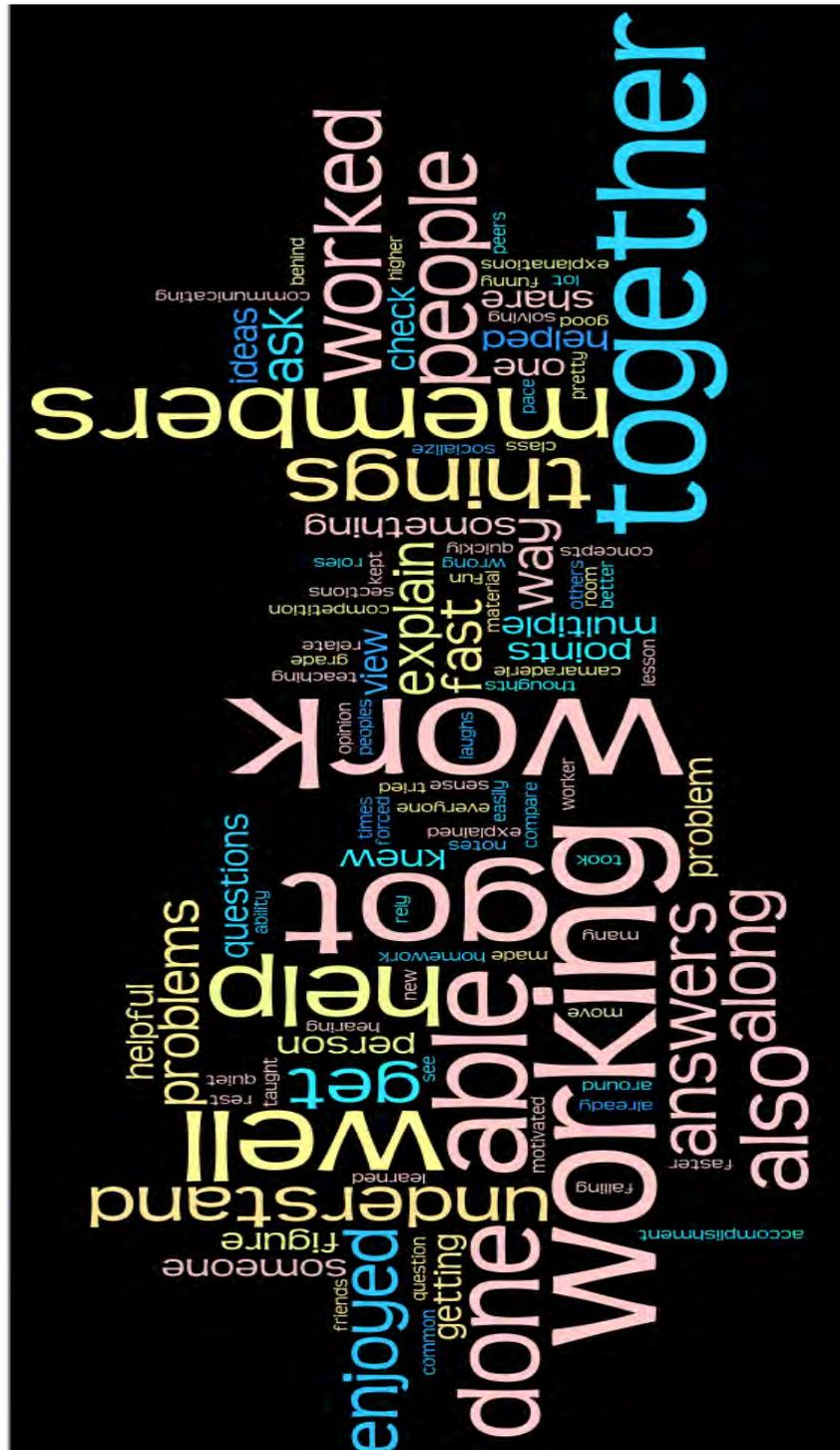


Figure 2: Wordle Using “Likes” From First Interviews

The interviews gave me direct answers from the students so I did not have to make any interpretations. It was obvious that they liked working with other students instead of working individually. They were able to get more immediate help from their group members and enjoyed sharing problem solving ideas.

During the “dislike” portion of the interviews the students were more specific with the information. They called out students by name that were not cooperating with the rest of the group.

After the interviews, I was able to analyze the information I received from all of the students, and along with the data I collected during my observations, place them into new groups that I felt would better suit their learning needs.

A Change for the Better

After using the same group building techniques a second time around, I observed the class as a whole for an entire math topic to see if any groups had an interesting dynamic. This also allowed me to see if there was a change in the amount of off-task discussion taking place among the newly formed groups, compared to the previous groups. I was amazed by the dramatic change I witnessed.

Reflective Memo

Are these the same 28 students I started my study with? What a difference a group makes! They have been together for less than a week, but there have already been significant gains in the amount of on-task behavior and the level of conversations taking place within each group. Sure, no class is perfect and there is still a period where the students need to adjust to this new working environment, but I could not be any happier with my class. Even Martin, who indicated that he doesn't like math and thinks he is better when working alone, led his group to the discovery that all inscribed angles are half the measure of the central angles. We are not covering that lesson until Tuesday! These new groups seem to extend the students' learning instead of inhibit them. I am so happy I made a switch.

Figure 4: Reflective Memo at the Beginning of New Groupings

While moving on to the next topic in the curriculum, I started observing each group separately, just as I did during the first half of the study. I randomly selected two groups to observe first, "Goldfish Creamers" and "The Teal Twinkies." The big difference between these observations and my individual observations during the previous groupings was that my attention was not constantly drawn to one group that was continually having problems. I was able to focus all of my

attention on one group at a time and analyze the conversations taking place.

Ivan: How did you get arc WT? I was still on the second one.

Frank: No, you're right. I added them instead of subtracting them.

Mario: Wait, how do you get that arc?

Frank: You need to take the measure of the big arc, minus the measure of the little arc, then divide by two.

Ivan: So we have to subtract the arc, not the angle? That means this one is wrong too. (As he points to a problem on the worksheet.) If we work backwards, that times two is 60, so 100 minus 60 is 40. (The rest of the group nods in agreement.)

Ivan and Frank were two students that were pointed out as being distractions during the first set of groups. They are two of the five sophomores in the class, so I decided to place them together in this second grouping. They may have been more beneficial to their group during this one interaction than they were during the entire first part of the study!

I observed three of the remaining groups during the next topic of study. It was clear to see that the new groups were still having an impact, because after two weeks, I still was able to observe the groups

individually. My attention was not divided among all of the groups because they were all working and communicating effectively with one another. I was able to interact with a specific group and be the facilitator that cooperative learning encourages me to be.

This was evidenced when I was observing the “Fearsome Foursome.” Mike, one of the students who preferred working alone at the beginning of the study, still was not out of the habit of working individually, however. He started working before the other members of his group even got their desks together. I decided to intervene and explain the purpose of working together and the benefits it has. At this time, Brad, one of the higher achieving students in the class, corrects Mike on the first problem he did on his own. It was a shock to Mike, but he immediately realized how important it was to stay at the same pace as the rest of the group. This group surprised me even more, later in the observation.

Eric: How do you find the Los Angeles?

Teacher: Wait, what did you say?

Mike: He means the lateral area. We came up with nicknames for the lateral area, total area, and volume.

Dom: Yea, it helps me remember, plus adds a little humor to our conversations. (The entire group chuckled a bit. He

gave his answer to Eric, but then began questioning himself.)

Brad: No, you were right. Keep going Dom.

Dom: Okay, so you just put the x on the end when you're finding the perimeter, because we are adding. If we were multiplying you would get x squared.

Eric: Oh, okay, I knew that!

The engagement level and unity among the four members was amazing. They were utilizing all the resources available to them, and even came up with some resources on their own, as was the case with their mnemonic device.

Another group dynamic that was fascinating to me occurred in "The Awesomeness Club." They were the last group I observed in my study, so a few weeks had gone by since they started working together. This group basically split into two sub-groups, that would reconvene toward the end of the period and make sure all four of them had the same level of understanding. I discovered that it had nothing to do with dislike for each other, but simply because of learning preference. Adam and Ali worked at a quicker pace and discussed all of the problems when they were both finished. Amy and Isabel preferred to discuss each question individually,

and compare their ideas along the way. They always made a point to discuss everything as a group before the end of each session, though.

Isabel: Are you guys finished?

Amy: You didn't have any problems with anything?

Adam: We had a little trouble with the ratios. We couldn't agree on number 14.

Ali: Since the radiuses. . .

Teacher: It's radii. (I had to intervene. They are communicating, but I wanted to make sure the vocabulary was correct.)

Ali: Oh, sorry. The radii are five and seven. Is that the scale factor? Or is it 25 to 49?

Amy: No it's five to seven. The radii are the same as the scale factor.

Isabel: Yea, you only square it if you want the ratio of areas.

Jake: And then cube it for volumes, right?

Amy: Correct!

I realized that this was another valuable form of cooperative learning that I had never thought of before. Whether they planned this separation or if it just happened naturally was not the important thing, it was the fact that in the end, all four of them had the same understanding of the material.

Brad's Journey

Throughout the entire study, I always had one eye on Brad's involvement. The first reason was because he was probably the best student in the class. Second, because I wanted to make sure he did his best to help those around him. During the first cooperative groups much of his time was spent working with Jackie. She was absent from school quite often, so when she returned he would take the responsibility of trying to get her caught up, while the other two group members continued on. I could tell this was beginning to frustrate him, and he made me aware of it during the first round of interviews. He said that he did not mind teaching other students, as long as they worked at a quicker pace than Jackie was able to do.

When I switched the groups, I kept him with students who would benefit from his help, but also could handle a quicker pace. The other three students seemed to look up to him and acknowledge him as the leader of the group. The result was possibly the hardest working group, yet the group that had the most fun, the "Fearsome Foursome." In order to describe this study from Brad's perspective, I wrote a first person narrative.

First Person Narrative

Brad

Ah, finally, our last test until Mr. Gimbar's study is over! I will never have to work with those slow pokes again. I don't understand why I was in charge of helping others in both of the groupings. It's not that anyone was mean or we didn't get along, I'm just so bored. I had very little in common with them and I feel like I did all of the talking, and worse yet, all of the work. I thought the whole point of working in a group was to split the work evenly? That is definitely not how my groups functioned. OK, enough complaining, back to the test.

Solve for "L" and find the lateral area, total area, and volume of the pyramid. How do I do that; and what do those marks on the sides of the base mean? Oh, I remember! It's a square pyramid; the marks mean they are equal in length. I remember doing the worksheet on this section with the other members of the Fearsome Foursome. Eric had a problem with the slant height of the pyramid so I reminded him that you need to get the "L" before you get the "Los Angeles." We reread our notes on triangles and reviewed the use of the Pythagorean Theorem to get the slant height of the pyramid. So now I just need to solve for "L" using my algebra and plug the information into the formulas for the LA, TA, and V.

Wow, I guess explaining it to the group really helped me understand it too! I remember exactly how to solve this question from the example we did together. I helped them out, and it helped me out also. I think there was some benefit to this cooperative learning stuff after all, even if working together wasn't as fun as I wished.

Figure 5: First Person Narrative: Brad

Final Pieces of Information

The ability to focus all of my attention on observing the final groups gave me more time to focus on the final survey and interviews. During the final week, I gave the students the post-study survey, which was very similar to the pre-study survey given to them at the beginning of the research period. Then, comparing their answers on to two surveys allowed me to conclude my study with a final round of interviews to gather information on the students' overall feeling towards to class during their last eight units of study.

Table 2

Selected Questions and Responses From Post-study Survey

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoy math.	1	1	6	10	10
I think I am good at math.	1	0	7	11	9
I like math when it is challenging.	2	5	12	7	2
I think I can learn every math concept taught to me.	0	4	10	11	3
I try to participate during math class.	0	2	7	14	5
I pay attention during math class.	0	0	4	11	13
I think math concepts are important because I will use them in the future.	0	1	9	6	12
When struggling with a problem, I try to work it out on my own first.	0	0	2	14	12
When doing math I am always focused on the material.	0	4	9	11	4
I feel nervous and pressured in math class.	9	12	5	1	1
I ask for help if I don't know how to solve a math problem.	0	1	7	12	8

Comparing these results to the responses I obtained on the pre-study survey provided valuable insight. The number of students who responded that they “strongly agree” with the fact that they enjoy math, are good at math, pay attention in math class, think math concepts are important, and ask for help when they are struggling all increased, compared to the responses on the pre-study survey.

Looking at the individual responses on the final survey allowed me to question each student to determine what aspect brought about the most significant change in behavior or attitude toward the class and towards cooperative learning. The responses varied from student to student, but there were a few similarities. The students became more confident and comfortable working with others and asking for help. They enjoyed being around a small group of people because if they made a mistake they would not feel as embarrassed. Similarly, if they had a question, it was safer for them to casually ask a fellow group member, instead of raising their hand and having the attention of the entire class put on them.

Other students said that type of learning was beneficial because it put them in control. The teacher was not there pushing them in the right direction, so it made them more responsible. However, on the down side, some of the students took advantage of this lack of control and admitted to slacking off once in a while. This is not entirely bad though. If these

freshmen and sophomores understand at this young age what it means to be independent and the work it takes to succeed, it will have a greater impact on them as they progress through their lives.

Data Analysis

Introduction

The sheer volume of data that was collected over the entire semester meant nothing unless I was able to organize it in such a way that conclusions could be drawn from it all. To prevent myself from becoming overwhelmed with data, I took the advice of Bogdan and Biklen (2003) and started analyzing the data as I was collecting it, but left the more formal analysis and interpretation until the data collection was finished. Doing so allowed me to keep the data organized and make adjustments mid-study to assure the students were making the most with their time spent together, while being able to decipher the main patterns and themes when the study came to a conclusion.

Analysis During Data Collection

Observational analysis. At the end of every day that I spent time observing my students, I took around 15 minutes to read through my observations and write down my commentary on them. Heeding the advice of Hendricks (2009), at the end of each week, I looked through my newly-created double-entry journal and assigned codes to specific pieces of information that seemed to appear frequently. This list of codes was ever-changing because at the end of each week, when more data were collected, codes needed to be added, deleted, or modified, to best match

the new information I was receiving. Coding my observations throughout the study enabled me to focus on the emerging themes and condense the amount of data I needed to analyze.

Written work analysis. During the study, I also focused some attention on the students' quiz and test results. This allowed me to see if the cooperative learning groups were making an impact on the students' grades. It was also important for me to see which students, or which groups, would benefit from me spending a little extra time observing them, and consequently, offering my suggestions to them as to what parts of the lessons they should be focusing on. Keeping a constant eye on the students' grades was also beneficial to me when I grouped the students for the second time. It gave me a better understanding of which students would be able to help out those who were struggling.

Survey and interview analysis. Aside from observations and student work, I also utilized my pre-study survey and first round of interviews with the students to modify my study. I used those pieces of data to regroup the students about halfway through the study. I was able to gauge the students' attitudes and feelings toward their groups and toward the use of cooperative learning in general. Having the students tell me directly what was and was not working for them was the most beneficial piece of information during the study.

I also coded the responses I obtained in the surveys and interviews to compare them with the information I was receiving through my own observations. This reassured me of the common themes that were developing during the course of the study.

Educational philosophers analysis. Throughout the duration of my study I read works from various educational philosophers: Kozol (2005), Dewey (1938), Freire (1970), and Vygotsky (1978). After reading each, I wrote reflective memos that compared the viewpoints of those philosophers to what was happening in my study. Analyzing ideas from these philosophers gave me better insight into my own study and reinforced the value of action research in my classroom.

Analysis After Data Collection

Observational analysis. Upon the completion of my study, I constantly went back and read over all of my previous observations and subsequent reflections on those observations. It seemed as if every time I read my data over again a new piece of information would stick out to me. I used this information to modify my list of codes and to determine which themes were most prevalent throughout the entire study.

Written work analysis. There were approximately 15 different assessments that I analyzed. Doing so allowed me to see the progress the students were making throughout the study. It enabled me to get an

idea as to which form of cooperative learning worked best for each student. Analyzing the students' assessments at the end of the study also allowed me to compare the quality of work the students were producing at the beginning of the study to what they could accomplish after using the cooperative learning strategies.

Survey and interview analysis. The post-study survey and the final round of interviews were vital pieces of data that were collected. I was able to compare the students' answers on the two surveys that were given to determine what impact the study had on their feelings toward cooperative learning. I also coded that information and added it to the data collected from my observations. The interviews enabled me to directly question the students on their experience in the class and to determine if the new grouping strategy implemented in the middle of the study was beneficial to them.

Bin and theme analysis. Coding the data throughout the study and analyzing the students' work made it much easier to see the main ideas that happened during the study. I was able to place all of my similar codes into groups called bins. I created a graphic organizer to better display these bins, which also more clearly displayed the main idea of each bin. These big ideas, my theme statements about the study, were

the major findings of my research, as evidenced by all of the data used to create them.

Summary

Constantly analyzing the data was a necessity for me to maintain focus over the course of the study. I was able to find patterns that were taking place through my observations, see the intellectual growth of my students through their written work, and also obtain the exact thoughts and feelings of my students through their surveys and interviews. These data were all coded, placed into bins, and eventually led me to my findings.

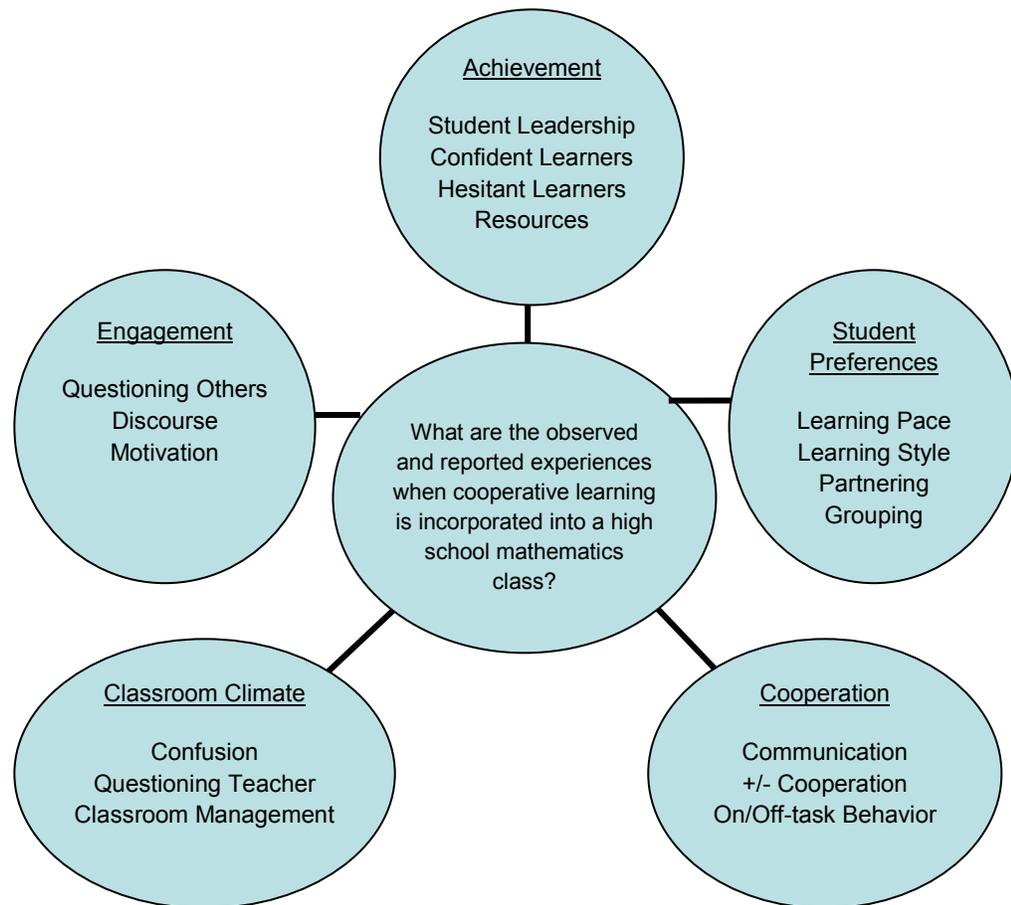


Figure 6: Coding Bins

Findings

“Yet only through communication can human life hold meaning. The teacher’s thinking is authenticated only by the authenticity of the students’ thinking. The teacher cannot think for her students, nor can she impose her thought on them. Authentic thinking, thinking that is concerned about *reality*, does not take place in ivory tower isolation, but only in communication.” (Friere, 1970, p. 77)

Achievement: Although cooperative learning may not increase achievement for every student, it teaches students how to learn and increases their awareness of the resources available to them.

When designing this study, I wanted to incorporate a strategy in my classroom that would prepare my students for life after high school while improving their academic achievement at the same time. Although there was no dramatic change in the students’ grades, a few individuals did increase in their averages for the course; however, the majority of the students increased their overall problem solving ability.

Discovering the effect that the cooperative learning strategies had on the students’ grades was determined by analyzing their quiz and test scores throughout the study. As the study progressed, so did the difficulty of the material the students were learning. Although grades typically tend to decline as the course topics progress from basic introductory material

into analyzing various two- and three-dimensional figures, there were a few students that were able to utilize the support of their peers and improve their grades throughout the study. There was not a specific type of student that succeeded, though. Some higher achieving students were able to excel even further because their understanding was reinforced as they helped others, while some found it more difficult because their pace and concentration were often interrupted by the constant questioning of fellow group members. As for the lower achieving students, some flourished when placed into a group with peers who can communicate with them differently than I could, while others got frustrated because they could not concentrate when other group members were in discussion.

Simply looking at the grades does not justify the positive affect that this study had on my students. This study may benefit them later on in their educational career based on their interactions during my observations and the responses I received on the surveys and interviews. While observing and working with specific groups, I constantly made it a point to never give them a direct answer to questions such as, "How do we do this?" The students were forced to question each other, look back in the book or notes to compare problems similar to what they were working on, and discover how to solve problems on their own. According to the post-study survey, almost all of the students "strongly agreed" with the fact

that they ask for help if they do not know how to solve a problem. I learned from the interviews that even if they do not remember how to solve a problem immediately, they know how to research the topic, assess the given information, and use examples to work their way to the solution. I am so thrilled to realize that my students were able to develop these valuable skills. Recently, a lot of emphasis has been placed on standardized tests, but when we focus on them, “we’re *stealing* time from anything that actually contributes to a child’s education” (Kozol, 2005, p. 65). The communication and problem solving skills that my students developed are far more important than a standardized test. I am not sure if the students will ever write a formal proof again, or be faced with the task of identifying similar figures, but I am confident that if they do, they would be able to use every tool available to them to figure it out.

Engagement: All types of communication, whether it is on-task or off-task, lead to better relationships among group members.

As distracting and disruptive as 28 teenagers talking at the same time can be, especially when they are talking about topics completely unrelated to math, that communication is necessary for developing quality working relationships. The students needed to feel comfortable around each other in order to share their thoughts and feelings, and especially to

seek the advice of their peers. The only way to do this was to encourage communication, through either on-task or off-task discussions.

Not many people, teachers included, enjoy that first day of school that is filled with awkward silences. That was exactly how this study started, with a bunch of blank stares and students hesitant to work with others with whom they were unfamiliar. I immediately thought of Vygotsky's (1978) idea that learning and development are intertwined; maybe my students were not developmentally ready to work with their peers and needed a more structured environment. This is when the advice from Durand (2008) and Gillies and Khan (2008) played a pivotal role in changing the tone of the class, because after the students were forced to ask their group mates questions before they came to me, and especially after the group building exercises were implemented, the students were able to open up to one another and feel relaxed in the group setting. This feeling only grew as the study progressed; the more downtime each group had, the more communication sprouted, and the easier it was for the students to work with, and more importantly, trust each other. Even the students who indicated that they preferred working alone at the beginning of the study were able to open up, develop new friendships, and feel more relaxed in the social learning setting than they did during a traditionally structured class. Hopefully this experience will

lead to more friendships and better relationships for my students in the future.

Cooperation: An increase in cooperation leads to an increase in student engagement.

There is a fine line between communication and cooperation. Just because students are communicating with one another does not mean that they are cooperating. This was made evident by the first round of interviews that occurred while the students were still in their randomly assigned groups. Although the amount of communication increased as the weeks went on, the healthy communication, such as debating, questioning, and reasoning, was non-existent. Some students tended to their work on an individual basis with little or no enthusiasm for the topic. Even the groups that were communicating, I eventually discovered, had issues that prevented all group members to become active participants. Students complained that certain group members would dominate the conversation, that others believed they were always correct, or that someone was constantly getting the group sidetracked. This lack of cooperation, not communication, turned some people off to the group environment and therefore left them unmotivated to learn the topics presented.

Once the groups were rearranged and the students were matched with others that best fit their learning style or that they had developed a friendship with, the atmosphere in the classroom livened up dramatically, and, consequently, the students became more engaged in the material. During my observations of these second groups, I spent a lot less time reminding students to stay on task. I heard a lot more mathematical discussions taking place, and it was easier for students to remain engaged with the material. The post-study survey and interviews confirmed my observations. There was an increase in the number of students who “agreed” or “strongly agreed” with the fact that they pay attention in class. Through the interviews, I also discovered that the new groups kept most of the students focused on the material because they wanted to be proud of their grades when they discussed the assessments within the group.

Student Preferences: The most challenging aspect of cooperative learning is grouping students in such a way that is both fair and preferential to all students.

Since every student learns differently, grouping the students effectively was clearly the most difficult aspect of the study. The idea of partnering, utilized by Parsons et al. (2004) and McCurry (2010), allowed students to work with someone of their choice. However, this was not the best method for my class because some students spent more time just

talking to their friend instead of focusing on the material, while others decided to work alone, completely neglecting the notion of cooperative learning altogether.

When placing the students into their first cooperative learning groups, I could not decide on how to group the students, so I randomly assigned them, another bad decision. Some groups basically refused to work together while others had trouble working at all, spending time socializing.

Even the time spent working in the second cooperative groups, although it was the most successful portion of the study, still was not perfect. I constantly used Chapman's (2004) five suggestions to foster peer interactions when I observed some hostility within the groups. My final interviews provided even more insight into the displeasures some students experienced. Some students told me that although they thought they learned better during the second cooperative grouping, they still had some instances where they got sidetracked because they were talking too much or did not like the pace that the rest of the group was working at.

After completing the study, I have concluded that placing students in cooperative groups that perfectly fit their learning style is impossible, given the range of preferences that students have. However, when

significant time is spent determining what groupings will work best, there will still be positive outcomes from the study.

***Classroom Climate:* Classroom management can become difficult when every group is working at a different pace.**

At the beginning of my study, I did not give much thought to the idea of classroom management. I just figured that I was implementing a study in an honors level class and the students would be mature enough to handle the change from the traditional learning style. Not only was there an issue among each group in regard to work pace, but the pace of the groups as a whole was something that I did not expect. This caused a larger classroom management issue that I had to deal with. For the first 10-15 minutes that I observed the students, whether it was during the partnering or either of the groupings, most students worked very diligently. However, when one group finished their assignment for the day, they started conversations about unrelated topics and brought students from other groups into it as well. Even when I was observing one specific group for the day and tried to focus all of my attention on them, I was constantly interrupted by issues throughout the classroom that needed my attention.

As the study progressed, I combated this issue by only assigning a portion of the work that was to be completed that day at one time. This

seemed to cut down on the amount of distraction after awhile. The students first worked really fast to get the work done, thinking that was all they had to do. Then, whenever the class was beginning to get out of control, I would hand out another worksheet or assign more work out of the textbook that the groups could work on together. Eventually, the students seemed to get a bit annoyed with the constant flow of practice exercises coming their way and stopped worrying about getting done fast and started working slower and more deliberately. Naturally, the groups still worked at different paces, but since everyone was working at a slower rate, it lessened the down time, and consequently allowed me to focus for on observations and less on classroom management.

Summary

Cooperative learning is a valuable teaching strategy when implemented properly. It takes time, however, to ensure all of the students are placed with others who will benefit them and not distract them. When the proper groupings are in place, there are significant benefits of this strategy. However, these benefits may not be evident immediately. They may be seen a few weeks in the future, as in the study done by Whicker, Bol, and Nunnery (1997), or may take even longer. The communication and problem solving skills that the students learned will stick with them long into the future. Although the students' grades in my

class did not instantly increase, the amount of communication allowed for authentic thinking, just as Friere (1970) suggested.

Next Steps

The wide array of benefits stemming from cooperative learning, identified by Kagan (1994), Friere (1970), and others, and supported by the research in my own classroom, has encouraged me to continue to use cooperative learning as an instructional tool. Cooperative learning helped foster relationships among the students, taught them how to use their resources, and enhanced their problem solving and communication skills. This study was not perfect, however, and the speed bumps along the way allowed me to develop sub-questions which could lead to future research topics.

The first problem that arose during my study was due to hesitancy towards cooperative learning. Therefore, the first area I would like to study more is the effect that assigning roles, or other strategies that mandate or limit discussion among group members, has on the cooperative groups. Too often, students were either forced to sit back while others dominated the group, or chose to sit back and not contribute to the discussions taking place. "Control of individual actions is effected by the whole situation in which individuals are involved, in which they share and of which they are co-operative or interacting parts" (Dewey, 1938, p. 53). Therefore, these new strategies would force everyone in the

group to get involved, take control of their actions, and create more equitable discussions.

A second idea that I am interested in is the effect that a more rigorous curriculum or more challenging problems would have on the actions of the cooperative groups. Since my study was done in an honors class, many of the students were exceptionally bright and learned the material quickly and solved problems a lot faster than other students. However, I am curious to see the effect cooperative learning would have in a calculus or other higher level class where the material is more complicated. Similarly, I wonder if different results would occur if I assigned longer and more complex problems or projects for the students to work on. If the material were so difficult that one person was not able to figure it out on his own, or if the assignments were so complicated that each group member had to focus on a specific part, I believe that more communication would be an outcome of the process. It would make the communication among group members a necessity in order to produce one final project.

A final thing I would like to change from my study is the amount of background information I had on the students. If I had a round of interviews prior to grouping the students the first time, it would have had a positive impact on the first groupings. I would not have placed them

together randomly, but instead used the information I gathered to place them with other students whom they would cooperate with. Then, for the second groups, only a few slight changes could be made, instead of a complete overhaul of the groupings. If the students were placed with the same group for a longer period of time it would increase their familiarity with each other and create a more relaxed, yet positive cooperative setting.

Despite its imperfections, I believe that this action research study had a positive effect on my students, and I know it had a positive effect on my teaching. My students were not only able to comprehend the material necessary for them to succeed in the classroom, but also to enhance the skills that they use outside of the classroom, and will continue to use throughout their lives. During this process I became more aware of student needs and also became a better listener and communicator. I will continue to reflect and analyze every piece of information I gather in my classroom in order to make teaching a more positive experience for myself and to make learning a more valuable experience for my students.

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Resources

<http://www.wordle.net>

Appendix A



MORAVIAN COLLEGE
A SMALL NATIONAL TREASURE

Office of Academic Affairs
1200 Main Street
Bethlehem, Pennsylvania 18018-6650

TEL 610 861-1348
FAX 610 625-7784
WEB www.moravian.edu

July 11, 2011

Douglas Gimbar
[REDACTED]
[REDACTED]

Re: HSIRB proposal by Douglas Gimbar

Dear Douglas:

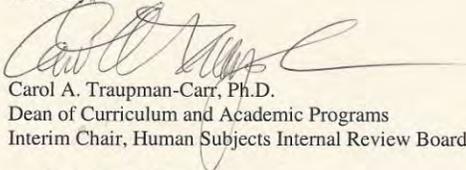
The Moravian College Human Subjects Internal Review Board has accepted your proposal: "Increasing Academic Achievement in High School Mathematics Students Through Cooperative Learning Strategies." Given the materials submitted, your proposal received an expedited review. A copy of your proposal will remain with the HSIRB Chair.

Please note that if you intend on venturing into other topics than the ones indicated in your proposal, you must inform the HSIRB about what those topics will be.

Should any other aspect of your research change or extend past one year of the date of this letter, you must file those changes or extensions with the HSIRB before implementation.

Please do not hesitate to contact me by telephone (610-861-1348) or through e-mail (caroltcarr@moravian.edu) should you have any questions about the committee's requests.

Sincerely,



Carol A. Traupman-Carr, Ph.D.
Dean of Curriculum and Academic Programs
Interim Chair, Human Subjects Internal Review Board

cc: R. Grove, J. Shosh

Appendix B

September 20, 2011

Dear [REDACTED]

I am currently working towards my Master's degree in Curriculum and Instruction at Moravian College. This action research program is designed to focus on the most current and effective teaching methods and requires teachers to analyze and reflect on their own teaching practices. As a result, I will be conducting a study of my own classroom teaching from September, 2011 through December, 2011.

The focal point of my study is the use of collaborative learning and the effects it has on student achievement. Cooperative learning will allow the students to have more effective communication with one another in the classroom which will not only help them understand the required material better, but also improve their communication skills which will help them outside of the classroom as well.

The students will have the opportunity to work in pairs and groups during class, except for the chapter tests. Aside from the students' work, I will also be collecting information from student surveys and interviews, as well as my own classroom observations. I will only use information in the written parts of my study from students who have permission to participate from their parents/guardians. Any child may withdraw from this study at any time without penalty. Also, the names of this school, other faculty members, if applicable, and the students themselves, will be kept confidential. Any other information that may reveal the identity of the parties involved will be altered to protect anonymity.

My faculty sponsor at Moravian College is Dr. Charlotte Zales. If you have any questions about this study you can contact me, or you may contact Dr. Zales at 610-625-7958 or by e-mail at crzales@moravian.edu. If not, please sign and return this letter. Thank you for your help.

Sincerely,



Douglas Gimbar

I attest that I am the principal of the teacher conducting this action research study and I have read and understand the consent form. Douglas Gimbar has my permission to conduct this study at [REDACTED]

Signature: [REDACTED]

Date: 9/20/11

Appendix C

September 21, 2011

Dear Parents/Guardians,

I am currently working towards my Master's degree in Curriculum and Instruction at Moravian College. This action research program is designed to focus on the most current and effective teaching methods and requires teachers to analyze and reflect on their own teaching practices. As a result, I will be conducting a study of my own classroom teaching from September, 2011 through December, 2011.

The focal point of my study is the use of collaborative learning and the effects it has on student achievement. Cooperative learning will allow the students to have more effective communication with one another in the classroom which will not only help them understand the required material better, but also improve their communication skills which will help them outside of the classroom as well.

The students will have the opportunity to work in pairs and groups during class, except for the chapter tests. Aside from the students' work, I will also be collecting information from student surveys and interviews, as well as my own classroom observations. I am asking your permission to use the data gathered pertaining to your child in my study. Please keep in mind that participation is voluntary and will have no effect on your child's grade. Also, any child may withdraw from this study at any time without penalty. The names of the school, other faculty members, if applicable, and the students will be kept confidential. Any other information that may reveal the identity of the parties involved will be altered to protect anonymity.

High School principal, [REDACTED] has already given his consent for this study. My faculty sponsor at Moravian College is Dr. Charlotte Zales. If you have any questions about this study you can contact me by e-mail at [REDACTED] or you may contact Dr. Zales at 610-625-7016 or by e-mail at crzales@moravian.edu. If not, please sign and return this letter. Thank you for your help.

Sincerely,

Douglas Gimbar

I attest that I am the child's legal guardian and I have read and understand the consent form. Please check the appropriate box below.

I am willing to have my child participate in Mr. Gimbar's study.

I am not willing to have my child participate in Mr. Gimbar's study.

Child's Name: _____

Parent/Guardian Name: _____ Signature: _____

Date: _____

Appendix D

Pre-Study Self Evaluation

Name: _____ Date: _____

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoy math.	1	2	3	4	5
I think I am good at math.	1	2	3	4	5
I am better at math when working with others.	1	2	3	4	5
I like math when it is challenging.	1	2	3	4	5
I think I can learn every math concept taught to me.	1	2	3	4	5
I try to participate during math class.	1	2	3	4	5
I pay attention during math class.	1	2	3	4	5
I think math concepts are important because I will use them in the future.	1	2	3	4	5
When struggling with a problem, I try to work it out on my own first.	1	2	3	4	5
When struggling with a problem, I give up on it too easily.	1	2	3	4	5
When doing math, I am always focused on the material.	1	2	3	4	5
Talking aloud helps my problem solving skills.	1	2	3	4	5
I feel nervous and pressured in math class.	1	2	3	4	5
I help people who are struggling if I understand the material.	1	2	3	4	5
I ask for help if I don't know how to solve a math problem.	1	2	3	4	5
I enjoy working with other people.	1	2	3	4	5

Appendix E

Post-Study Self Evaluation

Name: _____ Date: _____

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoy math.	1	2	3	4	5
I think I am good at math.	1	2	3	4	5
I would describe math as fun.	1	2	3	4	5
I like math when it is challenging.	1	2	3	4	5
I think I can learn every math concept taught to me.	1	2	3	4	5
I try to participate during math class.	1	2	3	4	5
I pay attention during math class.	1	2	3	4	5
I think math concepts are important because I will use them in the future.	1	2	3	4	5
When struggling with a problem, I try to work it out on my own first.	1	2	3	4	5
When struggling with a problem, I give up on it too easily.	1	2	3	4	5
When doing math, I am always focused on the material.	1	2	3	4	5
I would like to be better in math.	1	2	3	4	5
I feel nervous and pressured in math class.	1	2	3	4	5
I like math when it is easy.	1	2	3	4	5
I ask for help if I don't know how to solve a math problem.	1	2	3	4	5
I have trouble learning math concepts.	1	2	3	4	5