THE EFFECTS OF A COOPERATIVE LEARNING STRATEGY ON POST-SECONDARY STUDENTS' MATHEMATICS ACHIEVEMENT

by

Rose L. Russo

A Master's Project
Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science in Education
Curriculum and Instruction in Inclusive Education
Department of Curriculum and Instruction
State University of New York at Fredonia
Fredonia, New York

May 2014

State University of New York at Fredonia
Department of Curriculum and Instruction

CERTIFICATION OF PROJECT WORK

We, the undersigned, certify that this project entitled THE EFFECTS OF A COOPERATIVE LEARNING STRATEGY ON POST-SECONDARY STUDENTS' MATHEMATICS ACHIEVEMENT by Rose L. Russo, Candidate for the Degree of Master of Science in Education, Curriculum and Instruction in Inclusive Education, is acceptable in form and content and demonstrates a satisfactory knowledge of the field covered by this project.

[redacted]
Master's Project Advisor
Dr. Robert Dahlgren, Course Instructor
Department of Curriculum & Instruction

May 7, 2014
Date

[redacted]
Department Chair, Mira Berkley
Department of Education

5.16.14
Date

[redacted]
Dean Christine Givner
College of Education
At SUNY Fredonia

5-21-14
Date

Abstract

This study compared the effects of a cooperative learning strategy, "Send-a-Problem" on pre-service teachers' achievement in a college math education course at a small liberal arts state college in western New York state (Kagan, 1992, p. 10:11). Through use of a quantitative design, over a 1 week period in the spring semester of 2014, one group of students taught by the same teacher participated in three classes, two being the experimental and one being the control. Participants were selected based on the target audience that would best answer my research question. Results may show that post-test scores were higher in the experimental group over the control group. Additional findings may suggest that pre-service teacher's would use this cooperative learning strategy in their future classrooms, that they enjoyed participating in the groups, and found it to be an engaging strategy.

Table of Contents

Introduction

The research surrounding the use of cooperative learning strategies concurs that students in primary and secondary grade levels increase their achievement in subjects areas, increases understanding on given topics, and increase motivation (Celikten, Ipekcioglu, Ertepinar, & Geban, 2012; Ebrahim, 2012; Galton, Hargreaves, & Pell, 2009; Law, 2011; Mevarech, 1985; Whicker, Bol, & Nunnery, 1997; Souvignier, & Kronenberger, 2007; Tarim, 2009; Pierce, Cassady, Adams, Speirs Neumeister, Dixon, & Cross, 2011). Cooperative learning is a teaching strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a concept in different subject areas (Kagan, 1989). Each member of a team is responsible not only for learning what is taught but also for helping teammates learn, thus creating an atmosphere of achievement.

With education rapidly changing, teachers are faced with increased accountability of student learning and are required to use evidence-based instructional strategies, one being cooperative learning groups. According to the New York State Department of Education (2013), the purpose of the new accountability system is to ensure that there is an effective teacher in every classroom that will grow professionally, and improve their instructional practices in order to impact student achievement to create grade level and school wide growth. The New York State Department of Education (2013) states, "The evaluation system will also foster a culture of continuous professional growth for educators to grow and improve their instructional practices" (p. 6). This is a reality in many schools across the country, and many educators are not adequately informed of the effectiveness of certain evidence-based practices.

Interdisciplinary

Recently, a variety of studies regarding cooperative learning strategies across multiple disciplines have been carried out in multiple countries and at different educational levels, in

which most were elementary and middle schools (Celikten, Ipekcioglu, Ertepinar, & Geban, 2012; Ebrahim, 2012; Galton, Hargreaves, & Pell, 2009; Law, 2011). Students of a wide range of abilities, grade levels, and ethnicities have been shown to increase their achievement in a multiple subject areas, while using a cooperative learning strategy when learning a new concept. Although these cooperative learning strategies show an increase in achievement, some strategies are better to use than others due to student interests and experiences. Law (2011) stated that, "as cooperative learning activities encourage students to read and understand the meaning of a text together in small groups, such activities should also arouse students' interests and intrinsic motivation" (p. 419). An individual student will respond to multiple cooperative learning strategies in a variety of ways depending on if they found it fun, engaging or boring. Educators must carefully choose these strategies based on the material being taught, and the interests and learning styles of their students.

Mathematics

Additionally, many studies have investigated the effects of cooperative learning strategies on student learning in the discipline of mathematics (Hooker, 2011; Mevarech, 1985; Nichols, 1996; Whicker, Bol, & Nunnery, 1997; Souvignier, & Kronenberger, 2007; Tarim, 2009; Pierce, Cassady, Adams, Speirs Neumeister, Dixon, & Cross, 2011). Many researchers argue that not only does student achievement significantly increase while engaged in cooperative learning, but students also understand the concepts being taught (Hooker, 2011; Mevarech, 1985; Whicker, Bol, & Nunnery, 1997; Souvignier, & Kronenberger, 2007; Tarim, 2009; Pierce, Cassady, Adams, Speirs Neumeister, Dixon, & Cross, 2011). Hooker (2011) stated that, "results indicate that the collaborative learning groups did have a positive effect on the learning of mathematical concepts" (p. 224). Using cooperative learning strategies within Mathematics instruction also has many benefits to student growth that can contribute to a well-rounded learner. Nichols (1996)

argues that:

> Students receiving cooperative learning experienced increases in their intrinsic valuing of the learning task, self-efficacy, and learning goal orientations and their reported use of deep processing strategies. ...The findings of this study suggest that the cooperative group instruction may be one avenue that could be used to effectively promote a positive change in student perceptions and motivation later in the school year. (p. 474)

These findings are significant in the field of education in today's age, and are an integral part of what the new teacher accountability is aiming towards in order for students to receive a high quality education.

Experts in cooperative learning, a field with a wide range of strategies that has been rapidly growing and changing with the trends in education, have generally agreed that appropriate uses of cooperative learning strategies do increase achievement levels amongst all students regardless of race, gender, and ability in multiple subject areas (Slavin, & Oickle, 1981; Johnson, Johnson, & Taylor, 1993; Nattiv, 1994; Stevens, & Slavin, 1995). However, specific guidelines must be followed in order for cooperative learning to be successful. For example, Johnson, Johnson, & Roseth (2010) advise that:

> ...the size of groups should be small. Groups of two to four are optimal, depending on the age of the students, the level of their social skills, the task, and the time available.... groups should arranged in a horseshoe shape so that students can face each other... students need to remember that the goal is to make each member a stronger individual.

> This is not accomplished by giving members the "right" answer. It is accomplished by ensuring that each member understands the strategy and procedures needed to derive the correct answer. (pp. 12-13)

Although there are many different strategies and forms of cooperative learning, many of the strategies model those guidelines stated above.

Many of the studies done in the area of cooperative learning in education have been carried out at the elementary, middle, and high school grade levels. I would like to extend the previous research into higher education, namely post-secondary education, not only to see its effectiveness on student achievement, but also to make cooperative learning strategies a more reliable evidence-based strategy. Hooker (2011) attests: "The American College Testing Program (ACT) estimates that only 40% of all U.S. students are ready for college level algebra, dropping to 23% for the Native American population" (p. 220). This leads to the purpose of my purpose of my thesis project.

"Send-a-Problem"

"Send-a-Problem" is a cooperative learning strategy by Spencer Kagan (1992). The steps of this strategy according to Kagan are that, "Each student on a team makes up a problem and writes it down on a flashcard, ...teams pass their stack of review questions to another team, ... the team attempts to answer it" (p. 10-11). Then, "...upon return of the cards to the senders, there is opportunity to discuss and clarify any questions." (p. 10-11) This cooperative learning strategy has yet to be studied, and I find this strategy very interesting due to the competitive nature

between groups. Due to the nature of the strategy I hypothesize that this will benefit the achievement of students in undergraduate college level Math classes.

The main purpose of my project is to investigate the effects of a cooperative learning strategy, "Send-a-Problem" on pre-service teachers' achievement in a college Math education course in order to extend the research on cooperative learning groups into post-secondary education. In multiple education courses in college, I have worked in cooperative groups, however in many undergraduate courses not related to the field of education, cooperative learning rarely existed. I am interested in the idea of an increase in cooperative learning in post-secondary education, and since so many students struggle in the area of Mathematics, I feel this is an important area to do my research. Through use of a quantitative design with pre and post tests, 23 pre-service teachers taught by the same professor in a Math education course participated in three classes, two being the experimental groups and one being the control group. This research project strives to provide the educational world with a strong and reliable evidenced-based strategy, in order to overcome the new accountability system as a means to increase student achievement not only in Mathematics, but rather in all subject areas.

The research question that drives this project thus is:

• Does "Send-a-Problem", a cooperative learning strategy, significantly increase student achievement in Mathematics?

Possible research questions for future research could be:

- Would pre-service teachers use this cooperative learning strategy in their future classrooms?
- Did pre-service teachers enjoy participating in the groups?
- Did pre-service teachers find this to be an engaging learning strategy?

Literature Review

A review of the literature shows that interest in cooperative learning groups has grown over the past two decades. An initial study compared the effects of cooperative learning groups on two different races in ten integrated middle school English classes. The subjects participating in the study consisted of 230 students where 33.9% of the students were African American, the rest being Caucasian, and 5 teachers. Slavin & Oickle (1981), over the span of 12 weeks, through a 2 × 2 factorial design with an external control group, placed students into teams of 4-5 people made up of all levels of academic achievement, sex, and race in the proportion they represented in the class as a whole along with the control group where students were not placed into teams. Measures were taken on academic achievement through a standardized test, and cross-racial friendships were measured by a simple question, Who are your friends in this class? Slavin and Oickle concluded that Caucasian students in the team condition gained more than Caucasians in the Non-Team condition, while African Americans in the Team condition gained much more than African Americans in the Non-Team group, thus proving that African American students gain more than Caucasian students from being in the Team treatment.

A later study conducted by Mevarech (1985) discovered that cooperative learning with groups of students can improve computational and comprehension skills. Through use of a 2x2 factorial design, this study investigated the effects of a cooperative grouping strategy, Student-Team Mastery Learning (STML), on students' mathematics achievement over fifteen weeks. The 34 participants involved were mostly middle class, fifth grade students in an Israeli school. The study compared four treatments where students were randomly assigned: student-teams using mastery learning strategies, student-teams without mastery learning strategies, mastery learning strategies, and a conventional setting which served as the control group. Data was collected

through means of a pre/post test. The results indicated that small groups promoted computational skills, while MLS improved both computation and comprehension skills. Additional findings stated that high, medium, and low-ability students improved. Mevarech stated, "My observations showed that when a difficult problems was presented, students first attempted to solve the problem individually; the cooperative work began only after one team member discovered the solution..." (p. 231). However, a limitation of this study would be the fact that it was conducted in Israel; it may not be generalized to other countries in the world.

A third empirical study showed the effectiveness of cooperative learning on student achievement. Johnson, Johnson & Taylor (1993) conducted a study that investigated the effects of cooperative and individualistic learning on the achievement and attitudes of high-ability students. The study employed 34 high-ability students from four 5th grade classes and two classroom teachers. The group of students participated in six 55 minute instructional sessions, where both the randomly selected control and experimental group studied the same unit where teachers were given scripts to follow. During experimental phases, students were instructed to work efficiently as a group and received praise and group rewards. In the control phase students were instructed to work independently, avoiding interactions with other students, and students were rewarded individually. Johnson, Johnson & Taylor stated, "The results of this study indicate that working in cooperative groups, as opposed to working individualistically, is beneficial for high-ability students' academic self-esteem" (p.843). Johnson, Johnson & Taylor (1993) concluded that the high-ability students in the cooperative condition performed better on the recall questions, and their academic self-esteem was also higher than the individualistic condition.

The use of cooperative learning strategies benefits both females and males. Another empirical study (Nattiv, 1994) examined the relationship between helping behaviors amongst

students and their math achievement. Through a mixed method design, over 6 weeks, 101 students in grades 3-5 in northern Utah participated in the study. Data was collected through means of a pre/post test, as well as videotaping a mean time of 80 minutes per week to record helping behaviors. Students worked in cooperative teams of between 5-6 people daily for under an hour a day, for the first 3 weeks before videotaping, then 3 weeks afterwards with videotaping. Results indicated that "giving explanations," "receiving explanations," as well as "giving and receiving other help" correlated positively with math achievement gains (p. 291). Additional findings suggested that this held true for both boys and girls in all three grades, and that high achievers gave more explanation and help than middle or lower achievers.

The next investigation (Stevens & Slavin, 1995) discovered that cooperative learning strategies help both general education students, as well as special education students. Stevens & Slavin employed a 2-year study where the goal was to extend research on the effectiveness of the Cooperative Integrated Reading and Composition (CIRC) program on academically handicapped and non-handicapped students. The participants in this study included 1,299 students in second through sixth grade in a suburban working class school district in Maryland. The schools selected for the study were similar in socioeconomic status, achievement levels, and in ethnicity. This study made use of 31 experimental classes and compared these to 32 non-experimental classes, both including special education students. In the experimental group, teachers used the CIRC program along with basal readers for 60-90 minutes a day typically using two or three reading groups for instruction. The non-experimental group received traditional instruction using their traditional teaching methods and curriculum for 60-90 minutes daily. Stevens & Slavin stated, "...the district prescribed the amount of time to be allocated for reading and language arts at various grades, so there was a great deal of consistency on many of these

variables across classes and schools, and therefore across treatments groups" (p. 249). For the purpose of measurement, students' scores on the California achievement test were used as pre-test scores and as the post-test, along with observations. Results indicated that there were significant and positive effects on reading vocabulary, comprehension, and language expression on academically handicapped students who were mainstreamed in the CIRC classes, as well as non-handicapped students. An additional finding is that the positive effect was maintained over 2 years. Also, there were no significant findings on the effects on the students' attitudes towards reading or writing.

Another study conducted by Nichols (1996) investigated the effects of cooperative learning on student achievement and motivation in a high school geometry class. Over an 18-week period for 55-minute class sessions, eighty students (68 tenth grade, 10 eleventh grade, and 2 twelfth grade) participated in this study and were randomly assigned to either a control group which received traditional instruction, or one of the two treatment groups which received cooperative learning instruction. In order to assess geometry achievement, Nichols used scores from the IOWA Test of Basic Skills and teacher-made exams. Nichols stated that he used these tests because the, "two teacher-made comprehensive tests reflected the state mandated curriculum as well as the local school district curriculum standards" (p. 470). Also, an 83-item questionnaire was used as a pretest, posttest, and post-posttest assessment of efficacy, intrinsic valuing, goal orientation, and cognitive processing. The control group in the study received traditional lectures while the treatment group was placed in Student Teams Achievement Divisions (STAD). The instructor placed the treatment students into heterogeneous achievement groups consisting of four to five students. Nichols (1996) concluded that achievement gains were observed in the two treatment groups when cooperative learning was implemented. Additional findings suggests that students receiving cooperative learning experienced increases

in their intrinsic valuing of the learning task, self-efficacy, and learning goal orientations and their reported use of deep processing strategies.

The use of cooperative learning strategies has been shown to improve achievement in mathematics. Whicker, Bol & Nunnery (1997) investigated over a 6-week period, the effects of cooperative learning strategies in 2 pre-calculus classes were investigated. The participants included 31 students in 11th and 12th grade in a lower-middle-class area in the mid south. One class was randomly assigned as the treatment, while the other was the control. The treatment group used cooperative grouping and studied using a variation of Student Teams-Achievement Division (STAD), while the control studied independently. The measures to collect data were 3 chapter tests. Results indicated that students in the treatment group had increasingly higher scores on tests than the control group, and had significantly outscores the control on the 3rd chapter test. Questionnaires also indicated that students favored the cooperative groups because they appreciated getting help from other students, while some disliked have pre-assigned and permanent groups. One limitation to this study is the sample size wasn't greater than 35 participants.

Cooperative learning strategies have been shown to improve achievement across the curriculum, not in just one subject area. Another empirical study conducted by Souvignier & Kronenberger (2007) compared the effects of cooperative learning methods at the elementary school level. The study lasted for ten months covering four units, three in math, and one in science. The study's participants included nine 3rd grade classes from three elementary schools in Frankfurt/Main, Germany, having a total of 208 students. Through an experimental study with randomly assigned classes, students were placed into one of three instructional conditions; standard jigsaw, jigsaw with additional questioning, or the control condition of teacher-guided instruction. For units of measurement, pre and post-tests were given prior to and at the end of

each unit, and classroom observations were done with use of videotapes. Shocking results showed that there were large gains from pre- to post-test in all groups and all units, and all four post-tests favor the teacher-guided group compared with the two jigsaw conditions taken together. Results did indicate that cooperative learning did improve scores; however, the study favored teacher-guided instruction.

Not only has cooperative learning been shown to improve student achievement, it has also been shown to be an effective tool for on task behavior. A later study conducted by Galton, Hargreaves & Pell (2009) compared the academic performance and classroom behavior of student's ages 11-14 involved in sessions of instruction organized either as cooperative group work or whole class instruction. Originally a "true" experimental design, changed due to the fact this was not feasible in this particular setting due to most teachers only joining the project in order to discover how to use group work more effectively, and did not want to be excluded from participating in the various training programs. The experiment employed three different types of group work throughout 3 subject areas. The designs were as followed; collaborative work (complete inter-dependence), cooperative work (taking roles and putting ideas together), and seated groups (checking each other's work). Data was collected through means of a pre and post-test and classroom observations. Galton, Hargreaves & Pell (2009) indicated that classes taught through the use of collaborative grouping outperformed those where whole-class instruction was dominant. For on task behavior, group work seemed to have a 5% increase above whole-class instruction. Additional findings show that open dialogue, and sustained interactions were both significantly higher in the group setting over whole-class instruction.

The use of cooperative learning strategies are effective in early childhood settings as well. Tarim (2009) examined the effects of cooperative learning on preschoolers' mathematics problem-solving abilities. Through an experimental design with random assignment of schools,

the study was carried out in two private kindergartens in Turkey containing two experimental groups, and one control group. A total of 65 children participated in the study, but only 54 were evaluated due to absences during data collection. In the experimental groups, students were randomly placed into small groups, and then were to participate in some activities about mathematical concepts. At the end of each activity, the groups were given instructions to paint a picture appropriate for the story or the topic from the activity. During the control group, the teacher gave class activities that involved the entire class, and sometimes students worked individually. Data for the study was collected through three means, one being a pre/post problem test used to evaluate the children's solving of verbal problems, another being an hour observation of each activity in the experimental groups, and the last was a semi-structured interview with the teachers in all three groups. Tarim (2009) concluded that there were significant overall effects from each group, however, children in the experimental group benefited significantly more than those in the control group. Another finding showed that students in the experimental group participated in the activities willingly and enjoyed the activities throughout the study. One last finding indicated that teachers in the experimental groups stated that the children improved their cooperation and sharing during the individual and classroom objectives.

The use of cooperative learning engages students because they enjoy working with others even when the work is challenging. Hooker (2011) examined the use of small peer-led collaborative learning groups in developmental math classes to change the students' perceptions of mathematics and their success. Through a quasi-experimental study, researchers used a two fall semester sections of Pre-algebra that met 4 times a week; one as the treatment section and the other as a control section. In the treatment section students were asked to place themselves into groups of four to eight students and each group of students' were assigned a group leader.

Results indicated that there was an 8% increase in student completion rate compared to the control group. Other results showed that there was a 15% increase in the perseverance rates compared to the control group. Through a survey interview, findings indicated the small, peer-led collaborative learning groups made the work more fun and worthwhile even when doing very challenging problems.

When used in an elementary setting, cooperative learning strategies have proven to be effective in the area of achievement. Law (2011) investigated the effects of cooperative learning on enhancing fifth graders' achievement goals, motivation, and reading proficiency in Hong Kong. The participants contained within the study were 279 fifth grade students from Hong Kong located in 9 classrooms, and 3 primary school teachers. Through a quasi-experimental design, over the span of one semester, the study incorporated three total conditions, two research conditions (Jigsaw approach and the drama approach) and one control group. Measurements for data collection were taken by a pre and post-test as well as questionnaires. Law (2011) determined that in reading comprehension, the Jigsaw group significantly outperformed the drama group and the control group, and the drama group and control group showed no significant difference. Similar results were shown on scores of the goal orientations, where the Jigsaw group had significant differences between all three groups for mastery goals. Additional findings indicated that students in the jigsaw group were more likely to agree that their teachers provided them with challenging tasks, stimulated their curiosity, and linked their learning activities to real-life experiences. A limitation of this study is the fact it was conducted in Hong Kong, and it may not be generalized to other countries in the world.

When used appropriately, cooperative learning strategies enable gifted learners to increase in their achievement. Pierce, Cassady, Adams, Speirs Neumeister, Dixon, & Cross (2011) reports the impact of using cluster grouping and specific curriculum to support gifted

learners' math achievement in urban elementary schools. This study employed a 6-year design that was to promote gifted learners. The participant's included52 schools, but not all schools met the requirements for reliability and fidelity. Three math replacement units were provided replace the standard third-grade math curriculum for the teachers in this study, which covered the topics of algebra, geometry, and probability. Teachers attended training in Project CLUE (Clustering Learners Unlocks Equity) which showed them how to effectively teach high-ability learners each year. For all assessment measures, gifted learners' achievement gains over the course of the academic units were compared to their classmates' gains over the same period of time, and the comparison students were randomly selected from the same classrooms as the gifted students. The results indicate that when the curriculum was delivered as designed, clustering tended to enable both gifted and comparison learners to enjoy achievement gains over time. Additional findings support that curriculum materials, grouping practice, and level of teacher intentionality were all significant factors contributing to the success of a programmatic intervention.

The use of cooperative learning strategies are effective in helping students solidify and understand new concepts being taught. Another study (Celikten, Ipekcioglu, Ertepinar, & Geban, 2012) compared the effects of conceptual change oriented instruction through cooperative learning and traditional instruction in Science on 4th grade students in a middle-range socioeconomic status, and average education level. Through an experimental design, over an 8 week period, two groups, one control and one experimental were taught by the same teacher and selected from six general science classes according to their equality-based characteristics. The results indicated that the experimental group had correctly responded to teacher asked questions 11% more than the control group. Another finding was that the cooperative learning led to better understanding of the concepts taught than the traditional instruction group.

Cooperative learning strategies also improve students' self efficacy. A later study conducted by Darnon, Buchs, & Desbar, (2012) investigated the effects of the Jigsaw technique and its relation towards boosting self-efficacy of students enrolled in a vocational curriculum. Through an experimental design, over a period of 4 sessions with each session being 2 hours, the experimenter broke students up into groups of 4 and gave them a topic for session 1. During session 2, students were broken up into expert groups, and then finally each individual returned to their jigsaw group in order to teach the other group members about the content. The control group had to read and work on four texts as well as answer questions. Findings showed that students reported a higher self-efficacy at the end of the four sessions in the Jigsaw group.

Not only has cooperative learning strategies been proven to be effective in achievement gains, it has also been shown to be effective in increasing social skills amongst students. The final study (Ebrahim, 2012) compared the effects of teacher centered learning and cooperative learning on 5th grade students' science achievement and social skills in Kuwait. Through use of a researcher-created pretest-posttest design with random assignment of 8 fifth grade classes, over a period of 6 weeks, science classes met 3 days a week for 45 minute lessons. Each teacher taught one cooperative learning group and one teacher-centered group. Students in both settings were taught the same material and concepts in the unit. Results showed that post-test scores were higher in the experimental group over the control group. Additional findings showed that even though the social skills mean pre-test scores of the control group were higher than the experimental group, the social skills post-test mean score of the experimental group surpassed the control group. One limitation of this study is the fact it was conducted in Kuwait, it may not be generalized to other countries in the world.

In conclusion, the body of research centered on cooperative learning strategies suggests that when used properly they can increase student achievement. The literature suggests as well, that students have been shown to increase their conceptual knowledge on given topics. Research also indicates that cooperative learning strategies can increase motivation and self-efficacy. This review focused on cooperative learning in interdisciplinary studies as well as mathematics in primary grade levels up to post-secondary education; however, there is a lack in the research of cooperative learning strategies in post-secondary education.

Therefore, the purpose of the present study was to investigate the effects of a cooperative learning strategy, “Send-a-Problem” on pre-service teachers’ achievement in a college Math education course in order to extend the research on cooperative learning groups into post-secondary education at a small liberal arts state college in western New York state. The primary research question is: Does "Send-a-Problem", a cooperative learning strategy, significantly increase student achievement in Mathematics? Possible research questions for future research could be: (a) Would pre-service teachers use this cooperative learning strategy in their future classrooms? (b)Did pre-service teachers enjoy participating in the groups? (c) Did pre-service teachers find this to be an engaging learning strategy?

In the next chapter, I will describe a project that investigated the use of cooperative learning strategies and their effect on student achievement in mathematics, in a post-secondary educational setting. Contained within the reading, I will explain in depth the processes used to complete the study. I will also explain how the subjects were selected, how the data was collected, the setting of the research project and how the data was analyzed.

Methodology

The current study is based on the works of Spencer Kagan and his simple structures for cooperative learning strategies, namely the "send-a-problem" strategy (Kagan, 1992). The extent of research done on cooperative learning has ranged from elementary education to secondary education, however, research is lacking in the post-secondary educational setting. Previous findings have shown that the appropriate use of cooperative learning strategies have increased student achievement amongst students in a variety of subject areas in pre-secondary education (Slavin, 1985). The effectiveness of cooperative learning on students' mathematics achievement in post-secondary education has yet to be researched in depth, and I hope to extend the research. A position statement from The National Council of Teachers of Mathematics (2012) attests: "Linking research and practice in mathematics education is necessary for addressing critical issues of mathematics teaching and learning." (p.1). Because many students tend to struggle in the area of mathematics, especially in post-secondary education, I wish to investigate the effects of "send-a-problem" on college student's mathematic achievement in a MAED (Mathematics Education) course offered by the Department of Mathematical Sciences at a small liberal arts college in Western New York.

Subjects

This study involved 23 undergraduate students enrolled in a section of a MAED course that is carefully designed to prepare pre-service teachers to learn mathematics in depth, so when they do have their own classroom, these future teachers are confident in teaching this subject. I have made use of purposeful sampling as this group of students will best answer my research question. As Palys states, purposeful sampling “signifies that you see sampling as a series of

strategic choices about with whom, where and how to do your research" (p. 1). Participating in this study is voluntary as it will in no way affect their semester grades nor will it be made a requirement by the instructor. The criteria for this study are:

1) subjects are participating in the MAED course receiving training in problem solving and mathematical modeling within the real number system.
2) subjects anticipate a degree in education.
3) subjects may include both female and male participants.
4) subjects are at a minimum 18 years of age.

Setting

I investigated the effects of "send-a-problem" on college student's mathematic achievement in a MAED (Mathematics Education) course offered by the Department of Mathematical Sciences at a small liberal arts college in Western New York during the spring semester of 2014. In this Mathematics Education (MAED) course, pre-service teachers learn problem solving and mathematical modeling within the real number system over numerous topics including proportional reasoning, algebra, statistics, probability, properties of geometric shapes and measurement in 2 and 3-dimensions. The school is broken down by gender as follows, 57.4% female and 42.6% male.

Design

These particular research interests have led me to base my project design on the principles of quantitative research. As Johnson and Christensen (2012) state: "The point is that

most quantitative researchers try to indentify cause-and-effect relationships that enable them to make probabilistic predictions and generalizations" (p. 33). My rationale for choosing a quantitative framework is because at first, I had considered using a mixed methods approach; however, due to the fact that my study mirrors the scientific method I gathered that a quantitative approach was best. In my proposed study, I studied my hypothesis and tested it with empirical data to see if it is supported. Quantitative researchers usually start with a theory, which leads to a hypothesis or a prediction, and they then carry out a study to test that hypothesis. From this quantitative researches use the data to draw conclusions and identify patterns. However, qualitative studies are used to describe what is seen locally and sometimes used to come up with or to generate a theory or hypothesis. Qualitative researchers ask meaning about events taking place in given settings. Thus, a quantitative approach is the general framework that guides my research study.

Data Collection

Due to the quantitative nature of the study, I employed a 10-question pretest and a 10-question posttest during each observation as my inquiry method. With the approval from my university's Human Subjects Review Committee, I then distributed the informed consent form to those students who have chosen to partake in the study as well as the professor teaching the course during the Spring 2014 semester. Upon collection of these informed consent forms, I began the study. During one control observation, I administered the pretest prior to the professor's usual instructional method, typically a 35-40 minute direct instructional approach. After the lesson, I administered the posttest. For the following two experimental observations, I administered a pretest, and after the instructional intervention making use of the cooperative learning strategy "Send-a-problem", I administered the posttest. The pretest/posttest data was

collected during the spring semester of 2014. All of the data was placed inside a folder, which was locked away, in a fireproof lockbox, in which only I obtained a key. Also, to protect the students' identities, students' names were changed and I used identifiers such as "student 1, student 2" to keep the data obtained organized.

Data Analysis

I carefully compared pre and post tests scores during both the control and experimental groups. I placed the data collected into a chart in order to arrange the data into a more interpretable form. I also graphed this data in order to compare the control and experimental phases of my study. I hoped to discover that the gains from pretest to posttest scores amongst the experimental group are significantly higher than those in the control group. This examination is used to answer the original research question; Does "Send-a-Problem", a cooperative learning strategy, significantly increase student achievement in Mathematics?

Limitations

There are a few limitations to this study. Since the sample group of participants was not randomly selected, the data may be skewed due to the misrepresentation of the general population of post-secondary students. Also, because the purposeful sampled group was pre-service teachers, the data may also be skewed.

In the next chapter, I will describe the results from the study that investigated the use of cooperative learning strategies and their effect on student achievement in mathematics, in a post-secondary educational setting.

Results

The effects of a cooperative learning strategy, "Send-a-Problem" on college students' mathematics achievement can be seen in Table 1. During the initial control under normal teaching conditions (Direct instruction), students on average increased from pre to post test scores by 18.26 points. As can be seen in Figure 1, under direct instruction almost every student had an increase in achievement with the exception of 3 people, who stayed the same. I also noticed that no student achieved a score greater than 50.

First Experiment

Once the cooperative learning strategy was implemented, as seen in Column 3 in Table 1, students' mathematics achievement significantly increased. In fact, the scores increased on an average by 31.30 points. As seen in Figure 2, a visual representation of the scores, the difference between the pre- and post-test scores shows the noticeable increase. Most students either increased or stayed the same, with one student actually decreasing by 10 points. It is also noticed that some students were able to achieve a score greater than 50 on their post test.

Second Experiment

In the second experiment, there was an unexpected outcome. In the second experimental phase the students showed an increase in their test scores, however the increase was not significant. The average increase, as seen in Table 1 in Column 4, the students increased on average by 16.52 points. This is a lower outcome than with the control. This could be due to the break that followed this class, which happened to fall on the Friday before the college students' spring break. In this experimental phase, most students stayed relatively the same with their scores, with 2 students actually decreasing their scores. The students that did increase their

scores, increased more than they did during the control. As depicted, there were again students who were able to achieve a score greater than 50 points. This is visually represented, and can be seen in Figure 3.

When looking at Table 1, which shows the breakdown of each student and how they increased during each phase of the study, it can be determined which students may have benefited, stayed relatively the same, or did not benefit from the cooperative learning strategy as compared to direct instruction. There were students who seemed to have not benefited from the cooperative learning strategy, and these students are students 8, 10, and 22. I determined that this is due to the fact that during either experimental phase of the study these students had a decrease in their scores from pre to post testing. There were also students who had stayed the same with their pre- and post-test scores and only had an increase in achievement during the control. As seen in Table 1, these students are students 9, 11, and 19. The students who seem to have significantly benefited the most from cooperative learning are students 3, 6, 13, 14, and 15. Overall, it seems to be a mix of students in general who did and did not benefit from the cooperative learning strategy.

Discussion

For achievement, the results of this study confirm the findings of previous literature, that cooperative learning can improve achievement in the subject area of mathematics. The present findings showed that the cooperative learning strategy, "Send-a-Problem" produced an increase in college students' achievement in mathematics. During the control phase of the study, the average increase in score under direct instruction was 18.26 points. When the cooperative learning strategy was implemented during the first experimental phase, the average increase in scores from pre to post test almost doubled to an average increase of 31.30 points. Almost every student increased his or her score from pre- to post-test. More importantly, students were able to score higher on their post-tests than during the control phase of the study. These results are consistent with previous research that showed that cooperative learning groups increase student achievement in mathematics (Galton, Hargreaves, & Pell, 2009; Hooker, 2011; Johnson, Johnson, & Taylor, 1993; Mevarech, 1985; Pierce, Cassady, Adams, Speirs Neumeister, Dixon, & Cross, 2011; Souvignier, & Kronenberger, 2007; Stevens, & Slavin, 1995; Tarim, 2009; Whicker, Bol, & Nunnery, 1997). However, the second experimental phase of the study, on average, contradicted the results from previous research as student achievement actually decreased. It is hypothesized that this decrease was due to the break that followed this class, which happened to fall on the Friday before the college students' spring break. Additionally, the results of both experimental phases proved that many of the students were able to achieve scores higher than a 50% unlike the control phase of the study where students' highest scores never surpassed a 50%. So, the current findings extend the research and validity of cooperative learning groups in increasing student achievement.

Significance

It seems that there are two important lessons that can be learned from this study. One of the most important "lessons" from this study is that the use of cooperative learning strategies, when used at appropriate times, can improve achievement amongst students. When the students were first introduced to the "Send-a-Problem" cooperative learning strategy, they almost doubled their average score. However, on the Friday of break, the students' achievement actually decreased. This is consistent with previous research that discusses cooperative learning strategies should be appropriately used (Slavin, & Oickle, 1981; Johnson, Johnson, & Taylor, 1993; Nattiv, 1994; Stevens, & Slavin, 1995). The second most important lesson from this study is that not every student learns the same, or will benefit from just the use of cooperative learning strategies. Results showed that some students' scores benefited, stayed the same or decreased during the course of the study. This is consistent with previous research as well. As Law (2011) stated that, "as cooperative learning activities encourage students to read and understand the meaning of a text together in small groups, such activities should also arouse students' interests and intrinsic motivation" (p. 419). Therefore, the cooperative learning strategy, "Send-a-Problem" provided some evidence that it can increase student achievement in mathematics, as well as extending the research of cooperative learning strategies in a post-secondary educational setting.

Limitations

Although the present findings of this study were encouraging, there are some limitations that this study poses. First of all, the study was conducted with one sample group of students (N=23). Next, the sample group of participants were not randomly selected, as they were selected through purposeful sampling. Also, the selection of participants was contained within

one geographical location in one area of the academic curriculum. Therefore, the data may be skewed due to the misrepresentation of the general population of post-secondary students. An additional limitation that this study poses was the short duration (three sessions) where no generalization and maintenance data were collected. It would not be appropriate to conclude that the same effects would be obtained over a longer period of time and in different areas of the country.

Future Research

In summary, this study examined the effects of a cooperative learning strategy, "Send-a-Problem" on pre-service teachers' achievement in a college math education course at a small liberal arts state college in western New York state. Current findings indicated that the cooperative learning strategy did increase students' mathematics achievement. Findings also indicated that cooperative learning strategies may not be successful for every student. An additional finding was that students were able to achieve a higher score on the posttests during the experimental phase of the study over the control phase of the study when direct instruction was used. Clearly, there is still much more work to be done on cooperative learning strategies in a post secondary educational setting. Some future questions for inquiry would be, Does cooperative learning strategies produce the same results over longer periods of time? Would there be an increase in achievement in other areas of study in a post secondary education setting? Would pre-service teachers use this cooperative learning strategy in their future classrooms? Did pre-service teachers enjoy participating in the groups? Did pre-service teachers find this to be an engaging learning strategy? These questions among many others challenge future researchers. In the end, the use of cooperative learning strategies has the potential to increase student achievement in not only mathematics, but all subject areas.

References

Anonymous. (2013). Fast Facts. *SUNY Fredonia.* Retrieved February 12, 2014. From http://www.fredonia.edu/academicaffairs/facts/

Celikten, O., Ipekcioglu, S., Ertepinar, H., & Geban, O. (2012). The effect of the conceptual change oriented instruction through cooperative learning on 4th grade students' understanding of earth and sky concepts. *Science Education International*, *23*(1), 84-96. Retrieved from www.eric.ed.gov

Darnon, C., Buchs, C., & Desbar, D. (2012). The jigsaw technique and self-efficacy of vocational training students: A practice report. *European Journal Of Psychology Of Education*, *27*(3), 439-449. Retrieved from www.eric.ed.gov

Ebrahim, A. (2012). The effect of cooperative learning strategies on elementary students' science achievement and social skills in Kuwait. *International Journal Of Science And Mathematics Education*, *10*(2), 293-314. Retrieved from www.eric.ed.gov

Galton, M., Hargreaves, L., & Pell, T. (2009). Group work and whole-class teaching with 11-to 14-year-olds compared. *Cambridge Journal Of Education*, *39*(1), 119-140. Retrieved from www.eric.ed.gov

Hooker, D. (2011). Small peer-led collaborative learning groups in developmental math classes at a tribal community college. *Multicultural Perspectives*, *13*(4), 220-226. Retrieved from www.eric.ed.gov

Johnson, D. W., Johnson, R. T., & Roseth, C (2010). Cooperative learning in middle schools interrelationship of relationships and achievement. *Middle Grades Research Journal*, *5*(1), 1-18. Retrieved from www.eric.ed.gov

Johnson, D. W., Johnson, R. T., & Taylor, B (1993). Impact of cooperative and individualistic learning on high-ability students' achievement, self-esteem, and social acceptance. *Journal Of Social Psychology*, *133*(6), 839-844. Retrieved from www.eric.ed.gov

Johnson, R.B & Christenson, L.B. (2010). *Educational research: Quantitative, qualitative and mixed approaches.* Thousand Oaks, CA.: Sage Publications.

Kagan, S. (1992). Cooperative Learning. San Juan Capistrano, CA: Resources for Teachers Incorporated.

Kagan, S. (1989). The structural approach to cooperative learning. *Educational Leadership, 47*(4), 12-15. Retrieved from www.eric.ed.gov

Law, Y. (2011). The effects of cooperative learning on enhancing Hong Kong fifth graders' achievement goals, autonomous motivation and reading proficiency. *Journal Of Research In Reading*, *34*(4), 402-425. Retrieved from www.eric.ed.gov

Mevarech, Z. R. (1985). The effects of cooperative mastery learning strategies on mathematics achievement. *Journal of Educational Research, 78*(6), 372-377. Retrieved from www.eric.ed.gov

National Council of Teachers of Mathematics. (2012) Linking Mathematics Education Research and Practice. Retrieved October 25th, 2013, from http://nctm.org/about/content.aspx?id=34640

Nattiv, A. (1994). Helping behaviors and math achievement gain of students using cooperative learning. *The Elementary School Journal, 94*(3), 285-297. Retrieved from www.eric.ed.gov

New York State Department of Education. (2013). Guidance on New York State's annual

professional performance review for teachers and principals to implement education law §3012-c and the commissioner's regulations. Retrieved October 14th, 2013, from http://www.engageny.org/sites/default/files/resource/attachments/appr-field-guidance.pdf

Nichols, J. D. (1996). The effects of cooperative learning on students achievement and motivation in a high school geometry class. *Contemporary Educational Psychology, 21*, 467-476. Retrieved from www.eric.ed.gov

Pierce, R. L., Cassady, J. C., Adams, C. M., Speirs Neumeister, K. L., Dixon, F. A., & Cross, T. L. (2011). The effects of clustering and curriculum on the development of gifted learners' math achievement. *Journal For The Education Of The Gifted, 34*(4), 569-594. Retrieved from www.eric.ed.gov

Slavin, R. E. (1985). An introduction to cooperative learning research. In R. E. Slavin, S. Sharan, S. Kagan, R. H. Lazarowitz, C. Webb, & R. Schmuck, (Eds.), *Learning to cooperate, cooperating to learn* (pp. 5-15). New York: Springer.

Slavin, R. E., & Oickle, E. (1981). Effects of cooperative learning teams on student achievement and race relations: Treatment by race interactions. *Sociology of Education, 54*(3), 174-180. Retrieved from www.eric.ed.gov

Souvignier, E., & Kronenberger, J. (2007). Cooperative learning in third graders' jigsaw groups for mathematics and science with and without questioning training. *British Journal Of Educational Psychology, 77*(4), 755-771. Retrieved from http://dx.doi.org/10.1348/000709906X173297

Stevens, R. J., & Slavin, R. E. (1995). Effects of a cooperative learning approach in reading and writing on academically handicapped and nonhandicapped students. *Elementary School Journal, 95*(3), 241-62. Retrieved from www.eric.ed.gov

Tarim, K. (2009). The effects of cooperative learning on preschoolers' mathematics problem-solving ability. *Educational Studies In Mathematics*, *72*(3), 325-340. doi:10.1007/s10649-009-9197-x

Whicker, K. M., Bol, L., & Nunnery, J. A. (1997). Cooperative learning in the secondary mathematics classroom. *Journal of Educational Research, 91*(1), 42-48. Retrieved from www.eric.ed.gov

Appendices

	Control	Experiment	Experiment
Student 1	30	90	10
Student 2	10	40	0
Student 3	10	90	70
Student 4	20	40	0
Student 5	0	40	0
Student 6	30	100	0
Student 7	10	60	0
Student 8	10	70	-10
Student 9	30	0	0
Student 10	20	-10	10
Student 11	30	0	0
Student12	20	0	50
Student 13	30	40	90
Student 14	20	10	30
Student 15	20	10	40
Student 16	10	10	20
Student 17	20	0	30
Student 18	0	30	0
Student 19	20	0	0
Student 20	30	0	40
Student 21	0	30	0
Student 22	20	10	-10
Student 23	30	60	10
Average Increase	18.26	31.30	16.52

Table 1 shows the achievement increases from pre to post tests over all three phases.

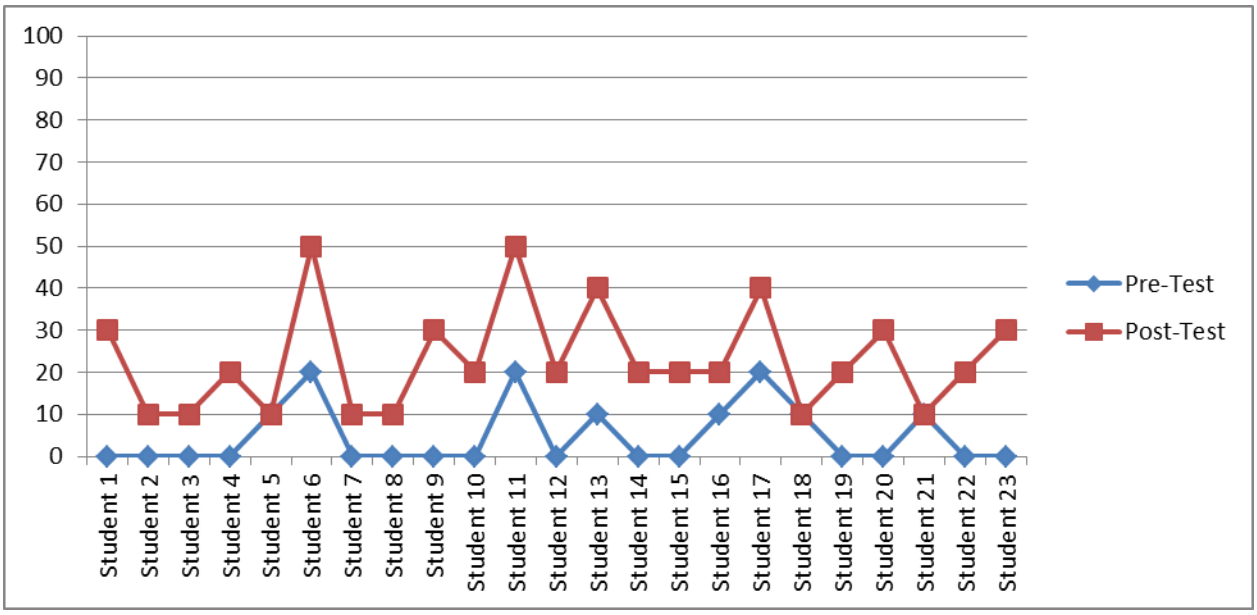


Figure 1 shows the pre and post test scores during the control phase of the study.

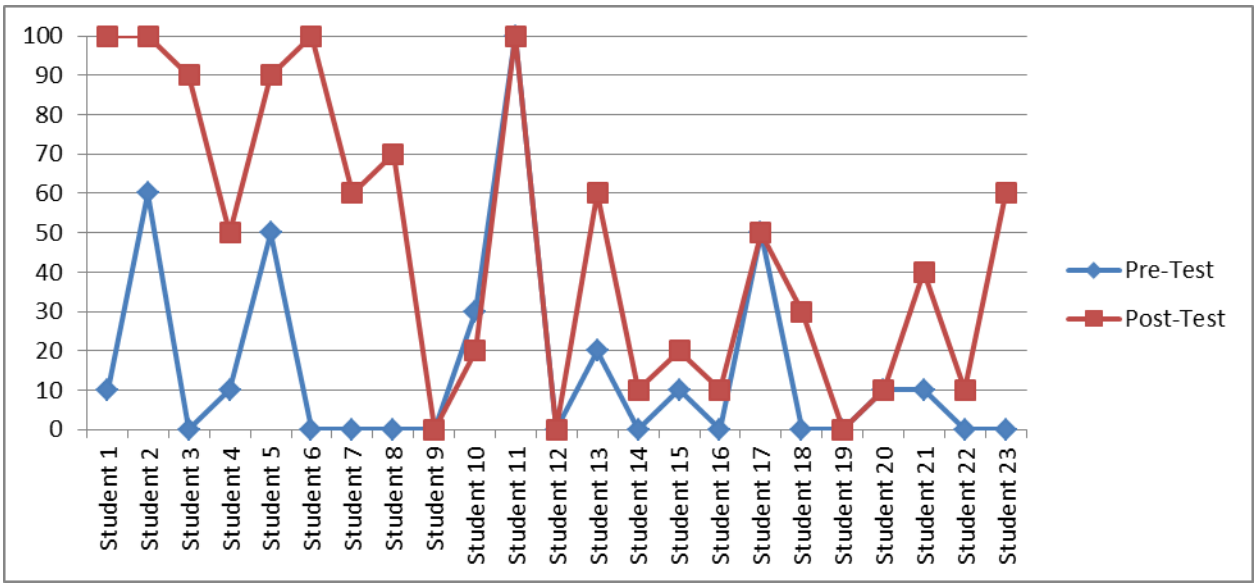


Figure 2 shows the pre and post test scores during the first experimental phase of the study that used cooperative learning.

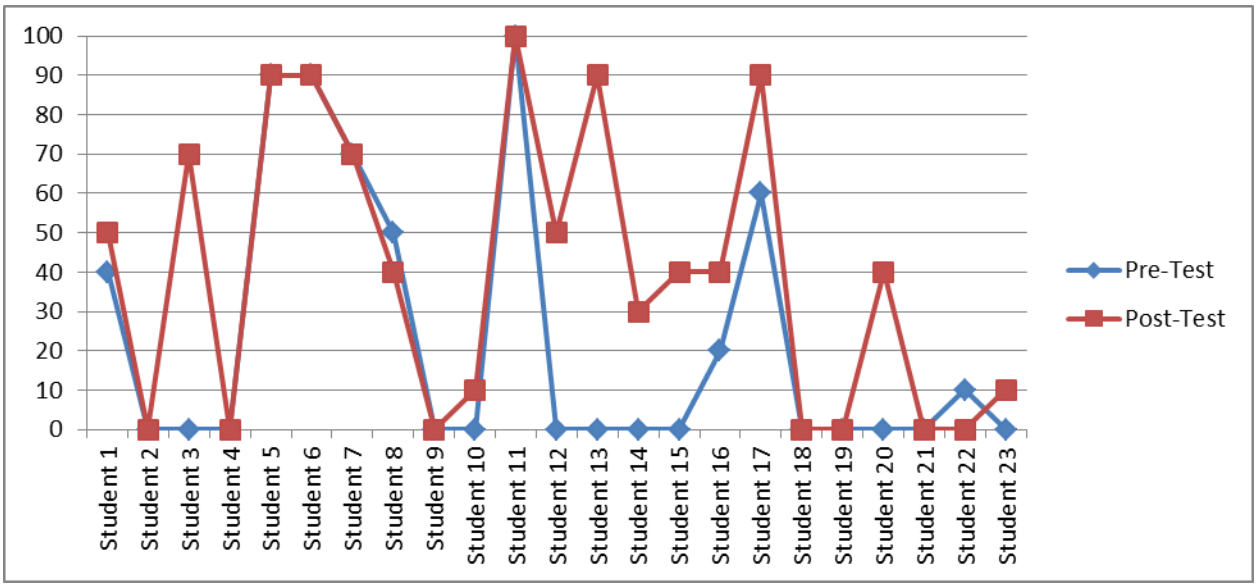


Figure 3 shows the pre and post test scores during the second experimental phase of the study that used cooperative learning.

Name:_____

Pre-Test - odds in favor/against

For questions 1-6 use the following scenario.

Two dice are thrown: Find the odds in favor for questions 1-3.

1.) Getting a sum of 7 _____

2.) Getting a sum greater than 3 _____

3.) Getting a sum that is an even number _____

Find the odds against for questions 4-6.

4.) Getting a sum of 7 _____

5.) Getting a sum greater than 3 _____

6.) Getting a sum that is an even number _____

For questions 7-9 use the following scenario.

Two fair dice are rolled, and the sum of the dots is recorded. For questions 7-9, give an example of an event having the given odds in its favor.

7.) 2 : 1

8.) 4 : 5

9.) 35 : 1

For question 10 use the following scenario. A card is drawn at random from a standard 52-card deck. Find the following odds.

10.) In favor of drawing a face card (King, Queen, or Jack).

Name:_____

Post-Test - odds in favor/against

For questions 1-6 use the following scenario.

Two dice are thrown: Find the odds in favor for questions 1-3.

1.) Getting a sum of 7 _____

2.) Getting a sum greater than 3 _____

3.) Getting a sum that is an even number _____

Find the odds against for questions 4-6.

4.) Getting a sum of 7 _____

5.) Getting a sum greater than 3 _____

6.) Getting a sum that is an even number _____

For questions 7-9 use the following scenario.

Two fair dice are rolled, and the sum of the dots is recorded. For questions 7-9, give an example of an event having the given odds in its favor.

7.) 2 : 1

8.) 4 : 5

9.) 35 : 1

For question 10 use the following scenario. A card is drawn at random from a standard 52-card deck. Find the following odds.

10.) In favor of drawing a face card (King, Queen, or Jack).

Name:_____

Pre-Test Expected Value

1.) From the following data, compute the expected value of the payoff.

Payoff	-2	0	2	3
Probability	0.3	0.1	0.4	0.2

2.) What is the expected value associated with a game that pays $1.00 for a prime number and $2.00 for a composite number when tossing a pair of dice?

3.) According to a publisher's records, 20% of the books published break even, 30% lose $1,000, 25% lose $10,000, and 25% earn $20,000. When a book is published, what is the expected income for the book?

4.) A laboratory contains ten electronic microscopes, of which two are defective. Four Microscopes are to be tested. All microscopes are equally likely to be chosen. A sample of four microscopes can have zero, one, or two defective ones, with the probabilities given. What is the expected number of defective microscopes in the sample?

Number of defectives	0	1	2
Probability	$\frac{1}{3}$	$\frac{8}{15}$	$\frac{2}{15}$

For questions 5-7, use the following scenario.

A student is considering applying for two scholarships. Scholarship A is worth $1000 and scholarship B is worth $5000. Costs involved in applying are $10 for scholarship A and $25 for scholarship B. The probability of receiving scholarship A is 0.05 and of scholarship B is 0.01.

5.) What is the student's expected value for applying for scholarship A?

6.) What is the student's expected value for applying for scholarship B?

7.) If the student can apply for only one scholarship, which should she apply for?

8.) You roll two dice. What is the expected number of sixes that will show?

9.) An urn contains four balls numbered 2, 5, 6, and 7. You draw one ball at random. What is the expected value of the number on the ball?

10.) An urn contains 10 balls, three white and seven red. You win $5 if you draw a white ball and $2 if you draw a red ball. What is the expected value of this random game? Should you pay $2 to play the game? Should you pay $3 to play the game?

Name:_____

Post-Test Expected Value

1.) From the following data, compute the expected value of the payoff.

Payoff	-2	0	2	3
Probability	0.3	0.1	0.4	0.2

2.) What is the expected value associated with a game that pays $1.00 for a prime number and $2.00 for a composite number when tossing a pair of dice?

3.) According to a publisher's records, 20% of the books published break even, 30% lose $1,000, 25% lose $10,000, and 25% earn $20,000. When a book is published, what is the expected income for the book?

4.) A laboratory contains ten electronic microscopes, of which two are defective. Four Microscopes are to be tested. All microscopes are equally likely to be chosen. A sample of four microscopes can have zero, one, or two defective ones, with the probabilities given. What is the expected number of defective microscopes in the sample?

Number of defectives	0	1	2
Probability	$\frac{1}{3}$	$\frac{8}{15}$	$\frac{2}{15}$

For questions 5-7, use the following scenario.

A student is considering applying for two scholarships. Scholarship A is worth $1000 and scholarship B is worth $5000. Costs involved in applying are $10 for scholarship A and $25 for scholarship B. The probability of receiving scholarship A is 0.05 and of scholarship B is 0.01.

5.) What is the student's expected value for applying for scholarship A?

6.) What is the student's expected value for applying for scholarship B?

7.) If the student can apply for only one scholarship, which should she apply for?

8.) You roll two dice. What is the expected number of sixes that will show?

9.) An urn contains four balls numbered 2, 5, 6, and 7. You draw one ball at random. What is the expected value of the number on the ball?

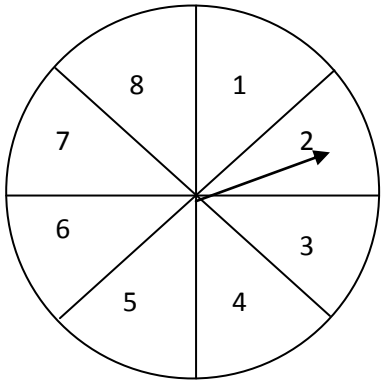
10.) An urn contains 10 balls, three white and seven red. You win $5 if you draw a white ball and $2 if you draw a red ball. What is the expected value of this random game? Should you pay $2 to play the game? Should you pay $3 to play the game?

Name:_____

Pre-Test Conditional Probability

For questions 1-4 use the following scenario.

A spinner is spun whose central angles are all $45°$. What is the probability that it lands on 5 if you know the following?



1.) It lands on an odd number.

2.) It lands on a number greater than 3.

3.) It does not land on 7 or 8.

4.) It lands on a factor of 10.

For questions 5-10 use the following scenario.

A six-sided die is tossed. What is the probability that it shows a prime number if you know the following?

5.) It shows an even number.

6.) It shoes a number less than 5.

7.) It does not show a 6.

8.) It shows 1 or 2.

9.) It shows and even number less than 4.

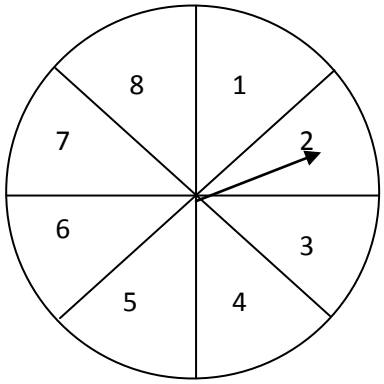
10.) It shows a number greater than 3.

Name:_____

Post-Test Conditional Probability

For questions 1-4 use the following scenario.

A spinner is spun whose central angles are all $45°$. What is the probability that it lands on 5 if you know the following?



1.) It lands on an odd number.

2.) It lands on a number greater than 3.

3.) It does not land on 7 or 8.

4.) It lands on a factor of 10.

For questions 5-10 use the following scenario.

A six-sided die is tossed. What is the probability that it shows a prime number if you know the following?

5.) It shows an even number.

6.) It shoes a number less than 5.

7.) It does not show a 6.

8.) It shows 1 or 2.

9.) It shows and even number less than 4.

10.) It shows a number greater than 3.

Informed Consent

Protocol Title: The Effects of Cooperative Learning on Post-Secondary Students' Mathematics Achievement.

Please read this consent document carefully before you decide to participate in this study.

Purpose of the research study: To study the effects that "send-a-problem", a cooperative learning strategy, has on college students' mathematics achievement. This study will involve research procedures including collection of data through means of pre and post tests.

What you will be asked to do in the study: To participate in one 50-minute control group and two 50-minute experimental groups with the principal investigator. During the control group, the researcher will first hand out a pre test containing 10 questions. After the participants are done, the researcher will collect the tests. Then, the professor will teach under their normal teaching conditions, which is very close to a direct instruction method. After the lesson, the researcher will hand out the 10 question post test and will collect them when the participants are finished. During the experimental group, the researcher will hand out a 10 question pre test before the lesson and will collect it once the participants finish. Then for the next 15-20 minutes the professor will teach the lesson. After this the students in the class will partake in a cooperative learning strategy based on "Send-a-Problem" where the professor will divide them into groups. After this, the class will return to their seats and the researcher will hand out the post test.

Time Required: One 50-minute control group session and two 50-minute experimental group sessions.

Compensation: There is no compensation for participating in the study.

Confidentiality: Your identity will be kept confidential to the extent provided by the law. In order to differentiate the participants and to protect identities, participants' names will be changed with use of identifiers such as "student 1, student 2" to keep the data obtained organized. All of the data will be placed inside a folder, which will be locked away, in a fireproof lockbox, in which only I obtain a key. Data will be stored for the duration of the proposed research project, and due to federal regulations, records held by researchers must be retained for at least 3 years after completion of research. After this, all data will then be destroyed. The final results will be presented as a graduate thesis project at SUNY Fredonia.

Voluntary participation: Your participation in this study is completely voluntary. There is no penalty for not participating.

Right to withdraw from the study: You have the right to withdraw from the study at any time without consequence. You do not have to answer any questions you do not want to answer.

Potential Benefits and Risks: This investigation will extend the current research on cooperative learning strategies in education. I anticipate that participation in this investigation will enhance the knowledge base of the study participants as pre-

service teachers in a cooperative learning strategy. I do not anticipate that there will be any negative risks for participating in this study.

As a result of the investigator's understanding of risks, a number of measures will be employed in order to protect against these risks. Strict measures of confidentiality will be implemented during the proposed study. In order to differentiate the participants and to protect their identities, students' names will be changed with use of identifiers such as "student 1, student 2" to keep the data obtained organized. All of the data will be placed inside a folder, which will be locked away, in a fireproof lockbox, in which only I obtain a key. Data will be stored for the duration of the proposed research project and will then be destroyed.

Whom to contact if you have questions about the study:

Rose L. Russo, Graduate Student, Curriculum & Instruction in Inclusive Education

8419 Heath Rd. Colden, NY 14033.

Email: Russ8910@fredonia.edu.

Whom to contact about your rights as a research participant in the study:

Catherine Kilpatrick, Acting Human Subjects Administrator

Director, Office of Sponsored Programs

E230 Thompson Hall

SUNY Fredonia

Fredonia, NY 14063

Phone: 716-673-3528

I have read the procedure outlined above. I voluntarily agree to participate in this study and have received a copy of this description.

_____ _____

Participant's signature *Date*

_____ _____

Principal investigator's signatures *Date*

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI)

HUMAN RESEARCH CURRICULUM COMPLETION REPORT

Printed on 11/07/2013

LEARNER	Rose Russo (ID: 3096102)
DEPARTMENT	Education
PHONE	7167719950
EMAIL	russ8910@fredonia.edu
INSTITUTION	SUNY - College at Fredonia
EXPIRATION DATE	09/19/2014

GROUP 1.

COURSE/STAGE:	Basic Course/1
PASSED ON:	09/19/2012
REFERENCE ID:	8796911

REQUIRED MODULES	DATE COMPLETED
Introduction	09/19/12
History and Ethical Principles - SBE	09/19/12
Defining Research with Human Subjects - SBE	09/19/12
The Regulations - SBE	09/19/12
Assessing Risk - SBE	09/19/12
Informed Consent - SBE	09/19/12
Privacy and Confidentiality - SBE	09/19/12
Research with Prisoners - SBE	09/19/12
Research with Children - SBE	09/19/12
Research in Public Elementary and Secondary Schools - SBE	09/19/12
International Research - SBE	09/19/12
Internet Research - SBE	09/19/12
Avoiding Group Harms - U.S. Research Perspectives	09/19/12
Vulnerable Subjects - Research Involving Workers/Employees	09/19/12
Conflicts of Interest in Research Involving Human Subjects	09/19/12
SUNY Fredonia State College	09/19/12

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI Program participating institution or be a paid Independent Learner. Falsified information and unauthorized use of the CITI Progam course site is unethical, and may be considered research misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Program Course Coordinator