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COOPERATIVE GROUPING IN THE INCLUSIVE STEM CLASSROOM

By

Catherine R. Elsey

A Thesis

Submitted to the
Department of Interdisciplinary and Inclusive Education
College of Education
In partial fulfillment of the requirement
For the degree of
Master of Arts in Special Education
at
Rowan University
May 20, 2019

Thesis Chair: Dr. Sydney Kuder

Dedication

This project is dedicated to my husband for supporting and encouraging me throughout this process.

Acknowledgements

I would like to express my gratitude to Dr. Sydney Kuder for all of his guidance and assistance in this research.

I would like to thank my parents for guiding me to pursue a career I love. Thank you for all your support.

Abstract

Catherine R. Elsey
COOPERATIVE GROUPING IN THE INCLUSIVE STEM CLASSROOM
2018-2019
Dr. Sydney Kuder
Master of Arts in Special Education

The purpose of this study was to determine if using cooperative group role assignments impacted on-task behavior in an inclusive STEM classroom. This study investigated if students were positively engaged, remained on-task, and completed STEM challenges with their group. There were two 5th grade classes, each with sixteen participants, involved in the study. In the experimental class, students had role assignments in their cooperative group of four members. The other class, was a control group, and students did not have role assignments in their group of four members. Data was collected through observation procedures of on-task and off-task behaviors for five class periods. Group processing surveys were used to collect student feedback on their cooperative group experience. Data was analyzed to determine if using group role assignments had a positive effect on the cooperative learning experience.

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Chapter 1

Introduction

STEM (science, technology, engineering, and math) classrooms are being established across the United States as a classroom for the 21st century. In the last two decades, there has been an emphasis on reforming our education system. The students in the United States have fallen behind other countries in the areas of math and science (Breiner, Johnson, Harkness, & Kohler 2012). In 1996, The National Science Foundation reported a need to improve education in the areas of science, mathematics, engineering, and technology (NCF, 1996). Project Lead the Way was founded in 1997 and is the curriculum used in this study. Project Lead the Way curriculum is aligned to the Next Generation Science Standards and uses an activity, project, problem-based approach to learning that gives students hands-on opportunities to develop content knowledge that can be applied to solving real-world problems (Project Lead the Way 2018). Finally, technology connects humans all over the world and today we live in a more global society. Students in the United States need to be prepared to contribute and excel in this global society. STEM education prepares them for the future.

Many STEM classrooms use cooperative grouping for inquiry and project-based assignments. Students are presented with a problem or challenge and need to develop a solution. The STEM challenges take students through the Engineering Design Process of asking questions, exploring solutions, building a model, evaluating the model, and explaining the solution. Many times, the students are placed in groups to work collaboratively, problem solve, and develop the solution. In a cooperative learning model, the group shares a common goal. The students work, help, and encourage each

other to reach that goal. All members of the group are held accountable and rely on each other to make sure the goal is met. (Johnson & Johnson, 1999) This is true in the STEM classroom, as all members of the group are working to complete a STEM challenge and determining a solution to a problem.

The inclusive STEM classroom has general and special education students of various academic levels, language ability levels, background experiences, and personal interests. The students are placed in heterogeneous cooperative groups to complete the design challenge. The key is to getting the students engaged and on-task throughout the design challenge. This can be difficult due to the diversity of the student population in the classroom. Some students need to develop socialization skills in order for the groups to work cooperatively. At times, students with behavior disorders also struggle with working cooperatively with others. The group dynamics will determine if the group will be successful or not. Students do not form a cooperative group just because they are seated together and told to work together (Johnson & Johnson, 1999). Teachers need to employ strategies to help the students engage in cooperative learning.

According to Johnson and Johnson (1999), there are five elements to cooperative learning. First is positive interdependence. Each child needs to feel that they are contributing to the group and making the group successful. Group role assignments help accomplish this. Next, individual accountability is where each student is responsible for knowing or producing information from the work the group has finished. Third, is promotive interaction that is face to face. Groups should have no more than 4 individuals. Students should promote and encourage each other throughout the assignment. It is not a competition, they need to be working together as a team to help

one another, explain concepts, and share ideas that will contribute to reaching the goal. Fourth, is interpersonal social skills. Important social skills for group members are listening skills, ability to share ideas, ability to make and accept constructive comments, accountability for behavior, and democratically make decisions as a group (Guilies, 2016). Finally, group processing strategies need to be developed. Students reflect on their ability to work together and identify what still needs to be completed in order to meet the final goal. (Johnson & Johnson, 1999).

Statement of Problem

The purpose of this study is to determine if using cooperative group role assignments impact on-task behavior in an inclusive STEM classroom. This study will investigate if students are positively engaged, remain on-task, and complete STEM challenges with their group. There will be two 5th grade classes involved in the study. One class, students will have role assignments in their cooperative group. The other class, will be a control group, and students will not have role assignments in their group. Data will be collected through observation procedures. On-task and off-task behaviors will be documented for five class periods. On-task behavior in groups include: eye contact with group members, discussion about class content or the assignment, writing and documenting information in notebook, and sharing materials. Off-task behaviors include: discussion about other topics or subjects, leaving the group, drawing or doodling in notebook, playing with materials, and staring into space or at another area of the classroom. Group processing surveys will be used to collect student feedback on their cooperative group experience. Data will be analyzed to determine if using group role assignments had a positive effect on the cooperative learning experience.

Research Questions

1. How does using group roles impact on-task behavior in the inclusive STEM classroom?
2. What benefits will be observed when students are placed in an effective cooperative group?

Significance of Study

This study is significant because students in a STEM classroom are placed in cooperative groups most of the time. Teachers in special area STEM classes desire to have their students be on-task, engaged, and learning in class. Students may come to STEM class for only 40 minutes once or twice a week. Grouping the students effectively is crucial. Ineffective groups cause disruptions, find difficulty staying on-task, and struggle to complete the STEM challenges. The limited amount of class time available needs to be productive. The significance of this study is to observe if using cooperative group roles keep the students more on-task and as a result make the group more productive in an inclusive STEM classroom. Once the cooperative group roles are established, the classroom should run smoothly, students will be on-task, and it will be positive learning environment.

Key Terms

For the purpose of this study, the following terms will be defined as the following

1. STEM- science, technology, engineering, and math
2. Cooperative groups- students working in a group to accomplish a common goal (Johnson & Johnson, 1999)

3. Inclusive- having students with special needs, different academic levels, and from diverse backgrounds being integrated with nondisabled peers (Taylor, 2011)

Chapter 2

Literature Review

The inclusive STEM classroom is a very diverse place. It has students with many different strengths and weaknesses. Students may be identified as gifted, general education, in need of basic skills instruction, having limited English proficiency, or eligible for special education. Some students may be very interested in the STEM subject areas, while others are not. As a STEM educator, I strive for my inclusive STEM classroom to be an environment where all students are accepted and included in all learning activities. Cooperative learning enhances the learning environment and includes all learners in the STEM classroom.

STEM Education and Problem Based Learning

STEM classrooms take a different approach to learning. In the STEM classroom problem based learning (PBL) is utilized. Students need to learn through solving a problem rather than an instructor lecturing on a subject. The teacher in the STEM classroom is a facilitator and is there to offer support, encourage discussion, and answer questions that would lead the students to an answer. Studies show that students have a greater long-term retention of skills in PBL (Strobel & vanBarneveld, 2009).

Wirkala and Kuhn in 2011 conducted a study of middle school students that compared PBL and a lecture/ discussion (LD) method. Two topics were presented to students that were divided into 3 groups: a PBL-team, PBL- individual, and LD. After nine weeks, students were assessed for comprehension and application. The researchers wanted to see which method had a higher learning retention rate with students.

In this study, the PBL-team was a group of three students and had a team leader that was chosen by the teacher. The teachers in this situation were called "coaches" and circulated the classroom answering questions and reminding students to all contribute ideas to arrive at a solution. In some teams, all members were active in conversation and debate, however, some teams did include passive members, that did not contribute much to the group. It was noted that most teams collaborated well together with the encouragement of the coach/ teacher.

The findings in this study concluded that the students in the PBL classroom performed better in the assessment. The students that were actively engaged in the activities had better long term retention and application of new material (Wirkala & Kuhn, 2011).

Cooperative Learning

Johnson and Johnson (1999) defined cooperative learning as students working in a group to accomplish a common goal. They identified the five learning principles of cooperative learning: positive interdependence, individual accountability, face to face interaction, appropriate interpersonal skills, and regular group function assessment (Johnson & Johnson, 1999). This is the point to review research on the effectiveness of cooperative learning in general, its effectiveness for students with exceptional learning needs, then specifically in secondary content areas such as science.

Studies show that using inquiry based cooperative activities are an effective strategy for teaching science for students with learning disabilities. In 1997, Dalton, Morocco, Tivnan, and Rawson Mead conducted a study analyzing two hands-on strategies used to teach science: support inquiry science (SIS) and activity based science

(ABS). This study included two fourth grade general education science classrooms that contained both general education and special education students. Students in the study worked collaboratively with a partner. Both forms were found to be effective, but the support science inquiry was superior to the activity based science. There were a couple reasons researchers gave for the discrepancy. One example stated, ABS students were given printed directions for building a circuit. However, SIS students used a more problem based approach and had to design their own circuit. Another discrepancy included the type of discussion used with the cooperative group. SIS groups were explicitly told to share predictions, outcomes, and explanations with their group partner. ABS groups were not given the same explicit directions and the discussion consisted on what was needed to complete the activity and not on applying the information. The study concluded with the aspects of inquiry based instruction that teachers need to consider: assessing for student misconceptions, allowing students to build concrete evidence, and facilitating students to test and change their ideas about the world around them (Dalton, Morocco, Tivnan, & Rawson Mead, 1997).

Another study conducted in 2007, by Lynch, Taymans, Watson, and Ochsendorf examined inquiry based science teaching practices in a middle school chemistry classes of disabled and nondisabled students. The researchers focused on the Conceptual Change Theory that describes learners as moving from a novice to an expert in a scientific field. Inquiry based experiences help students achieve conceptual change. *Chemistry That Applies* was the curriculum chosen for this study and is described as a guided inquiry unit that is "student-centered, hands-on, and phenomenon-based." It was found that the guided inquiry curriculum chosen for this study was a viable instructional strategy. The

curriculum relies heavily on students working together, participating in discussions, and using hands-on materials. Both nondisabled and disabled students showed growth in the scientific concepts at the conclusion of the study (Lynch, Taymans, Watson, & Ochsendorf, 2007).

Problem Based Cooperative Learning

The Cooperative Problem-Based Learning (CPBL) model is the integration of cooperative learning with problem based learning. Mohd-Yusof, Helmi, Jamaludin, and Harun (2011) wrote an article explaining CPBL. The authors break the CPBL model into 3 phases: problem identification and analysis; learning, application and solution formulation stage; and generalization, internalization, and closure stage. In the first phase, students need to come to their own understanding of the problem before discussing it with others. Once the students have an idea of the problem, they move to phase two. In phase two, peer teaching may be needed to be used to help students that may be struggling with content. Members of the group teach each other technical skills and concepts that will be needed to solve the problem. Students use questioning techniques to gain a better understanding from others in their group. In phase three, the groups conclude with a final product and reflect on the learning experience (Mohd-Yusof, Helmi, Jamaludin, & Harun, 2011).

The researchers found that the CPBL model was effective in their engineering course. Students were observed in the course as being engaged and motivated to learn more. Group discussions were described as being "engaging and lively." There were 66% of students who received a grade of an A or A- and only 5% of students received a D or below (Mohd-Yusof, Helmi, Jamaludin, & Harun, 2011).

Structured Cooperative Learning

Gillies and Ashman (2000) conducted a study using disabled and nondisabled students that investigated using structured and unstructured cooperative groups. They targeted their research on the behaviors, interactions, and learning outcomes of the disabled students. The structured groups of children were trained to work in a group. They were taught about accepting responsibility, encouragement of members, sharing information, and interpersonal skills. They role played such behaviors as: eye contact, body language, and positive comments and encouragement. Unstructured groups were not trained or taught about working in a group, but were given time to discuss amongst themselves how they would work together.

The researchers observed for four behavior categories in this study. Cooperative behavior that was students being on-task. Noncooperative behaviors that would show resisting the group, exclusion, and criticism. Individual on-task behavior would be working on the task, but not with the group. Individual non-task behavior would be not participating. There was a discrepancy for the disabled students working in a non-structured group as opposed to a structured group. There was a greater occurrence of disabled students displaying non-task behavior in the unstructured group setting. They were less involved in group discussion or work and displayed more off-task behaviors. However, in the structured group settings, learning disabled students were more actively involved in their group. The students were also observed as being more helpful to one another. These interactions enabled students to clarify information and build a stronger understanding of content (Gillies & Ashman, 2000).

Team Roles in a Cooperative Group

Many cooperative group models suggest teachers assign group roles to promote the components of effective cooperative grouping. Using role assignments in a cooperative group assist students in developing positive interdependence. A role or a job within the group allows the child to feel that they are contributing to the group and making the group successful. Also, having a job within the group promotes individual accountability and enables the student to be responsible for knowing, producing, and sometimes teaching others information on an activity (Johnson & Johnson, 1999). The following three studies examine using cooperative group roles in the classroom.

Ott, Kephardt, Stolle-McAllister, and LaCourse (2018) studied college student perceptions on using cooperative group team roles in a laboratory environment. There were four students to a group, each with a designated role. The roles were explained prior to the groups working together. The team leader oversaw the whole group and made sure individuals in the group were following their role, on-task, participating, and making contributions to the activity. The protocol manager was in charge of the experimental materials and made sure the experiment is being conducted correctly. The data recorder kept recorded data neat and organized. The researcher investigated items that needed that were needed to complete laboratory experiment. This person would report findings to the rest of the group. After the experience, students were given an anonymous survey on the use of team roles. The results of the survey showed that students understood their responsibilities in a team role. However, many students felt the team roles did not help them complete experiments or make their group more unified. Some students felt the role did not match a personality type. For example, an introvert

being the team leader. Also, students were too occupied on what their role was supposed to be and not actually completing the experiment.

In another study, Salah, Lazonder, and De Jong (2007) found that using cooperative group roles increase achievement, motivation, and participation among average ability students. Researchers in this study had conducted a previous study that showed high-ability students assumed a teacher role and the low-ability students were the learners in a heterogeneous mixed ability group. Average-ability students were excluded from the teacher-learner relationship and therefore struggled in the heterogeneous group, but performed better in homogeneous grouping with other average-ability students (Salah, Lazonder, & de Jong, 2005). The researchers wanted to increase the participation of the average-ability level students in a heterogeneous group and conducted a later study in 2007. In the 2007 study, group roles and helping behavior expectations were the focus. Students were placed in heterogeneous groups of four with a one high, one low, and two average-ability students. Role assignments and turn taking cards were used to increase participation. Average-ability students were given the opportunity of having the "explainer" role. There were written helping behavior prompts provided to students as reminders of what to say. There were cues for when they needed help and did not understand. Additional cues were provided of what to say if they understand and can provide the help needed by someone else in the group. Researchers found that using group roles increased participation, increased collaborative questioning, and helping behaviors displayed among the average-ability students (Salah, Lazonder, & De Jong, 2007).

Bertucci, Johnson, Johnson, and Conte (2016) researched two studies that examined the effects of task and goal interdependence on achievement, cooperation, and support of elementary students. The study took into account Deutsch's (1949) theory on social interdependence. Deutsch identifies "positive goal interdependence" as when individuals in a cooperative group believe they will obtain their goal only if the other members of the group obtain their goals (Deutsch 1949). Task interdependence, as defined by Johnson and Johnson (1991), is when an assignment or project is divided into subtasks that each member of the group is responsible for in order for the group to be successful and reach their goal (Johnson & Johnson, 1991).

In the first study, students worked in pairs. Achievement was highest among the group of students that combined positive goal and task interdependence. Positive goal interdependence was achieved because these students were told that they had to make sure all members of the group learned the material, were working together and helping each other, and they had to collectively earn at least 12 points on an assessment. Positive task interdependence was achieved because each member in the team performed a series of steps in order to learn and teach the other member the content (Bertucci, Johnson, Johnson, & Conte, 2016).

The second study, students were in groups of three members and were given one of two conditions. One condition was goal interdependence, all members working together to achieve a common goal. The second condition was goal interdependence and task interdependence where each student is responsible for certain content and teaching it to the other group members. Students working the groups that used both goal and task interdependence conditions had a higher success rate.

As a result of both studies, the researchers found that a combination of both goal and task interdependence results in higher achievement. Students had also been evaluated at the conclusion of both activities on their attitudes regarding cooperation and social support. It was discovered that students had a better attitude on cooperation and social support in an environment that utilizes both positive goal and task interdependence.

Summary

According to research, structured, task-oriented groups are more successful in the cooperative learning environment (Gillies & Ashman, 2000; Salah, Lazonder, & De Jong, 2007; Bertucci, Johnson, Johnson, and Conte, 2016). Students in whole group instruction show a greater amount of off-task behaviors than students in a small group or individualized instruction (Godwin, Almeda, Seltman, Kai, Skerbetz, Baker, & Fisher, 2016). Students with ADHD have also been found to be on-task a greater amount of time when in a small group as compared to a whole group or individual activity (Imeraj, Antrop, Sonuga-Barke, Deboutte, Deschepper, Bal, & Roeyers, 2013). When students are engaged in a classroom activity there is greater amount of on-task behaviors displayed. The inclusive STEM classroom utilizes problem based learning in cooperative groups of learners with a range of ability levels. On-task behaviors exhibited by group members allow collaboration, learning of content from each other, and achievement of a goal.

The purpose of this study is to conduct research that supports Johnson & Johnson's (1999) five learning principles of cooperative learning: positive interdependence, individual accountability, face to face interaction, appropriate

interpersonal skills, and regular group function assessment (Johnson & Johnson 1999). Teachers need to create a cooperative learning environment that will have students on-task, promote collaboration, and problem solving. Students need to be instructed on expectations and goals of the group experience. Group roles need to be identified and explained so that students can effectively be on-task to complete their duties in the group. Once these routines are established, the cooperative group will have success working collaboratively and achieving their goal.

Chapter 3

Methodology

Setting

School. The school used for this study is an urban public school located in southern New Jersey. The school had over 430 students in grades prekindergarten to fifth. The school was divided into two separate buildings. One building housed prekindergarten and kindergarten and the other, grades first through fifth. Students in grades K to 5 were on a three-day rotation for the following special areas: STEM, gym, and arts integration. Special area teachers taught 6 periods a day.

According to the 2017 NJ Department of Education School Performance report, the school demographics were 68% Hispanic, 18% Caucasian, 14% African American, and less than 1% are Asian. Languages spoken at home were 52% English, 47% Spanish, and less than 1% are listed as other. The school population had 83% that are economically disadvantaged. The report listed 34% of the population were English language learners and 20% of the students received special education services. (NJ Department of Education, 2017) There has not been a significate change to the school's demographics since the report completed in 2017.

Classroom. The STEM classroom was large and open. There were 8 rectangular tables each with 4 seats for students to work cooperatively or independently. There was a supply bin on each table for students to share materials. There were other various tables and cabinets used for STEM projects and supplies. The room also had 17 VEX IQ robotic kits 10 VEX kits without robotic components. Grades third through fifth used the VEX kits. Only fifth grade used the robotic kits. There was a large rug in front of the

series 6000 LED interactive SMARTboard that was connected to the teacher's computer and an Apple TV. This area was used for whole group instruction and group presentations. The room was also equipped with 17 iPads and 30 Chromebooks on a cart. The Chromebook cart was shared with all the other classrooms on the second floor and there was a sign out procedure in place.

The STEM teacher instructed grades first through fifth in this room. Groups traveled as a class to the room for STEM. Group sizes varied by grade level and range between 16 to 25 students. Since special area classes were many times considered the least restrictive environment, the students in STEM were a mixture of general education, special education, and English language learners. Some groups also included special education students from the self-contained classrooms. There was an aide in STEM only for one first grade class and one second grade class. This study was conducted during 5th grade STEM class.

Participants

This study included approximately 32 fifth-grade students from three different classrooms. Out of the total 32 students, there are 14 girls and 18 boys in the sample. They are between the ages of 10-11 years. The sample population included 56% that were Hispanic, 25% were Caucasian, and 19% were African American. Seven students had an IEP and qualified for special education services. There were no ESL students in this sample of students, but 12 students came from Spanish speaking homes and had previously tested out of the ESL program.

Group 1. This group was the control group and had a total of 16 students, 6 girls and 10 boys. There were two students with an IEP, one female and one male.

Classifications included CI and OHI. Five students were previous ESL students that had exited the program. Students were divided into groups of 4. Each group had students ranging in academic ability. Three groups had 2 female and 2 male members. One group had all male members.

Group 2. This group was the experimental group and had a total of 16 students, 8 girls and 8 boys. There were five students with an IEP, two female and three males. Classifications include CI, SLD, CMI, and MD. Seven students were previous ESL students that had exited the program. Students were divided into groups of 4. Each group had students ranging in academic ability. Each group had 2 male and 2 female members.

Procedure

This study used a two-group (experimental/control) experimental design to identify the effect of using cooperative group roles in the inclusive STEM classroom. There were approximately 32 fifth-grade students in two groups from three different classrooms in the study. The experimental group was instructed in the use of roles or jobs within a cooperative group. The four roles were: facilitator, technician, recorder, and materials manager (See figure 1). The facilitator managed the group and made sure all members were on-task and doing their part to help achieve the goal. The technician was responsible for the technology needed to complete the assignment. The recorder made sure each member of the group kept accurate data, diagrams, and observations. This person was responsible for checking other group member's Launch Logs throughout the project. The materials manager set up, got additional, and cleaned up the materials during each class. These group roles were explained to the class that used them.

Students ranked the top 3 roles they felt best suited them. The teacher made groups based on the student's input.

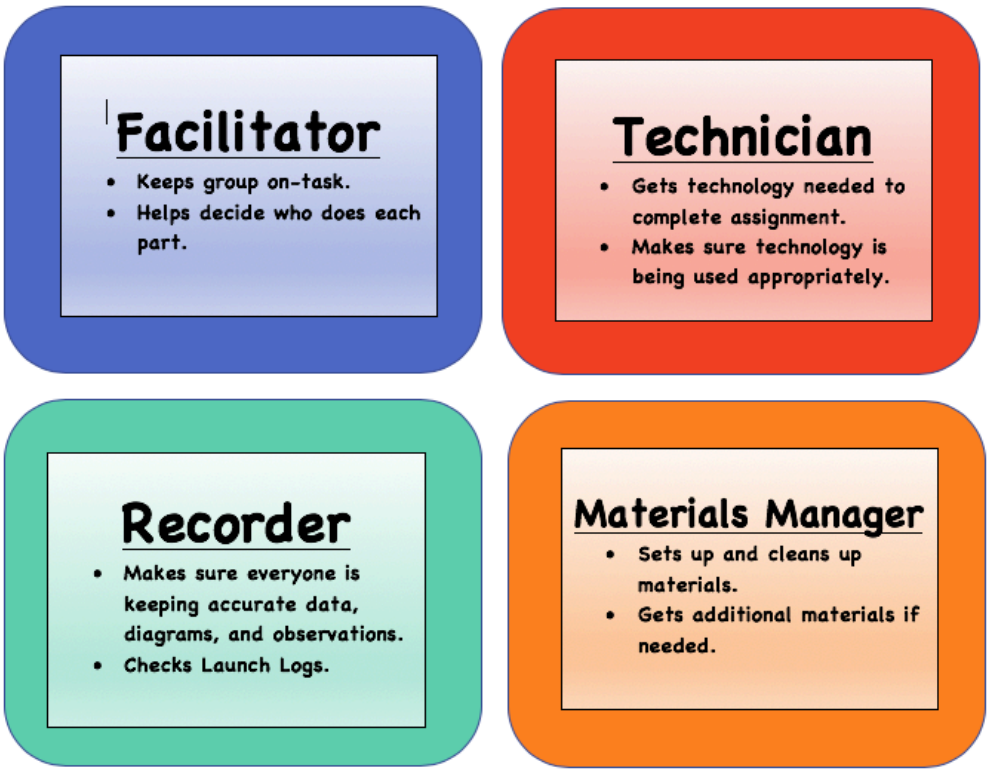

Figure 1. Group role cards.

The control group was placed in heterogeneous cooperative groups without the assignment of group roles. Both the experimental and the control group were taught the same STEM curriculum and given the same goal or assignment to complete with their cooperative group.

The researcher used interval recording to measure the number of times students were on or off-task in their cooperative group (see figure 2) during the 4 weeks of the

study. Short 10 second intervals were used. On a recording sheet a "+" was made for on-task behaviors or a "-" for off-task behaviors. Observations of each group were on a rotating 10 second interval. At the end of the class period, the researcher recorded how many times the group was documented as being on or off task.

STEM Behavior Interval Recording Form

Class: _____ Grouping: Roles No Roles

Date: _____

Behavior Definitions:

+ On-task- students engaged in discussion about content, documenting information in notebook, sharing materials, or eye contact among members

- Off-task- students' discussion is off topic, doodling in notebook, leaving group, playing with materials (VEX pieces/ robotic components) or staring off into space

Total Observation Time: _____ Interval Length: _____

Group 1

1	2	3	4	5	6	7	8	9	10	Total +	Total -

Group 2

1	2	3	4	5	6	7	8	9	10	Total +	Total -

Group 3

1	2	3	4	5	6	7	8	9	10	Total +	Total -

Group 4

1	2	3	4	5	6	7	8	9	10	Total +	Total -

Figure 2. Observation form

Dependent Variables

On-task behaviors. On-task behaviors were defined as discussion about content, documenting information in notebook, sharing materials, and eye contact among members. During an interval, if on-task behaviors were observed the researcher placed a "+" in the box. At the conclusion of the class period, the researcher counted the number of times the groups were observed as being on-task. (See figure 2)

Off-task behaviors. Off-task behaviors were defined as discussion not about topic, doodling in notebook, leaving group, playing with materials and staring off into space. During an interval, if off-task behaviors were observed the researcher placed a "-" in the box. At the conclusion of the class period, the researcher counted the number of times the groups were observed as being off-task. (See figure 2)

Completion of assignments. The researcher also documented if the group was able to compete an assignment or what step the group was on within the assignment. This allowed the researcher to see if the group was working at an acceptable speed. Furthermore, the researcher could compare the data of on and off-task behavior to the completion of the assignment.

Surveys. At the conclusion of an observed class period, students were given a group work- self and peer evaluation survey (see figure 3). Each member of the group was assigned a letter as an identifier for themselves and other group members. Students rated themselves and their group members for each of the following categories: participated in discussion, stayed positive, contributed to work, and stayed on task. A rating of "3" was when most or all of the time behavior was displayed. A "2" was when the behavior was sometimes displayed and a "1" was when the behavior was rarely or

never displayed. Finally, the survey asked the individual an open-ended question of what he or she felt the group needed to do in the next class to complete their goal.

Your Letter_____ Class_____ Date_____

Group Work- Self and Peer Evaluation

Rate each group member's performance on the following scale.

3= All/ most of the time 2= Sometimes 1= Rarely/ Never

	A	B	C	D
1. Participated in discussion.				
2. Stayed positive.				
3. Contributed to work.				
4. Stayed on task.				

What does your group need to do next class to help complete your goal? _____

_____

Figure 3. Student survey.

Data Analysis

The scores from on and off-task behaviors were converted into percentages. Survey results were compiled. The data collected from the dependent variables were presented in graphs and tables for a visual analysis. The comparison of the results from the control group and the experimental group were used to determine the effectiveness of using cooperative group roles in the inclusive STEM classroom.

Chapter 4

Results

Summary

This study examined the impact of using cooperative group roles in an inclusive STEM classroom. Two classes participated in this study. Each class had general education and special education students. Some students in each class came from a self-contained special education classroom. Each class had four groups with four students. The experimental class utilized cooperative group roles within their groups. The control class was in cooperative groups that did not have roles. The research questions answered were:

1. How does using group roles impact on-task behavior in the inclusive STEM classroom?
2. What benefits will be observed when students are placed in an effective cooperative group?

At the beginning of the study, the goal of building a robot was introduced and explained to both the experimental and control groups. In the control class, the teacher selected heterogeneous groups based on academic ability. Each group had one high achieving student, two average achieving students and one low achieving student.

The experimental group had an additional class period where the four group roles: facilitator, recorder, technician, and materials manager, were explained to the students. The students listed their top three choices of a group role. The teacher selected group members based on preferences and academic ability. Like the control class, the experimental class had heterogeneous groups one high achieving student, two average

achieving students and one low achieving student. The students in the group were each given a role based on their preference.

Intervention

The teacher used interval recording to monitor groups' on and off-task behavior. On-task behavior was observed as: group members in discussion about content, documenting information in notebook, sharing materials, and eye contact among members. Off-task behaviors included: members in discussion not about topic, doodling in notebook, leaving group, playing with materials, and staring off into space. The control and experimental class were each observed during 5 class periods. Each group was observed for 10 seconds, 8 times during a class period.

The results for each group are shown in table 1 and in figures 4 and 5. In the control class, students were observed as being on-task a total of 95 times and off-task a total of 65 times. The control group was on task 59.4% of the time and 40.6% of the time as off-task. The experimental class, which utilized having group roles, was on- task 138 times or 86.3% of the time. They were off-task 22 times or 13.8% of the time.

Table 1

Control and Experimental Class Totals of Time On and Off-Task

Group Totals	Times On-Task	Times Off-Task
Control Class - no roles	95	65
Experimental Class- roles	138	22

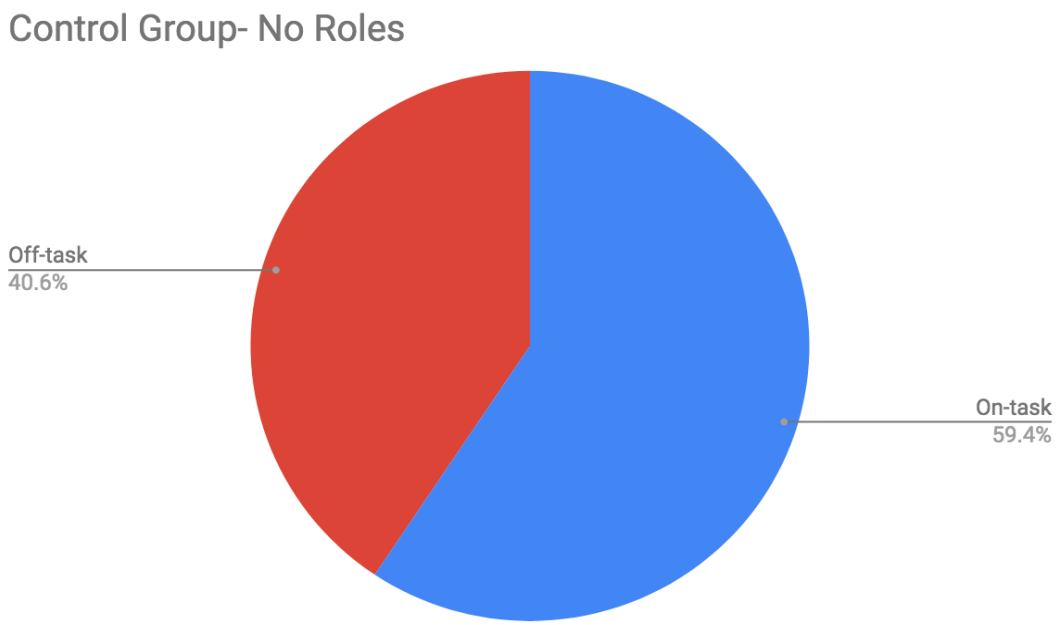

Figure 4. Control Class- Percentage of Time On and Off-Task

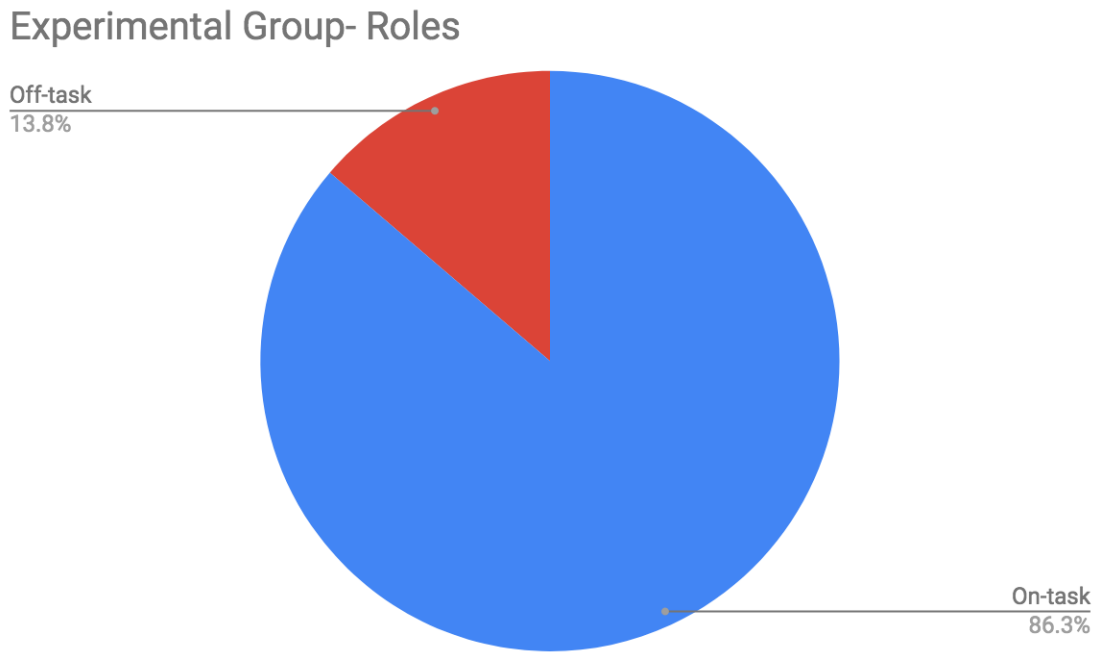

Figure 5. Experimental Class- Percentage of Time On and Off-Task

In the Control Class, groups 1 and 3 were off-task more times than being on-task. They were observed being on-task only 19 times and off-task 21 times. Group 2 was on-task 28 times and off-task 12 times. Group 4 was on-task 29 times and off-task 11 times (see table 2 and figure 6). Group 3 did complete the robot in 3 class periods. Group 2 completed the robot in 4 class periods. Groups 1 and 4 needed additional time following the 4th class period to complete the robot.

Table 2

Control Class- Group Totals of Time On and Off-Task

No Group Roles	Totals	
	On-Task	Off-Task
Group 1	19	21
Group 2	28	12
Group 3	19	21
Group 4	29	11

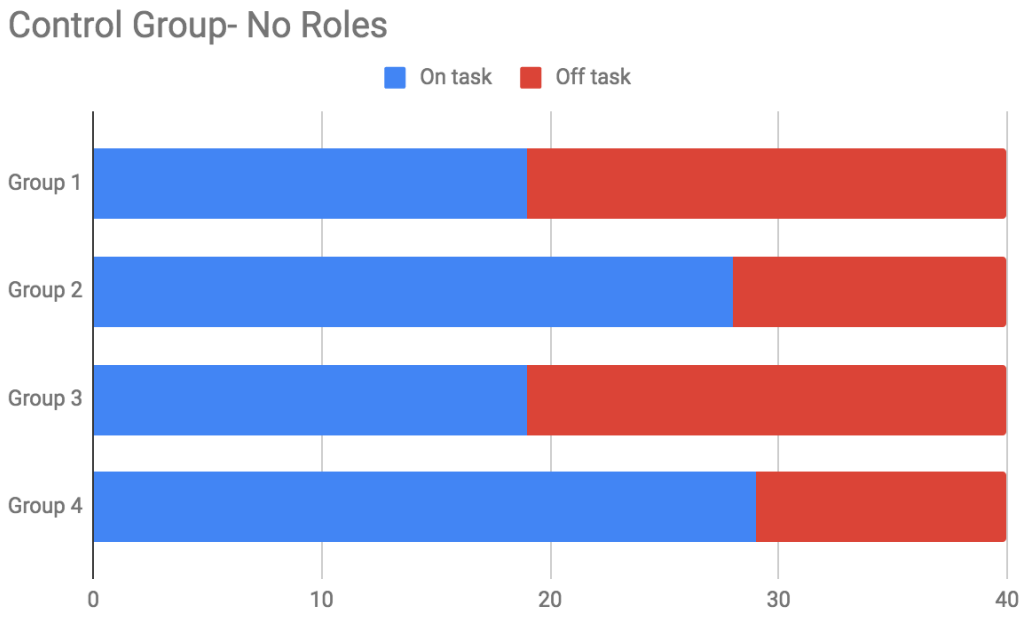

Figure 6. Control Class- Group Totals of Time On and Off-task

In the experimental class, all 4 groups were on-task a majority of the time. Group 1 was observed being on-task 29 times and off-task 11 (see table 3 and figure 7). Group 2 was observed being on-task 36 times and off-task 4 times. Group 3 was on-task 34 times and off-task 6 times. Group 4 was on-task 39 times and off-task 1 time. All four groups were able to finish the robot in 4th period and had some additional time to spare to test the robots.

Table 3

Experimental Class- Group Totals of Time On and Off-Task

Group Roles	Totals	
	On-Task	Off-Task
Group 1	29	11
Group 2	36	4
Group 3	34	6
Group 4	39	1

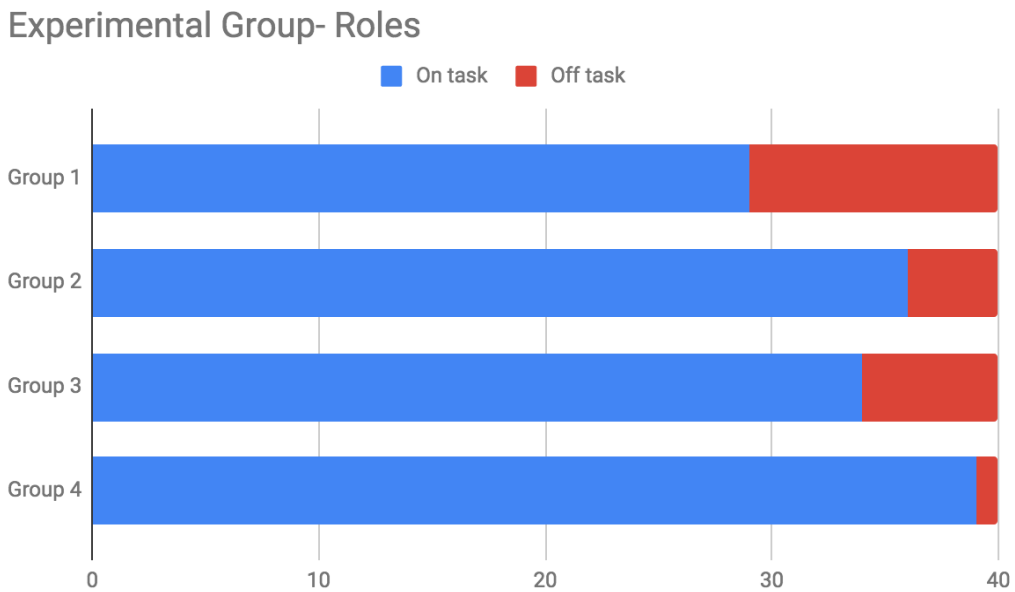

Figure 7. Experimental Class- Group Totals of Time On and Off-Task

At the conclusion of 3 observed class periods. Students were asked to complete and self and peer evaluation survey. Students rated themselves and their group members in the following four areas: participated in discussion, stayed positive, contributed to the work, and stayed on-task. There was a 3-point rating scale: 3 was all or most of the time, 2 was sometimes, and 1 was rarely or never.

The results of this rating are showed in table 4, figure 5, and figure 6. According to the data collected, students rated themselves and each other higher in the experimental class that utilized group roles. The response of "3- all or most of the time" was awarded 71% of the time in the experimental class, as opposed to 57% of the time in the control class. The responses of "2- sometimes," and "1- rarely or never" were given a less amount of time in the experimental class. The experimental class selected the rating of "2 sometimes" 27% of the time and the control class selected "2" 33% of the time. The experimental class only chose the lowest rating of a 1, 2% of the time. The control class rated themselves and each other as a "1" 10% of the time.

Table 4

Percentages of Responses on Self and Peer Evaluation Survey

	3	2	1
Control Class- No Roles	57%	33%	10%
Experimental Class- Roles	71%	27%	2%

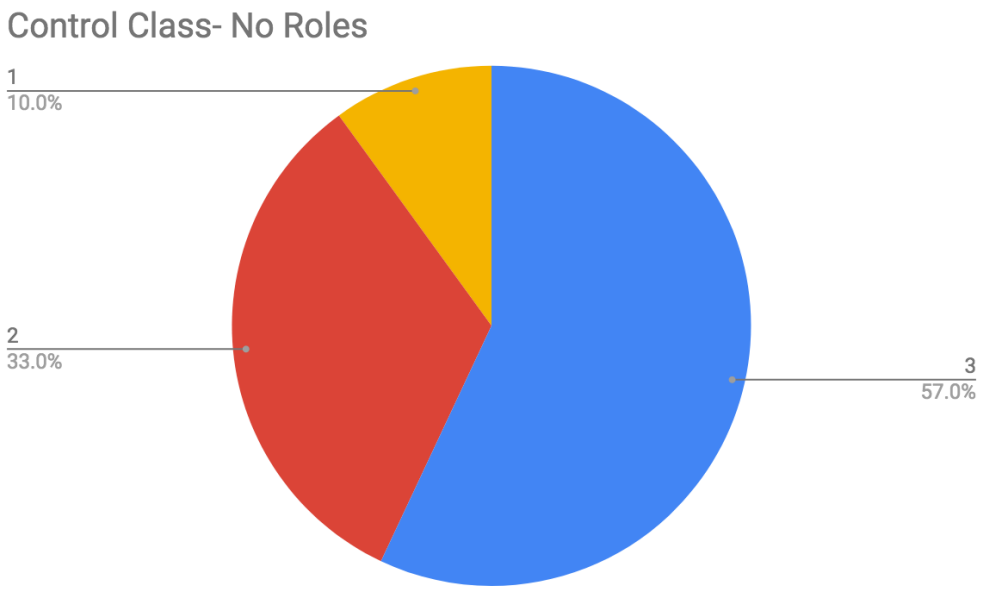

Figure 8: Control Class- No Group Roles Percentages of Responses

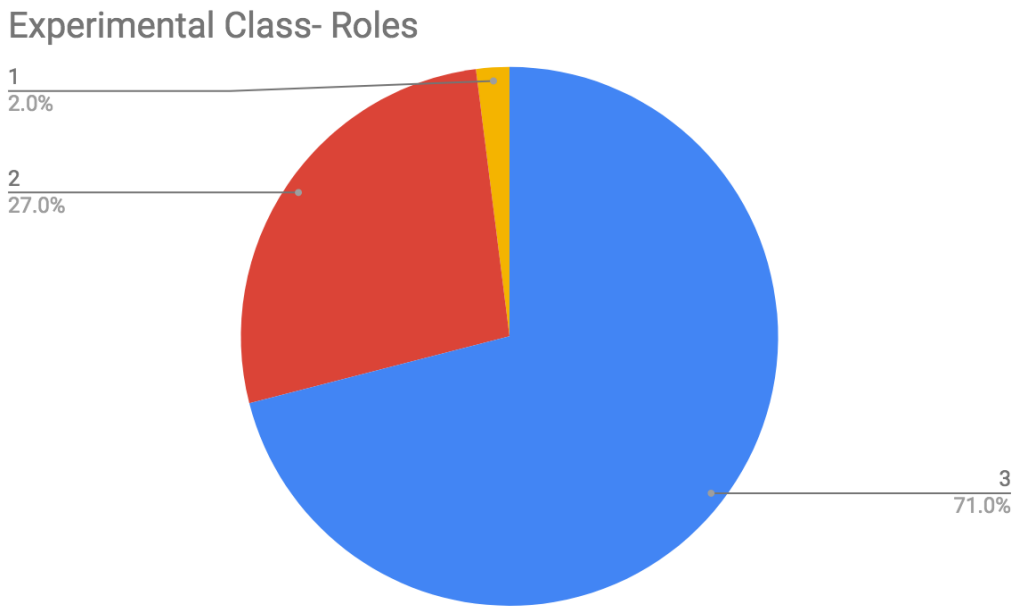

Figure 9. Experimental Class- Group Roles Percentages of Responses

Chapter 5

Discussion

The purpose of this study was to investigate on and off-task behaviors during cooperative groups. In the control class, the groups did not have cooperative group roles. In the experimental class, the groups had been assigned the roles of facilitator, technician, reporter, and materials manager. Students in both classes were given a self and peer evaluation survey to reflect on their experience in the cooperative group.

Findings

In this study, groups with cooperative group roles were on-task more than the groups without group roles. Students in the experimental group were on-task 86.3% of the time, as opposed to the control group being on-task 59.4% of the time. This is consistent with the findings of Gillies and Ashman's (2000) study using students with and without disabilities that investigated using structured and unstructured cooperative groups. They found that in the structured group settings, students with learning disabilities were more actively involved in their group. The students were also observed as being more helpful to one another. These interactions enabled students to clarify information and build a stronger understanding of content (Gillies & Ashman, 2000). It also collaborates, Salah, Lazonder, and De Jong's (2007) study where they found that using cooperative group roles increased achievement, motivation, and participation among average ability students. In this study, groups with cooperative group roles were trained and structured. These groups were found to more on task than the unstructured groups that did not utilize cooperative group roles (Salah, Lazonder, & De Jong, 2007).

In the current study, the experimental class, with cooperative group roles, was considered a structured cooperative group and performed better than the unstructured control group.

Students in the current study were given a self and peer evaluation survey. Results of this survey showed that students had a more positive cooperative group experience in groups that utilized cooperative group roles. Students rated themselves and their group members in the following four areas: participated in discussion, stayed positive, contributed to the work, and stayed on-task. There was a 3-point rating scale: 3 was all or most of the time, 2 was sometimes, and 1 was rarely or never. In the experimental class students rated themselves and others a 3 rating, 71% of the time. The control class gave the 3 rating, 57% of the time. The experimental class gave the 2 rating 27% of the time and the control class gave the 2 rating 33% of the time. The 1 rating was given in the experimental class 2% of the time and 10% of the time in the control class. These findings are similar to those found by Bertucci, Johnson, Johnson, and Conte (2016), where it was discovered that students had a better attitude on cooperation and social support in an environment that utilized both positive goal and task interdependence. In the current study, the control and experimental class both had a common goal to work together to create a robot. However, in the experimental class, each student in the group had task interdependence by having job or role within the group. The experimental class, that had both positive goal and task interdependence, rated themselves and each other higher on the surveys. Thus, it can be concluded that they had a more positive experience in the cooperative group.

Limitations

There are several limitations to this study. The first limitation is sample size and population. This study only included 32 students, 7 were classified and 12 used to be ESL. Also, the control and experimental class did not have an equal amount of special education and former ESL students, this may have affected the outcome of the data. In addition, absenteeism may have affected some of the data collected in the study as well.

Implementations and Recommendations

The results of this study, supported Johnson and Johnson's (1999) five learning principles of cooperative learning: positive interdependence, individual accountability, face to face interaction, appropriate interpersonal skills, and regular group function assessment (Johnson & Johnson, 1999). Having four individuals placed in a group and told to work together does not form an effective cooperative group. Utilizing cooperative group roles allows for positive interdependence and individual accountability. Each person, when they have role, has an intricate part in making the group successful. The classroom setting allowed for face to face interaction. The tables were rectangular and allowed for 2 individuals on each side with materials in the middle. Finally, the self and peer evaluation survey allowed for a regular group function assessment by having students to reflect on the group dynamics. This study did not focus on appropriate interpersonal skills. A recommendation would to have further research on strategies for incorporating appropriate interpersonal skills. If there had been more time to teach interpersonal skills and maybe have visuals that remind students of what they should be saying and how they should be speaking to their group members may have further affected results of this study.

In addition, data in this study, looked the groups as a whole and identified the group as being on or off-task. There were usually individuals in the group that did remain on-task, however since one member was not involved, the group was identified as off-task for that interval. In a future study, it may be beneficial to look at the individual students and identify them individually as being on or off-task. Looking at specific populations and how they perform in the group. Certain variables that may benefit from further researched are: specific classifications, gender, and academic ability.

Conclusion

The present study supports using cooperative group role assignments in an inclusive STEM classroom. There were benefits observed with the use of role assignments. First, the use of group roles positively impacted on-task behavior. These students were positively engaged, remained on-task, and completed STEM challenges with their group. Next, the teacher was also able to better manage the experimental class with cooperative group roles. The teacher knew which member to go to for certain tasks. For example, the materials manager got the VEX pieces and the technician got the iPads. These students knew their roles and responsibilities and after the first class were able to complete them without being asked. This allowed for a smoother class period, the groups were more efficient, and routines were completed in a timely fashion. As opposed to the control group that did not have roles, there was more arguing about who would complete certain tasks in the group, thus hindering the group and taking up class time. Two groups in the control class did need additional time following the 4th class period to complete their robot. In the experimental class, all the groups finished early on in the fourth class period and had free time to test their robots after they were built. Finally, the students

had a more positive cooperative group experience when group roles were used. This was apparent in their rating on the self and peer evaluation surveys. The experimental groups with cooperative group roles ranked themselves and each other higher and gave out less lower satisfaction scores than the control groups that did not have roles.

It can be concluded that teachers need to create a cooperative learning environment that will have students on-task, promote collaboration, and problem solving. Students need to be instructed on expectations and goals of the group experience. Group roles need to be identified and explained so that students can be accountable to be on-task and complete their duties within the group. Students need to reflect on their experience, group dynamics, and responsibilities. Once these routines are established, the cooperative group will have success working collaboratively and achieving their goal.

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