Direct Instruction in Group Dynamics and Small Group Communication Enhances Collaborative Group Learning

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Direct Instruction in Group Dynamics and Small Group Communication Enhances Collaborative Group Learning

Marie Kraus
Spring 2000
Graduate Research
Introduction

Initially, I wanted to conduct my research by integrating math, science and technology across each of the three areas. I currently teach in the Gananda School district and because Gananda is a very small school district, I felt that this would be a perfect arena to pose my question and conduct my research. I originally wanted to focus on engaging in a math/science/technology environment where all of the students could have the benefit of three teachers teaching in the same mode. The unique situation at Gananda lends itself to this research being feasible. There is one technology teacher for middle school and one math and science teacher for both 7th and 8th grade. I thought it would be very simple to coordinate between these teams of teachers and myself. Having started with an idea for my research in September, I searched for a “researchable” question that could really look at taking math/science/technology and teach it cross-curricular way.

My gears changed quickly after assigning a partner project for my middle school students. As their first project in September, their assignment was to work in pairs to research and then report on their topic. They had to choose an invention from one of the three areas of technology, biological, physical or information, and report on the past, present of the invention and make a prediction about the future of that invention. They then presented their findings in three forms: a written essay, a poster and an oral presentation. The students chose their own partners for this activity. Groups consisted of two students with one to two groups of three.

While the students worked on the project and afterward, the students articulated some major difficulties they experienced with working with their partners. Little communication took place outside of the technology classroom, some students did all of the work while their partner did none, some students reported that they could not present at their time because their partner
had not brought in their work and they were not ready. These behaviors were evident throughout all of the 7th grade classes. At this point, I realized I needed to change my question and direction for my research because of my observations and their experiences.

Having observed this behavior, I began thinking about group dynamics and small group communication. I thought back to a course at Rochester Institute of Technology called "Small Group Communications". Through that course, I learned how to be an effective group member. The course changed how I operate in groups and I apply what I learned in that course to every group setting I am involved in. My own experience directly related to the frustrations that my students were feeling in their groups. The realization that students, as well as adults, have difficulties working in groups led me to my question and research topic.

In this paper, I explored whether directed instruction in small group communication skills and group dynamics can make collaborative group learning more effective in my classroom. In my experience, I have found that educators constantly encourage students to perform tasks in a competitive individualistic environment. Teachers ask them to work alone; they set up reward systems where cooperation among students is discouraged and promote "acceptable" not outstanding work. Unfortunately, teachers are almost setting up students for failure in the real world. The environment that teachers create within the classroom does not represent the world that people live in where cooperation, interaction with others and teamwork is emphasized in most environments.

Based upon my experience in my own classroom and as a student, I looked for research that would support my argument that directed instruction in small group communication and group dynamics make collaborative group learning more effective. As a new teacher, especially learning in the MST "mode," I found that collaborative group work and cooperative learning is
one way students synthesize information more easily. I thought that teaching in a cooperative setting made sense to me as opposed to teaching in a traditional, lecture method. I was taught in this manner and I remember times that peer discussion and group discourse, either small group or whole group, would have helped me as a grade school student instead of a “here do this ditto” education that I received. I thought that I could reach more students using a cooperative environment with direct teaching in group dynamics and small group communication.

Literature Review

Throughout the latest renaissance of education, collaborative groups have been emphasized as a way for students to enrich their education. Studies have shown that cooperative learning models have improved students’ attitude toward learning, self esteem and inter group relationships (Sullivan, 1996). Implementing these group situations is the most difficult part. Teacher commitment to this method is also difficult because of the traditional stance that most teachers take in their teaching (Sullivan, 1996).

Sullivan (1996) conducted research in Greenwich, Connecticut where eight graders were used to implement cooperative learning during a social studies unit. In a program starting in 1983, teachers were trained in cooperative learning and were asked to volunteer to the research over the next year. The focus of the research was on Mrs. Beaton’s eight graders learning about the Civil War. She adapted the Group Investigation Model from Sharon and Schachar (1988) that suggests implementing a model where the classroom environment is a questioning one as opposed to traditional teaching approach (Sullivan, 1996).

The students were given research material packets so that they would not waste time during the research stage of the process (Mrs. Beaton only had a fifty-minute block of time to work in (Sullivan, 1996)). The model suggests that the students raise the questions, share
information and discuss findings within their groups. Short-term goals are also emphasized so that the students could complete specific tasks within their class period. Sullivan (as cited in Slavin, 1991, p. 26) states, "For cooperative learning to succeed, teachers and students need to create short-term goals. When students see their tasks carry over for an undetermined amount of time, students tend to lose direction and motivation".

Sullivan's (1996) study outlines that the students were given tasks to perform throughout this exercise on the Civil War that included active questioning, using multiple resources awareness of text organization, applying stages of research, participating in dialogue and presenting findings. Groups were divided into subject groups by which subtopic they chose during the question developing session. Groups were not larger than four students, which Sullivan found to be a good size for the groups because it promotes positive interaction within the group.

As the students moved through their unit, they brainstormed, researched, synthesized information and finally presented their findings to the class. At one point, Mrs. Beaton talked about the concepts of "groupness". She spoke of the importance of role-playing for effective group interaction. Sullivan (as cited in Kelly, 1978, p. 33) showed that Mrs. Beaton told her students what the major roles in a group were: moderator, presenter, questioner, encourager and recorder (Sullivan, 1996). As a role modeling technique, she demonstrated the role of the moderator with one group promoting interaction by eliciting questions from group members and asking for clarifications to their statements. Although Sullivan saw this research as successful because she saw the students increasing their note-taking abilities, link related ideas and draw effective conclusions, only one group learned one of the roles within the group. Sullivan (1996) does go on to state, "When questions are initiated by students and explored, the curriculum is
enriched and critical-thinking skills are developed, thus preparing students for more advanced study”. However, she never addresses how well each student functioned within the group and whether all of the student learning was enhanced.

Many studies and research approach collaborative learning by saying that it enhances student learning, students are more engaged by coming up with the questions themselves. Teachers have difficulty implementing these learning groups and making them effective (Leonard and McElroy, 2000). Leonard and McElroy (2000) point out that while educators are in favor of collaborative learning, most don’t have the proper training or feel as though they don’t have the time to implement collaborative learning. By learning implementation skills, the teachers in Leonard and McElroy’s (2000) study were more comfortable with implementing and teaching using collaborative learning.

In a study by Towns (1998), she like most teachers attended a seminar or conference or class that told her that collaborative learning was the way to go. She put her students into groups, turned them loose and waited to see the magical moment when the increase in achievement, increase in positive student attitude, etc., would occur. Towns met with disenchantment and disappointment when the expected outcomes did not occur.

Towns (1998) wanted to show how to do it better. She thought about how to implement cooperative learning if the students do not know how to work together. Simply placing students into groups and telling them to work together does not work because of two fallacies: one, that the students actually know how to work together; two, that students who know how to work together will actually do so (Towns, 1998).

Preparation is the key (Towns, 1998). She starts the first day of class by asking her students about cooperative learning and their activities (Towns teaches at a college level, but her
methods can be applied at most levels). She found out that doing activities that help the students to get to know each other helps to "break the ice" and starts to eliminate some of the communication difficulties within her classroom. She asks the students to fill out a "Getting to Know You" questionnaire and forms heterogeneous groups from the responses to the questions (Towns, 1998). In the real world, people are asked to work with different types of people all of the time and students need to value diversity so they need to be able to communicate and work with a wide variety of genders, races, ethnic groups, religions, etc. in order to be successful (Towns, 1998).

One of the most interesting group dynamic and communication activities that Towns implements is to have the groups set up "Group Covenants" which delineate the individual group members' responsibilities to the group and the group's responsibilities to each group member (Towns, 1998). Towns helps the students define acceptable behavior and how the group members deal with each other in order to get work done. She asks each member of the group to sign their group's covenant, and she keeps them until the end of the semester.

As one of her first cooperative learning activities, she does a "Looks Like, Sounds Like" activity with the whole class (Towns, 1998). In this activity, she asks the students what roles verbal and nonverbal behavior plays in a group setting. In this, she is training them how to act and function within a group. This very simple realization and direction helps the students to become more aware of themselves and shows what message they are sending by not making eye contact when speaking to another group member, doodling, rolling their eyes, sighing, etc., when speaking to each other. This dynamic is a key piece of training that she uses when setting up her cooperative groups.
This article also emphasizes that these collaborative learning skills are not intuitive and must be taught.

The article claims that students are naturally social creatures, and that they become bored when asked to merely work for grades. Middle school students pass notes, talk on the phone and are constantly interacting with each other. Realizing that this motivated activity could be tapped into, the article asks, “How do you transform that sociability and the testing of new ideas into formal learning outcomes?” (“Students benefit,” 2000, pg. 43).

Barrett (1999) takes this a step further by promoting a more group friendly work environment. Although Barrett is commenting on the work environment, his ideas can be implemented in the classroom with ease. Barrett emphasizes creating a “Smart Room” (p. 17). In this Smart Room, the workstations are shaped in a “U” so that all members of the environment can face each other. The room also includes a brainstorming space, a project space and a hands-on space to allow the students a work area to get their projects complete. This may be impossible for some teachers in their current classroom setting, but it can be made to happen by setting up mini lessons or lesson days that accommodate the Smart Room ideas.

Once the environment is conducive to collaborative learning, teachers must focus on group discourse. Communication is the key to any successful group. Chizhik (1998) says it best when he states, “In collaborative groups, students express their thoughts and can engage in high-level verbal interaction as they discuss pertinent subject matter” (p. 60). The students see this type of learning as fun and the students are more motivated to learn. Chizhik emphasizes, though, training students in this high-level verbal interaction is the most important part of collaborative group dynamics.
respond to the verbal and nonverbal behaviors. By doing this, students are able to answer questions such as, "How would the first person speak to shape a conversation?" (p. 19). They concentrate on content and process when viewing the verbal and nonverbal behaviors on videotape.

Finally, cooperative learning was presented to special needs students where the outcome that was looked at was acquiring social skills (Prater, 1998). In this study, three research groups were established. Group one was given teacher directed instruction on three socially validated skills: listening, problem solving and negotiating. The second group received the same instruction but using a structured, natural approach as suggested by Kagan (1993). The third group generated, defined and discussed cooperative group rules. This group identified the three skills taught to the other two groups (Prater, 1998). The study showed that during an assessment of their skills during a role-playing situation, students in group one showed significant improvement in the three skills area whereas group two students showed minimal gains and group three students did not improve their skills in these three areas (Prater, 1998).

Additionally, studies by Johnson and Johnson (1987) show that once students know what role they are to play within the group and what the expectations are, the students learn more material, are more confident with themselves and accept differences among other students, if they are learning cooperatively. Johnson and Johnson have been affiliated with the Cooperative Learning Center at the University of Minnesota since approximately 1972, and their research shows that roles help the group to define their interdependence and interconnectedness (Johnson & Johnson, 1991).

Goal structures are defined as a type of social interdependence among students as they strive to accomplish their learning goals. They are defined as cooperative, competitive and
individualistic (Johnson & Johnson, 1991). Instruction takes on all three types of goal structures. Cooperation of students is the students working together to accomplish a shared goal. This is where the individual seeks benefits and outcomes for “self” and for the good of the group members. Johnson and Johnson (1991) critique competition as detrimental to students in a learning environment. Students commonly will “joust” with each other to see who got the best grade on the quiz or will compete to give the “correct” answer the quickest within the classroom. Johnson and Johnson (1991) claim that to be “the best” is one of our basic human characteristics. This characteristic is evaluated with standardized testing and individual performance assessments within the classroom. Students working by themselves to accomplish goals unrelated to and independent from the goals of others illustrate individualistic effort. Although competitive and individualistic goal structures have been emphasized for the past 45 years, Johnson and Johnson maintain that such emphasis can create a classroom life that is a “rat race” if it is too competitive and very isolated individuals who ignore their classmates if it is too individualistic (Johnson & Johnson, 1991).

Johnson and Johnson’s (1991) choice is cooperative learning in the classroom. These groups can be formal, informal and base groups. Formal groups are groups that are more structured and stay together until the task is completed. Informal groups are groups that are short-term and less structured (turu to your neighbor and tell them what you know). Base groups are long-term groups whose role is peer support and long-term accountability (Johnson & Johnson, 1991). The formal learning groups act as a base model for the other two once a teacher has gained expertise in using cooperative learning procedures.

In Learning Together and Alone, Johnson and Johnson outline the differences between cooperative learning groups and traditional learning groups shown in Figure 1.
As Johnson and Johnson point out in Figure 1, the students create interdependence within the group where the students and the learning are more complete.

Cooperative efforts begin when group members commit themselves to a mutual purpose and coordinate and integrate their efforts to achieve their goals. Countless Johnson and Johnson studies and research show that this can be accomplished through the assigning of roles. These roles create positive role interdependence when each member is assigned complementary and interconnected roles that specify responsibilities that the group needs in order to complete a joint task. Although Johnson and Johnson (1991) define some roles, role possibilities can be assigned depending upon the specific task or activity. They do, however, emphasize that these roles should be rotated daily so that each student obtains considerable experience in each role. Some
of the roles that Johnson and Johnson (1991) define are: Reader, Checker, Writer/Recorder, Prober/Questioner, Praise and Encourager.

Once taught skills, group dynamic and communication skills are retained by students and do not need to be reemphasized. Gillies (1999) points this out with a group of sixty-four 4th graders, who had been previously trained in cooperative group behaviors and a group of eighty-four 4th graders, who did not have any training. Gillies (1999) indicates that those students, even after a year away from the training and no "refresher" training, were more helpful and cooperative than their peers who had not received the training in the previous year.

Theoretical Framework

This study considers four measures for success. First, in the article entitled “Students benefit from collaborative learning in the classroom” (T.H.E. Journal, 2000), emphasis is placed upon the fact that collaborative learning skills are not intuitive and must be taught. Both Gillies (1999) and Marotta (2000) draw the same conclusions in their studies. Towns (1998) goes on to show that by simply placing students into groups and telling them to work together does not work because of two fallacies: one, that the students actually know how to work together; two, that students who know how to work together will actually do so. Research shows that students who have learned skills in group dynamics and small group communication retain these skills and take them into their professional lives beyond their formal education (Marotta, 2000).

Second, cooperative efforts begin when group members commit themselves to a mutual purpose and coordinate and integrate their efforts to achieve their goals. Countless Johnson and Johnson studies and research show that goals can be accomplished through the assignment of roles. These roles create positive role interdependence when each member is assigned
complementary and interconnected roles that specify responsibilities that the group needs in order to complete a joint task. Although Johnson and Johnson (1991) define some roles, role possibilities can be assigned depending upon the specific task or activity. They do, however, emphasize that these roles should be rotated daily so that each student obtains considerable experience in each role. When students have a clear understanding of what the roles are and what is required of them, they use their skills to accomplish their goals (Johnson and Johnson, 1991).

Third, Towns (1998) states that “Group Covenants” need to be implemented because they delineate the individual group members’ responsibilities to the group and the group’s responsibilities to each group member. With these “Covenants,” each individual is accountable for their own actions in the group. Towns helps the students define acceptable behavior and how the group members deal with each other in order to get work done. Having the students create the list of acceptable behaviors, they become stakeholders (Towns, 1998). When students take ownership in what they do, as opposed to a teacher-generated list of behaviors, a document, such as a “Group Pledge” or Group Covenant” become much more valuable tool for everyone.

Finally, Giordano and Yost (1999) and Towns (1998) maintain their collaborative groups in similar ways in that they allow their groups to function but ask for group feedback on a regular basis. Towns calls it “group processing” (p. 68). In this, Towns asks her groups to respond to several questions and complete statements such as (Towns, 1998):

1. To operate as an effective team, we need to do the following:
2. To operate as a more effective team, we need to start doing the following things:
3. To operate as a more effective team, we need to stop doing the following things:
4. To carry out these actions, here are the steps that we are going to take to address the first three statements.” (p. 68)
By taking this approach, the authors feel that the students take greater responsibility in their learning and the teachers are not solely responsible for student learning.

Methodology

Setting

In this study, I used my resources as a technology teacher in the Gananda Central School District, Macedon, New York. The school district is considered very small and every student knows one another. Most have been in school together since elementary school and have formed strong friendships. The district is homogenous as compared to other districts in that there is little ethnic, religious or racial diversity among the students. The community is also small, only six square miles, and would be considered rural.

During the course of the school year, I meet with the technology classes every other day from September to June. I teach the entire 7th and 8th grade at the middle school level as well as two courses each day at the high school level. Class periods are 40 minutes long. I used the entire 7th grade to perform my study, however I focused on one class period, 4th period of the day on “A” days. This class meets from 9:57 to 10:37. Within this group of 7th graders, I have focused in on four individuals that I grouped together.

Participants

I selected four students to group together to conduct my research. There are two boys and two girls so that there is no gender bias within the group. Research conducted by Gillies (2000) has shown that students are more likely to facilitate other’s learning in heterogeneous groups than with groups that were homogeneous. These four students have displayed somewhat extreme behaviors in past group activities and in their individual performance. I wanted these particular
students together because I wanted to see if these individuals, who displayed a wide range of performance levels, behaviors and personalities, could come together to accomplish the goals set for them within a particular unit.

The students in the study group were described as follows:

Tiffanie: a white, 13 year old girl who is an extremely hard worker, but would be described as an average student. She has a very strong personality and could be described as a leader. She is very concerned about her grades and strives to do well. Tiffanie’s behaviors can be described as energetic and sociable. She was chosen as student of the month at one point this academic year. Tiffanie comes from a fractured home and is living in foster care.

Jimmy: a white, 12 year old boy who is an average student that struggles in most subject areas. He is a big talker, would be described as obnoxious, and can tend to be disruptive in class. He waits for his group members to complete the project and is the first to take credit for the work. He is very outspoken and is inappropriate at times. He likes to be the center of attention and could be described as a “class clown”. Jimmy lives with both parents.

Vince: a 13 year old boy of Asian decent who is a high achieving student and is very quiet. He could be described as an over achiever. He is very creative and is willing to try “different” things that other students would not try. For example, he is the president of the middle school origami club. He is a focused, diligent and very precise in everything that he does. This reflects in his work. Vince lives with both parents.
Nicole: a white, 13 year old girl who was adopted as an infant. She works hard to be successful. She tends to be distracted by her friends in the class and will socialize before getting down to the task. Although very social, she tends to the task and is very conscious of grades and doing well. Nicole lives with both adoptive parents.

Materials

For the duration of this unit, I kept a field note journal that followed my study group’s progress. In this journal, I reflected on the progress of the group during its formation, development and functioning. Along with my field note journal, I used cassette tapes to record the group’s interaction. I recorded the group five times during the study period. These tapes acted as audio journals allowing me to reference and reflect upon the group’s interaction. The audiotapes allowed me to hear the type of interaction and communication my students have with each other and I have within the group. They also acted as an unbiased observer of the group’s interaction. Finally, group reflection sheets were used for the group to reflect on their performance as individuals and as a group for that class period. This reflection allowed the group to see their own progress, areas for improvement and how to become a more effective group.

Curriculum Studied

This study focuses on a section of a whole unit on simple machines and their uses. The unit takes student knowledge of simple machines and how to transfer energy from one simple machine to the other. Students use their knowledge of the lever, screw, wedge, incline plane, wheel and axle and pulley to create a series of machines placed together in order to perform a
simple task. In other words, as Rube Goldberg did in his comic strips, take a simple task and make it complex but still accomplish the same task. This study focuses on the first section of the unit where students worked in their groups of four to draw the machines; first as thumbnails then as a scale drawing. Before final drawings were completed, groups met and negotiated with their neighboring group so that the energy (in this case a marble) could be passed in the correct place.

In the final section of the unit, the students fabricated each machine; attached them to a board transferring the energy of a marble from one machine to another. Once they had their machines on their boards, they joined up with their neighbor so that the marble could travel from one board to the next. The whole series performed a final task. In the study group, the task was to ring a bell. A configuration of the boards and the task can be found in Appendix A.

Procedure

The focus of my study is the individual behaviors within the group, group dynamics and communication of this group. I gathered data for approximately four weeks during part of a unit on simple machines. During this time, I met with the students ten times (a sequence of days and activities are shown in Appendix B).

Day One

On Day One of the unit consisted of three activities: one, "Expert Survey"; two, description and discussion of group roles, and three, a brainstorming session of what the students thought was a simple machine and examples of each.

First, each student filled out an "Expert Survey" (see Appendix C). In the survey, each student rates his or her strengths and weaknesses on a scale of "expert" to "no way". At the bottom of the survey, students were asked to list the three people that they could work with and
the three people they could not work with. They were told to base their choices on their past experiences working in groups in technology and other classes. I used this technique as a third way to group my students for the year. In their first and third projects, the students chose their own groups and in their second project, I used a random draw to group the students. For this activity, I chose to use a survey format because it would enable me to group the students according to their own perceptions of their strengths and weaknesses.

The second activity the students were given was a description of the roles they were to follow. Students were encouraged to discuss the roles, their characteristics and why it was important for us to follow roles. Each role was read aloud and discussed as a class. Roles are set out in writing so that each member has full knowledge of what the role expectations are. Roles were rotated each class, as suggested by Johnson and Johnson (1987), so that each student can become expert at each role. Students were encouraged to make their own notes and ask questions of the teacher and each other. As Johnson and Johnson (1991) pointed out, these roles do not have to fit a static list, but they should conform to the individual project or activity. Following Johnson and Johnson (1991), the students were asked to rotate the roles within their group when we performed a group activity in class. The group roles for this study were defined as Facilitator, Scribe, Monitor and Materials Handler. Full descriptions of these roles are found in Appendix D.

The final activity of the first day was asking the students to brainstorm what they thought were simple machines and students were encouraged to build upon prior knowledge of simple machines from previous classes. Ideas were written out on the chalkboard for the students during this classroom discourse.

On the evening of Day One, students were grouped together based upon areas of strengths and areas of improvement. Under consideration were the three people that each student
said that they could and could not work with. Groups consisted of four people and one group of three because of an odd number of students in a particular period. These groups were prepared and ready for the next class meeting. Students were placed in heterogeneous groups whenever possible.

Day Two

The opening activity on Day Two, the students were asked to respond on a piece of paper, "What makes a good group?" As individuals, the students created a list of what they thought were characteristics of a good group. I used a slight twist on the idea of Think/Pair/Share. Their individual responses were brought into their new groups that were established the evening before. After I announced their new group members, the students broke into their new groups, assigned group roles and shared their individual ideas with their new group members. Once each group member shared their thoughts, the group decided on their top five characteristics of a good group and created a poster to showcase their ideas. The group was then asked to create a name for their group, one that each member agreed upon that represented their group. The groups created a folder for storage of group activities, thumbnails, drawings and any other unit activities. This exercise is similar to Towns (1998) Looks like, Sounds Like activity.

As part of the activity and unit, each group was responsible for daily group reflections on what was accomplished in the group and how well the group did or did not function. The reflection was completed as a group, not individually, and was completed at the end of the period. This was a group performance assessment and was incorporated into my study as a group dialogue and group self-assessment. Teacher comments were given on the group reflections on a daily basis so that students could improve, grow and develop as a more effective group.
The series of questions outlined, adopted by Towns (1998) were:

1. "To operate as an effective team, we need to do the following things:

2. To operate as a more effective team, we need to start doing the following things:

3. To operate as a more effective team, we need to stop doing the following things:

4. To carry out these actions, here are the steps that we are going to take to address
the first three statements." (Towns, 1998)

Towns (1998) points out that this data can show two different things. First, the teacher
checks to make sure the students are functioning effectively in the group. If not, action can be
taken early on to correct any major problems. Second, the four statements allow the students to
reflect on and discuss what things they are doing well and see what they need to improve upon to
function more effectively. The questions developed by Towns (1998) were used for three class
periods of group reflections. After reviewing the students' responses, I decided that the wording
needed to be changed so that the students could grasp some of the concepts about group
reflections easier. Developmentally, I didn't feel as though the students were responding in the
group reflections to their fullest capability. The questions were changed to:

1. These are the things that our group did well today:

2. These are the things that our group did not do well today:

3. These are the things our group has perfected as a group:

4. These are the things that we still need to work on:

5. This is how we are going to solve our problems within our group and become a
more efficient group.

The concepts in the changed questions are essentially the same as Towns (1998) outlined, but in
language that seventh graders could understand more completely.
Day Three

The third day of the unit added on to our initial activity of “What makes a good group?” The students were asked to work in their groups to accomplish two tasks: one, agree to the “Group Pledge”; and two, complete a group activity. The class listened to the Group Pledge (see Appendix E) and was asked if they agreed to follow the characteristics listed on the Pledge. The Group Pledge I created for my classroom aligns with Towns (1998) Group Covenants. Group Covenants, as described by Towns (1998), delineate the individual group members’ responsibilities to the group and the group’s responsibilities to each group member (Towns, 1998). Towns helps the students define acceptable behavior and how the group members deal with each other in order to get work done. She asks each member of the group to sign their group’s covenant, and she keeps them until the end of the semester.

During this unit, groups were asked to complete group skills development activities from The Cooperative Learning Companion, Ideas, Activities and Aids for Middle Grades. These activities included teaching skills in: using quiet voices, criticizing ideas and not people, listening and expressing feelings. The group activity for Day 3, the group activity was on “Criticizing ideas, not people” (Appendix F). While students completed this activity, I traveled from group to group with a “Group Pledge”.

The Group Pledge was created from compiling all of the characteristics of a good group generated from the posters created by the students. I compiled the list and ranked them according frequency. From this list, the top twelve characteristics were listed on an individual Group Pledge with each group member’s name at the bottom for the students to sign. Each member was asked if they agreed to each of the twelve characteristics and they were then asked to sign the
pledge stating that they agree to follow all of the rules of what makes a good group. These pledges were placed in their group folders.

At the end of the group activity, we shared, as a whole group, the students' thoughts and solutions to the “Criticizing Ideas, Not People” activity. The groups picked a speaker for their group and each shared their responses to the statements on the activity sheet.

Days Four and Five

Teacher directed lessons dominated days four through seven. These directed lessons encouraged classroom discourse and a constructivist approach to what the students knew about the six simple machines we were studying. Definitions were built from classroom discourse and each student's ideas. Discussion materials included: Rube Goldberg biography (Appendix G), Rube Goldberg cartoon examples (Appendix H.1 through Appendix H.4) and Rube Goldberg Project Sheet (Appendix I). Note pages were also given (Appendix J and K) for students to continue to build upon their knowledge and eliminate any misconceptions they may have had about simple machines.

Day Six

As a whole group activity on Day Six, the groups were asked to place the 12-inch by 12-inch boards in a configuration unique to their class (see Appendix A). Groups were asked to volunteer for their placement and where they wanted their board to fit together. Students were encouraged to negotiate tasks and placements and justify their selections. Following this activity and mirroring Rube Goldberg, the students brainstormed ideas of what task they wanted their series of machines to perform. Ideas were written on easel paper, which also showed their configuration for their class. No idea was eliminated during the brainstorming section of the
class. When the class had nothing more to add to the list, they started to eliminate tasks that were impossible to accomplish in the technology classroom.

As an independent activity, students were given a creative exercise for homework. This activity was completed as individuals and reinforced the Rube Goldberg cartoons (see Appendix L). This assignment was used for assessment for the students individually. Assessment was based upon creativity and application of how to transfer energy. In this activity, the students were asked to create a “Rube Goldberg-like” machine using cartoons and explain how their machine worked by writing a short paragraph. Individuals could use the cartoons provided or draw some of their own but could only use six (6) different items to accomplish the task. The paragraph had to explain what their machine was, how it worked and the steps it took to accomplish the task.

Day Seven

After discussion on the homework activity and handing it in, Day Seven started with a mini-quiz on group roles and the “Criticizing ideas, not people” activity. The quiz consisted of naming each of the group roles and describing one task each performs and a response to a statement that criticized a person, not their idea. The quiz was worth 10 points: one point each for the correct name of the role; one point each for the correct description; and two points for an acceptable response to criticize the idea, not the person. At the end of the quiz, a question was posed to the whole class, “Why do you think we had a mini-quiz on group roles and criticizing ideas activity?” Whole group discussion followed and student responses were encouraged and discussed. This brief activity was used to reinforce and revisit group roles. Students had not used these roles in four class periods because of teacher directed lessons or whole group activities.
Following the mini-quiz, the students, as a whole group, looked at the list of remaining task ideas for the class. They continued to eliminate ideas that were impossible to accomplish in the technology classroom. When a list of four to six ideas were remaining, students were asked to put their heads down and close their eyes and vote on the remaining ideas. This method was used so that the students were not encouraged or discouraged to vote in a particular way. A final decision was made on this day. The range of activities was: feed a fish, finish a sandwich, pop a balloon and, for the class containing the study group, ring a bell.

As the final activity for the day, the students broke into their groups and started brainstorming ideas of how they wanted to put their machines together to pass the energy on to the next group. The students were asked to generate thumbnail sketches of the machines and calculate how they could fit together on their board. Group reflection followed this activity.

Day Eight

Three activities were performed on Day Eight: mini-quiz on group roles, continuation of brainstorming and negotiation with neighboring group and a skills activity. The students were given a mini-quiz on group roles and the “Criticizing ideas, not people” activity. The quiz consisted of naming each of the group roles and describing one task each performs and responds to a statement that criticized a person, not their idea. At the end of the quiz, a question was posed to the whole class, “Why do you think we had a mini-quiz on group roles and criticizing ideas activity?” Whole group discussion followed and student responses were encouraged and discussed. This brief activity was used to reinforce and revisit group roles. Students had not used these roles in four class periods because of teacher directed lessons or whole group activities.

Following the mini-quiz, as a whole group, second activity continued the brainstorming and negotiation activity. This is where the groups had to meet with their neighboring group to
find out where and how to transfer the energy. From past experience, these negotiations can be
difficult because some groups don’t want to adjust or change. Groups worked with the group
before their board to the group after their board and made any adjustments necessary.

The third activity for Day Eight was an activity from The Cooperative Learning
Companion, Ideas, Activities and Aids for Middle Grades titled “Expressing Feelings” (see
Appendix M). In this activity, students read a short paragraph and responded to three short
questions related to that paragraph. The activity focused on how to express feelings within a
group to individuals as a part of a small group. This activity was completed as a small group
activity and placed in their folders for teacher comments and reflection. Each group completed
group reflection sheets.

Days Nine and Ten

On Days Nine and Ten, the groups’ task was to make a scale drawing of their
mechanism. A drawing rubric was given to each student so that group knew the criteria for
grading their drawings (see Appendix N). This drawing was to be neat, complete and to scale. It
acted as a template for the groups to build from. Each member of the group, in a rotating fashion,
worked on the drawing. Each member had an opportunity to work on the drawing. Drawings
were to be completed after teacher approval. Final drawings were put on 12” x 18” paper. Each
group completed a group reflection sheet.

As a part of Day Nine, students were introduced to anchor activities because not all
members could participate in drawing at the same time. These activities were designed to
reinforce and expand their knowledge of simple machines and their uses (see Appendix O.1
through Appendix O.6). Each person, not group, was responsible for completing all six activities
and a running record of each activity appeared on the front of a folder with their period on it.

Each group completed group reflections.

Data Collection and Analysis

Following each taped session, transcripts were made of the focus group’s dialogue and discussion. For the duration of this unit, I kept a field note journal that followed their progress in writing. In this journal, I reflected on the progress of the group during its formation, development and functioning. This acted as a reference for me to use to plan and adjust activities. Along with my field note journal, I used cassette tapes to record the group’s interaction. I recorded the group five times during the study period. These tapes acted as audio journals allowing me to reference and reflect upon the group’s interaction. The audiotapes allowed me to hear the type of interaction and communication my students have with each other and I have within the group. They also acted as an unbiased observer of the group’s interaction. Finally, group reflection sheets were used for the group to reflect on their performance as individuals and as a group for that class period. This reflection allowed the group to see their own progress, areas for improvement and steps to take to become a more effective group.

Results and Analysis

In this section, you will find that data were collected on Day One through Day Three and Days Seven through Ten. The results of the data collected are analyzed in the following text.

Day One

On the first day of the unit, the students' initial activity was to fill out an “Expert Survey” (see Appendix C). The Expert Survey was followed by a “think aloud” about group roles leading
us into reading and discussing our group roles for the unit. The final activity for the Day One was a whole group discussion of simple machines.

Upon completion of the Expert Survey, we discussed what they thought a “group role” was and why did they think we were implementing roles at this point in they year. Student discussion was enthusiastic. Overall, the students thought that a group role was something that outlined jobs within a group. They thought it was a good idea to outline roles because they thought they could follow something that was in writing. The students also thought that group roles were important because then everyone would know exactly what to do when working in their groups and could help someone more easily if a group member wasn’t doing their job. Following our discussion, students then looked at each of the group roles (see Appendix D). These roles were read aloud, as a whole group. After the reading of each role, we discussed what each role meant and why each component was important. The students brought up points about each of the roles and made notes on their role sheets. Some comments that were made were; “The facilitator is like the captain of a team and the monitor is like the assistant captain,” “The materials handler is in charge of clean-up and can ask for help,” and “The monitor is like a cheerleader because they get the other group members involved.”

From this discussion, I was encouraged. First, I observed that the students needed the explicit descriptions of roles and when discussed, they had a more complete understanding of what was expected of them in this unit as opposed to prior units. For me, this realization further supported Johnson and Johnson's (1991) and their countless studies on cooperative efforts and assignment of roles. These roles created positive role interdependence and interconnected roles that specify responsibilities that the group needs in order to complete a joint task. At this point, however, the students did not know who their groups were or what the task was, therefore, it was
important to me to allow the students to have this understanding prior to learning their task and their groups. Second, by posing a question about group roles to the students, they directed the discourse in the classroom and enhanced their understanding. From their discussion, my students developed a "high level verbal interaction as they discuss pertinent subject matter" (Chizhik, 1998, p. 60). My students were involved with developing their own understanding of the group roles and had a clear understanding of what they were based upon their discussion of what each one was and why it was important.

The final activity on Day One was a brainstorming session on simple machines. The question was posed to the class and the students volunteered their knowledge of simple machines. They told me that they had studied simple machines previously in fifth grade; therefore, they were eager to volunteer responses. Each class compiled a sheet of easel paper of responses that we eventually referred back to during a note-taking day.

On the evening of Day One, I compiled information and grouped the students according to their strengths and weaknesses. Also under consideration, were the three people that each student said that they could and could not work with in order to accomplish a task. Students were placed in heterogeneous groups whenever possible. I grouped students together using the heterogeneous model shown in research conducted by Gillies (2000) that showed that students are more likely to facilitate other's learning in heterogeneous groups than with groups that were homogeneous.

In spite of my desire to group the students based solely upon the Expert Survey, I kept my study group intact. Even though they displayed strengths and weaknesses in a variety of areas and could have been grouped together, part of the criteria for grouping was the list of people the students could and could not work with. One of the most interesting observations I made was
that in the class containing my study group, approximately 90% of the students said that they couldn’t work with Jimmy, one of my subjects. Also, and unfortunately, two of my study subjects also indicated that they couldn’t work with him (see Appendix P.1 through P.4). Regardless of their choices, I kept my study group intact because I wanted to see if these particular individuals, who had previously displayed extremes in behavior, performance and personality, could come together to accomplish the goals set for them within a unit of study.

Day Two

At the beginning of Day Two, a question appeared on the board, “What makes a good group?” I used a twist on the think/pair/share concept for this exercise: individual response/small group/whole group. The new groups completed five tasks; share individual ideas, create a list of top five ideas for their group, think of a name for their group, create and decorate a folder and create a poster. After announcing their new group members, the students broke into their groups, assigned group roles and worked on the assigned tasks. When all five activities were completed, each group shared their ideas and their poster with the whole class.

This was the first opportunity I had to record my study group. As the students broke into their groups, and prior to beginning the activities for the day, I observed the study group assigning their group roles. Their discussion was minimal and no negotiation took place for this role assignment. They decided that Tiffanie was the facilitator, Vince was materials handler, Nicole was the scribe and Jimmy was the monitor. Tiffanie was the first one to volunteer for the role as facilitator. This matches her personality for being a leader and her own high rating for “leader” on her Expert Survey (Appendix P.1). I observed the study group working well together sharing their ideas and each took turns sharing ideas. An excerpt from their dialogue appears below as they worked toward accomplishing their first group goal for the day. This illustrates

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their communication skills, sharing of ideas and their commitment to a mutual effort of
achieving their goals for the day.

001 Tiffanie - “Friendly people, sociable, hard working and interested in what they are doing.”

003 Jimmy - “Work hard, do what they have to do, don’t give put downs.”

005 Vince - “Shows leadership, friendship, someone who can share ideas responsible, ability to accept opinions, loyal to the whole task and focused on the whole task.”

007 Tiffanie - “Let’s move on to the top five.”

009 Nicole - “Yo, I didn’t go yet. Okay. Cooperation, responsibility, respect for others, stick-to-itiveness, participation, organization, creativity, thinking, equal and good use of time.”

013 Tiffanie - “We have to decide top 5. Cooperation!” (shouting)

015 Jimmy - “Shhhh.”

017 Vince - “We have to do responsibility.”

019 Nicole - “Jimmy, what do you think should be on our top 5?”

021 Jimmy - “People that do their work.”

023 Nicole - “That is the same as responsible.”

025 Jimmy - “No put downs. That would be a good one.”

027 Vince - “Accept people’s ideas.”

029 Group - “Yep.”

031 Nicole - “We need one more. Hard workers?”

033 Tiffanie - “Yea.”
Vince - “Yes.”
Tiffanie - “Vince, could you go get a piece of paper.”

The dialogue shows a complete group effort toward accomplishing their goals as set out at the beginning of the class. Although I observed the study group floating in and out of roles and transferring roles as shown when Tiffanie asked Vince to get a piece of paper (line 037), their first experience following roles is a success. The group set out to accomplish the three tasks set out by me at the beginning of the class, they worked together toward that goal and, even though they floated in and out of roles at times, they followed the role sheets in order to accomplish their tasks for the class.

I observed that while the group was deciding on their top five, they were having discussions outside of the task at hand. Beebe and Masterson (1995) show that this dialogue is essential for groups to form a concrete base in order to become an effective group. The study group’s dialogue helped to establish the group and allowed them to “bond” as a group bringing them to a “common ground” so that they could work together. By bonding as a group, they form a comfort level within the group and they can get to know each other better (Beebe and Masterson, 1995).

Jimmy seemed to be the person who was the most off task at this point. As monitor for the day, he should have been the one to make sure that everyone was on task and motivate his other group members to complete the task. Each group member worked to keep him focused. During this activity, Tiffanie, as the facilitator, tried to pull him back into the group by saying, “Come on Jimmy, we need to get this done.” Her comment indicates two things: one, Tiffanie is following her role as facilitator; and two, she is committed to the task. Vince also brought him back in by asking, “Jimmy, do you think that our name should be blue or green?” Even though
Vince’s role on this day was materials handler, he tries to keep the group moving toward its goal. Nicole also tries to bring him back into the group shown in line 019. This brings him back into the activity.

With this having been the first time the study group worked together, the group bonded fairly well at this point. The study group has established common ground and some group bonding has occurred. Their dialogue was respectful and the roles were being followed, not incompletely. Despite Jimmy not following his role as written, he was involved with the task and wanted to be a part of the group. The group members established a comfort level with each other and were committed to the completing the task.

Their group reflection sheet for this day (Appendix Q) shows that, as a group, they knew that they needed to stay on task and not fool around. This shows awareness, by the group, of the task at hand and the desire to accomplish the goals for the day as a group. It also shows that they are trying to follow their roles. The handwriting in question one is different than the other responses showing that Vince, the materials handler for the day, started to act as scribe and remembered his role and turned the writing over to Nicole who was the scribe for the day.

Day Three

At the beginning of the class on Day Three, I told the students that they would be looking at a Group Pledge during the period. Like my Group Pledge, Towns (1998) used “Group Covenants” as a way for her groups delineate the individual group members’ responsibilities to the group and the group’s responsibilities to each group member. Towns (1998) helps the students define acceptable behavior and how the group members deal with each other in order to get work done. I explained to the students that the Group Pledge was created by compiling all of the characteristics of a good group generated from the posters created the previous class. Each of
the groups saw at least two of their ideas on the Group Pledge and all agree that they could follow the guidelines of the Pledge because they had created it. If I had created the Pledge from my own ideas, the students would not have seen as much value in the Pledge as they did by creating it themselves. Like Towns (1998) in her Group Covenant activity, the list of acceptable behaviors was generated from the students' ideas and was not created by me as something they had to follow.

Further group skills development on Day Three was an activity adapted from The Cooperative Learning Companion, Ideas, Activities and Aids for Middle Grades. The activity used was called, "Criticizing ideas, not people" (Appendix F). Two examples were given on the activity sheet and were reviewed as a whole group prior to breaking into small groups. While students completed this activity, I traveled from group to group with a "Group Pledge" (Appendix E) for each of the students to sign. At the end of the small group activity, we shared, as a whole group, the students' thoughts and solutions to the activity. After a brief explanation of the Group Pledges and the activity for the day, the students broke into their groups and begin working on their small group activity. In addition to their regular roles, the role of "group speaker" was assigned.

My study group moved to their work area and assigned roles. Again, this task is accomplished with little discussion. For this activity, Nicole was facilitator, Vince was monitor, Jimmy was materials handler and Tiffanie was scribe. Jimmy picked up the activity sheet and Nicole read the instruction aloud for clarification and the group began their task. Nicole, Tiffanie and Vince began the task while Jimmy moved to another group. I observed this behavior and heard an interesting response from Nicole on the audiotape. The excerpt is from the group's conversation that occurred while they were getting ready to start their group activity for the day.
Nicole – “Jimmy, you need to work with us today to get this activity done.”

Jimmy – “I did. I’m materials handler and I got the sheet, didn’t I?”

Nicole – “Yea, but we all have to share our ideas to get this done. Ms. Kraus said that we have to choose a speaker. Since you didn’t have that much to pick up today, do you want to be speaker too?”

Jimmy – “Sure.”

Vince – “That means that you have to give your ideas in our group not with other groups, Jimmy. Stay with us today.”

Jimmy – “Okay.”

Line 001 clearly shows that Nicole has taken on the role as facilitator by first, taking the lead and starting the activity and second, by trying to bring Jimmy back into the group with her idea of giving him an additional task to complete for the day. Vince is also following his role as monitor by helping Nicole. He, in Line 011, tries to encourage Jimmy by asking him for his ideas. This gives Jimmy equity in the group and also shows him that his input is important to the group so that they can complete the task.

A further observation I made was when I approached the group to ask them to sign their Pledge. Again, Jimmy seemed off task as got closer to the group. I heard Vince say, “Jimmy, we need everyone’s ideas.” The following dialogue took place while the students were working on the “Criticizing ideas, not people” activity.

Nicole – “Tiffanie, what’s the next one?”

Jimmy – “What is it for?”

Tiffanie – “How stupid can you get?”

Jimmy – “How about -That’s not a good idea.”
“Be nice Jimmy.”

“What was wrong with that? That’s not talking about somebody.”

“You can think of a better way to say what you did.”

“I don’t know. (Pause) How about, ‘Let’s use that idea for something else.'”

“I like that one.”

“I think that’s better.”

“Yea. Write that one Tiffanie.”

Analysis of this conversation shows that the group is functioning well. First, they are following roles as they are written, clearly shown by Nicole throughout the excerpt. She is leading the group and guiding the members through the activity. Second, Vince is supporting her in his role as monitor. Vince shows support and encouragement of Jimmy in Line 059 by asking him to “think of a better way.” This request asks Jimmy to use a “higher level of thinking” to respond to the statement, not just his first response. The high-level of verbal interaction displayed by the study group aligns with Chizhik’s (1998) point that states, “In collaborative groups, students express their thoughts and can engage in high-level verbal interaction as they discuss pertinent subject matter” (p. 60). Without teacher intervention, the study group had developed communication skills that encouraged collaborative group discourse in order to accomplish a goal. They did not respond to the activity questions in order to just complete the activity; they discussed their answers and came up with their best responses as a group.

The group reflection sheet for Day Three for the study group (Appendix R) showed that they felt as though they were off task and needed to work toward accomplishing the task for the day. Their response to question one on the Group Reflection was, “We need to start accepting
of group roles. Although Gillies (1999) shows that no reinforcement was needed in his study after a period of one year, my students had only practiced their new skills for two class periods. I felt that reinforcement of group roles and how to criticize was necessary.

Although I didn’t record my study group on Day Seven, I did observe them working together to design their series of simple machines. The group activity for the day was to brainstorm ideas of how they could make four to six machines fit together to pass the energy on to the next board. The study group’s board was the third in a series of seven boards, therefore, they had to be able to receive and pass energy. Their ideas were all being heard and nobody’s ideas were being eliminated without justification. They were referring back to their notes that they received during the teacher directed lessons on Days Four through Six. However, there were moments of disagreement. Vince was the facilitator for that day and was leading the discussion and brainstorming session. He suggested they start with an inclined plane that would drop into a pulley. Jimmy made a suggestion of putting what he called “bumpers” on the inclined plane so that it would take the marble longer to reach the pulley. Tiffanie shot down this idea saying, “That would take too much work to put it together, Jimmy.” Nicole said, “Yo, Tiffanie, we can’t shoot down anyone’s idea during brainstorming we have to listen to all of the ideas. But, actually, that’s a good idea because our machine has to run for three seconds and that will slow the marble down.” Tiffanie then thought about what she said to Jimmy and apologized.

The study group’s reflection for Day Seven shows (see Appendix S) that they were aware of the communication breakdown and that listening was something that they needed to work on. The group’s response to question two was, “Stop talking so much.” Their response to this question shows that they were aware that their conversation was not directed toward their tasks for the day. Question four asks for steps to accomplish the previous three questions and their
response was, “Listen to each other.” Although they were not sure how to solve the problem or what steps they should take, they were aware that communication was a skill that they needed to work on. This awareness showed that the group was aware that clear communication and listening were key skills they needed to be successful.

Day Eight

Two activities were performed on Day Eight: the first activity continued the brainstorming and negotiation activity started in Day Seven; and the second activity was an activity from The Cooperative Learning Companion, Ideas, Activities and Aids for Middle Grades titled “Expressing Feelings” (see Appendix U). Negotiations took place during prior to the groups using “good” paper for their final drawing.

Negotiations for my study group went well with one group and fair with the other. They decided that their board would consist of an inclined plane to a pulley that would drop the marble into a screw machine and finally, the screw machine would send the marble into an interesting lever/inclined plane configuration (see Appendix T). Their negotiations took place with boards two and four. The negotiation with board two was easy. On this day, Jimmy was facilitator and therefore led the negotiations. An excerpt from the negotiation with group members from board two follows

027 Jimmy - “What is your last machine, Justin?”
029 Justin - “It’s a screw machine.”
031 Jimmy - “We have a ramp as our first machine and we need to know how tall the last ramp on your screw machine is.”
033 Justin - “I don’t know. I need a ruler” (The groups work to measure the height of each machine)
her knowledge from that activity and has applied it to another circumstance. Jimmy, however, did not want to wait for Steve’s to be ready. Having overheard this conversation, I waited to see how Jimmy and the rest of the study group would respond to the exchange between Jimmy and Steve. I hoped that the two groups would come to a resolution on their own, however, I had to intervene when Jimmy came to me.

055 Jimmy - “Ms. Kraus, Steve won’t work with us.”

057 Ms. Kraus - “What do you mean, Jimmy?”

059 Jimmy - “We’re ready to finish and they’re not.”

061 Ms. Kraus - “Steve, may I please see you and your group.” (Steve and his group move to the study group’s work area) “What is the issue here?”

065 Steve - “We’re not ready yet and Jimmy demanded that we work with them. We don’t even have our last machine yet!”

067 Ms. Kraus - “Jimmy, I thought that teamwork was a part of working as a group? I thought we talked about this at the beginning of the unit?”

069 Jimmy - “I know. I’m sorry, Ms. Kraus.”

071 Ms. Kraus - “Teamwork is one of the characteristics we all agreed that was something needed in order to be a successful group. Do you think that we need to teamwork with other groups in this class and not just our own?”

073 Jimmy - “Yea. I’m sorry, Steve.”

At this point, I tried to reinforce one of the characteristics, teamwork, that the students established in the Group Pledge. By doing this, I wanted Jimmy to realize that he needed to be mindful of being a good team player with other groups besides his own. As the conversation continued, Jimmy stepped back and reflected.
Ms. Kraus - "Steve, does your group have your first machine in place?"

Cait - "Yes we do and I'm building it."

Ms. Kraus - "Then we can work to match them together to transfer the energy in the right place for both."

Steve - "We have an inclined plane that's nine inches tall."

Tiffanie - "That won't work with ours. Our inclined plane gives energy at five inches. You have to change yours."

Tom - "Why do we have to change ours? Change yours!"

Ms. Kraus - "Let's take a look at both together."

Jimmy - "Can I see that drawing Steve?" (Steve hands his drawing to Jimmy and Jimmy places the drawing next to his groups' drawing. He and Vince examine the two drawings.)

Jimmy's statement and action in Line 089 illustrate his reflection on teamwork. First, he used language that is not offensive or demanding to Steve. Steve complied with the request without and further harsh words or actions toward Jimmy. Second, Jimmy placed the drawing between Vince and himself so that he and Vince could look at the drawing together. This showed that he realized the importance of his own group and that they could solve problems together. Finally, Jimmy stepped back into the discussion after hearing the group members from both groups disagreeing again. He realized that, as facilitator, he needed to take the lead to move through the negotiations.

Vince volunteered his idea after looking at the two drawings together.
Vince - "What if you add a pulley before your inclined plane so that you can connect the other end of the string to the top of the inclined plane to move another marble. That way you don't have to change anything."

Ms. Kraus - "Steve, have you used a pulley yet?"

Steve - "No."

Ms. Kraus - "Would you be willing to add this machine to your mechanism?"

Steve - "I guess so. That means that we can connect with board five with our lever and don't have to add another machine right?"

Ms. Kraus - "Sounds like we have a plan here. We have to remember that we have to work together to come up with solutions. When we have more than one person trying to solve a problem, like adding the pulley to Steve's board and looking at things in a different way, negotiations can be easy. But, we can't shut down ideas or get angry with each other because then nothing gets accomplished."

Jimmy - "Okay."

Both groups were satisfied with Vince's solution. Even though this negotiation was more difficult and somewhat heated, compromises were made and the task was completed. While the negotiations and brainstorming took place, there was no need to use each of the roles. Jimmy was assigned to be the facilitator and performed his role well, although, at times not diplomatically. He moved the group through its task by following his role and connecting with the other two groups. Teacher intervention was necessary, however, when Jimmy tried a little too hard to get the task completed. With a brief reminder of what teamwork was and that we all agreed to be good team members, Jimmy took a different posture with Steve and was able to accomplish his
goal of completing the task and keeping the group focused. Jimmy needed processing time and additional modeling by me so that he could practice teamwork skills himself.

When the negotiations were completed, the study group started their second activity. Jimmy directed Tiffanie to get the activity sheet and asked who wanted to start the final drawing. Vince volunteered. While Vince began the final drawing, the other group members completed the activity sheet. Their conversation was respectful and everyone’s ideas were heard. The group was following their roles and was able to complete the activity before the end of the period. Even though Vince was involved with working on the final drawing of their machine, Nicole continually asked him for his input and ideas. She felt that he still needed to be involved in the activity even though he was starting another task for the group.

The group reflection for Day Eight (see Appendix W) shows that the group was aware that they needed to cooperate. Their response to question two was, “Cooperate, work together and listen to each other.” The study group is aware of the difficulties they had with the negotiations with their response, though they were not able to plan any actions in order start being a more effective group. Their response to question four was, “Work harder, pay attention and stay on task.” I would agree with the group that cooperation was an issue on this day, but in the end, with teacher intervention, they were able to negotiate successfully with groups that connected with them and were able to accomplish their goals for the day.

Day Nine

On Day Nine, the groups’ tasks were to make a scale drawing of their machine, grade their own drawing based upon the criteria in the drawing rubric (see Appendix N) and begin the anchor activities (see Appendix O.1 through Appendix O.6). Each member of the group, in a rotating fashion, worked on the drawing while the other group members began anchor activities.
After introducing the anchor activities and modeling what a final drawing should look like, the students broke into their groups and began working. My study group met with some difficulty. They could not remember who held which role the prior class. The following excerpt is from my study group’s discussion of role assignment. From this discussion, it is apparent they had difficulty with assignment of roles as opposed to prior days.

001 Tiffanie - "We have to assign roles first before we start. Jimmy, you can’t be facilitator this time."

003 Jimmy - "I know. I don’t want to do it anyway."

005 Vince - "Remember, Jimmy, we all have to take turns with our roles."

007 Jimmy - "We don’t need roles today anyway."

009 Nicole - "Yes we do, Jimmy. Ms. Kraus said to assign roles so we have to. Besides, we get more done when we do."

011 Jimmy - "Yea, but nobody is in charge today. We just have to draw and do our anchor activities."

013 Tiffanie - "Jimmy, someone has to watch the time to see when we get the chance to draw. We all have to take turns with that too."

In this part of their conversation, the group members have realized that when they use the roles, they get more accomplished, indicated in Line 009 by Nicole’s comment to Jimmy. Despite some disagreement with their task, the study group is using respectful language toward each other. Additionally, Tiffanie’s comment in Line 013 illustrates her awareness of the roles and the responsibility of each.

As part of the unit, each group was responsible for daily group reflections and on Day Nine, the group reflection sheet changed. This changed form would be used for the remainder of
the unit. Originally, I used Towns’ (1998) group processing questions verbatim for my group reflections. The series of questions outlined by Towns (1998) were:

1. “To operate as an effective team, we need to do the following things:
2. To operate as a more effective team, we need to start doing the following things:
3. To operate as a more effective team, we need to stop doing the following things:
4. To carry out these actions, here are the steps that we are going to take to address the first three statements.” (Towns, 1998)

Towns (1998) points out that this data can show two different things. First, the teacher checks to make sure the students are functioning effectively in the group. If not, action can be taken early on to correct any major problems. Second, the four statements allow the students to reflect on and discuss what things they are doing well and see what they need to improve upon to function more effectively. The questions developed by Towns (1998) were used for four class periods of group reflections. After reviewing the students’ responses in the first four group reflections, I decided that the wording needed to be changed so that the students could grasp some of the concepts about group reflections more easily. Developmentally, I didn’t feel as though the students were responding in the group reflections to their fullest capability. The questions were changed to:

1. These are the things that our group did well today:
2. These are the things that our group did not do well today:
3. These are the things our group has perfected as a group:
4. These are the things that we still need to work on:
5. This is how we are going to solve our problems within our group and become a more efficient group:
Even though the language changed from Towns' (1998) original questions, the concepts remain the same. The language was clearer for the students to understand. The students were also having difficulty remembering who held which role the previous class. By adding this single component, at the top of the reflection sheet, the students, including my study group, were able to easily assign roles without difficulty. The students were aware that each role could not be repeated from class to class, therefore, after the change, they could keep track on their own.

I observed the study group assigning roles and moving into the task for the day. Jimmy was the materials handler and quickly moved to get all of the supplies needed for the work period. Tiffanie, as facilitator, asked Vince to get anchor activities for the group. She also asked Vince to be the scribe and asked Nicole to be the monitor. Tiffanie went on to ask, “Vince, since you started the drawing last class, do you want to be the first to draw today?” At this point, the group has complete understanding of what the group roles are and how to implement them in a rotating fashion. While Vince began to draw, Nicole made the following statement:

021 Nicole - “Yo, how about if we take seven minutes each on the drawing so that we can all have a chance? I can keep time.”

023 Jimmy - “I’m not that good at drawing. Someone can take my turn.”

025 Nicole - “Jimmy, we all have to take turns on the drawing. Vince is the best at drawing, maybe you guys can work together.”

029 Vince - “Sure, I can help.”

031 Jimmy - “Can I start with you now so that I can see how you are doing it?”

033 Vince - “Okay.”

This conversation illustrates three group dynamics. First, the group has taken mutual interest in their goals. Nicole, in Line 021, has divided up the time in the period so that each
person can contribute to the drawing. Second, Nicole understood her role of monitor and can practice these skills. Her suggestion, in Line 025, of Vince helping Jimmy with the drawing shows that she realizes that Vince is the expert in drawing and he can share his skills with Jimmy. This will move the whole group toward the goal of completing the drawing. Finally, the group is interconnected. They worked within the group in order to solve a problem without asking for outside assistance.

The study group had a “breakthrough” on Day Nine and this is apparent in their group reflection for the day (see Appendix X). Their response to question one was, “Stay on task. (Finally).” This breakthrough is further supported by their response to questions four and five. Responding to question four, the group wrote, “Communicate better.” Although this seemed to be an ongoing issue with the group, their response to question five in this group reflection helps to solve their problem, “We will have the monitor invite more people.” The study group relied upon their understanding of the role of monitor and used this understanding to take a step to solve their problem of communicating better. Furthermore, making the language of the questions easier to understand helped the group to make a plan for the following work period.

Day Ten

On Day Ten, the groups’ tasks were an extension of Day Nine’s activities; complete the drawing of their machine, grade their own drawing based upon the criteria in the drawing rubric and continue the anchor activities (see Appendix O.1 through Appendix O.6). Each member of the group, in a rotating fashion, worked on the drawing while the other group members continued anchor activities.

Two members of my study group were absent from school on Day Ten, Tiffanie and Jimmy. Without reminding, Vince and Nicole divided the roles between themselves, each taking
on two roles for the day. I found it interesting that Vince was facilitator and Nicole was monitor. This is interesting because, as previously discussed, these roles act as “captain” and “co-captain” and the students recognized this. They decided, “Not just one person should have both roles.”

In their dialogue, Vince took the lead by setting the goals for the day. He is also aware that one goal cannot be accomplished for the day, grading the drawing.

015 Vince - “Ms. Kraus wants us to finish the drawing today and grade it using the rubric. I don’t think that we should though.”

019 Nicole - “Why not? I think that we can finish it today.”

021 Vince - “Yes, but Tiffanie and Jimmy need to grade the drawing with us and they’re not here today.”

025 Nicole - “You’re right. Ms. Kraus, can you help us?” (I walk to the group). “We will finish our drawing today but Jimmy and Tiffanie are not here to grade it with us. Can we wait until next class to grade our drawing?”

031 Ms. Kraus - “Not a problem. Let’s make a note in your folder.”

This excerpt further illustrates that the group has bonded as a unit. Nicole and Vince want Tiffanie and Jimmy to be a part of the decision making process when grading their drawing. Vince points out this out in Line 021 and Nicole, in the next passage, confirms the importance of having all members present to complete this task. By asking me to step into the conversation, Line 027, Nicole brings this to my attention and asks for additional time to complete the task when the whole group is present.

The group reflection (see Appendix Y) for Day Ten shows that both students took on two roles for the day. Their response of, “As of today, staying on task was perfected,” to question three shows that the group has mastered this skill. However, in analyzing their response to
question four, "Cooperating as a group," I became confused. I observed the group assigning and following roles, working toward and accomplishing the goal of completing the drawing and, when not drawing, working on the anchor activities. Their dialogue was respectful and sounded as though they were cooperating. Reading their response to question five, "We’ll make even more effort to follow through on our goals as a group," brings me to the conclusion that the two students felt that, perhaps, because of the absence of two group members they couldn’t complete one of the tasks for the day and they needed to work harder.

Summary

Looking back at the data and the unit as a whole, I find parallels with current research on collaborative learning and my own study group. First, cooperative efforts begin when group members commit themselves to a mutual purpose and coordinate and integrate their efforts to achieve their goals. Countless Johnson and Johnson studies and research show that this can be accomplished through the assignment of roles. These roles create positive role interdependence when each member is assigned complementary and interconnected roles that specify responsibilities that the group needs in order to complete a joint task. When students have a clear understanding of what the roles are and what is required of them, they use their skills in order to accomplish their goals. I saw my study group do just that. In spite of some difficulties at times, the study group used the roles to their advantage in order to accomplish their daily and overall goals for this unit.

Second, when students define individual group members’ responsibilities to the group and to each group member, each individual is accountable for their own actions in the group. By helping the students to define the acceptable behavior and how the group members deal with
each other in order to get work done, again, they know how to hold themselves and each other accountable for the group’s goals. Having the students create the list of acceptable behaviors, they become stakeholders. When students take ownership in what they do, as opposed to a teacher-generated list of behaviors, a document, such as a “Group Pledge” becomes much more valuable tool for everyone to use.

Third, in the article entitled “Students benefit from collaborative learning in the classroom” (T.H.E. Journal, 2000), emphasis is placed upon the fact that collaborative learning skills are not intuitive and must be taught. These collaborative learning skills can be taught through group dynamics and small group communication activities. By using the activities in The Cooperative Learning Companion, Ideas, Activities and Aids for Middle Grades, my study group were able to change their own behaviors in order to accomplish their mutual goals. Each student in the study group had equity in the group and was responsible for the mutual goals of the group. Frequently, the study group participants stopped and remembered their group dynamic activities when addressing each other and made corrections.

Discussion

In this section, I will discuss my thoughts of the research project, draw conclusions and make suggestions for the future.

My Thoughts

This wasn’t easy. Looking at the big picture, my first year of teaching and this project, I would make some changes. First, I would sequence these group dynamic skills activities in the beginning of the school year. Learning these skills was beneficial for the students in the final quarter of the year but would have been even more beneficial to student learning if the cooperative learning skills took place at the beginning of the academic year. The entire 7th grade
student body, especially my study group, benefited from these lessons and I saw a giant leap in their level of performance both curriculum wise and in small group interactions. The extremes in the study group illustrate this leap in performance and interaction. Their breakthroughs on Day Nine, illustrated in their group reflection, showed me that even though they were, in some cases, on opposite ends of the performance/behavior/achievement scale, they could come together to accomplish anything set before them. Wow! They used the concept of group roles in order to accomplish all of their goals. Even when, on Day Nine, they didn't think they needed to follow roles, they, as a group, saw the importance of using the roles to accomplish the goals for the day.

Second, the focus of this study took place in very brief period of time, just ten observation and data collection days. I found success during the study period and especially in the unit as a whole. The simple machine unit ran smoother than any other unit I taught for the year. Each student took what they learned at the beginning of the unit: group roles, expressing feelings, communicating without criticizing and responsibility, into the hands-on part of the unit. It was worth the additional time it took to teach group dynamic and small group communication skills to the students. Because of this extra time and effort, I didn't have to spend extra time "putting out little fires" along the way during the unit. During this unit, not one student approached me with the issues that arose from our first project: little communication outside of the technology classroom or some students doing all of the work while their partner(s) did none. Each student took responsibility for themselves and the group and was accountable for their own actions. They worked together to accomplish mutual goals and tasks. In the end, beyond the drawing stage, each class was able to place their boards and machines together to transfer energy accomplishing the decided task.
Third, successful negotiations were achieved more easily than in my previous experience. I originally taught this unit, without directed lessons in group dynamics and small group communications, as a student teacher. I found that negotiations could be very difficult because some groups didn’t want to change or adjust their drawings or actual machines. This held true in my own classroom. Some groups were able to negotiate and compromise very well whereas others were not. The groups that were successful relied upon the communication skills learned in the small group activities: Criticizing ideas, not people and Expressing Feelings. These activities made my students aware of their own actions and language and how they can be translated or perceived by others. Across the board, I found that my 7th grade students were more respectful toward each other than they were at the beginning of the school year. In the future, I would like to build upon these ideas and teach additional skills to my students.

Fourth, implementing group reflections and group roles allowed the students to grow as group members. They were able to look at their own performance, as well as the group’s performance, for the day and work to improve upon it. The students were able to, on paper, list steps they could do in order to become more efficient as a group. Each student knew what their responsibility was by knowing their role for the day. This achievement was illustrated best when I was out of the building at a conference and had a substitute teacher for the day. The substitute commented that, “I really didn’t need to be here for third or fourth period today. Your students knew exactly what to do and how to do it without any direction. I only told them when it was time to clean up. They are great! What a pleasure!” Without this prior instruction, the days that I was out would not have been as successful.

Finally, my study group surprised me in many ways. I would have to say that Jimmy was the biggest surprise. His development from the beginning of the year to the end of the year can
be described as remarkable. His growth within the simple machine unit was exemplary. Originally, I would have described him as a “slacker,” however; his performance and behaviors in this unit changed my opinion of him. Through the influence of the directed instruction and his group members, Jimmy became an active, responsible member of the study group. He took responsibility for himself as well as for the group and worked hard so that his group would be successful. Although his performance during negotiations didn’t run as smooth as I would have liked, he took his role of facilitator seriously and made it possible for his group to compromise with neighboring groups in order to accomplish a goal. With gentle reminders, Jimmy’s language changed as well. He realized that harsh tones wouldn’t help but would hinder his group’s progress, so he changed to a more respectful language when talking to his peers. Jimmy’s biggest area of growth was in the area of responsibility. He took an active role in the project and was not a hindrance to his group in this activity.

At the beginning of the study, I would have thought that Vince would be the quietest member of the study group. He proved me wrong. Vince very vocal and was the first person to step in when the group was having a problem or needed an idea to carry the group to another level. He built his communication skills by questioning his group members drawing them to high level of thinking. He guided the group with his creative way of thinking without becoming the outright leader of the group.

Nicole was a surprise in that she was the most concerned with the tasks and the goals for the day. I would have to say that if I had to choose an unnamed “leader” for the group, it would be Nicole. She worked hard to follow the roles that were assigned to her but took the lead when another member was not following their role. Nicole’s area of growth came in the area of
focusing on the task at hand. She was much less concerned with being social, as I originally observed, than she was with the goals for the group and accomplishing those goals.

Tiffanie surprised me the least out of all of the members of my study group. Her energy and enthusiasm guided the group throughout the unit. She thrived when she was the facilitator and took the role very seriously. Her growth within this unit came in the area of communication and listening. Tiffanie was the first to remind the study group members of our skills activities when they were using inappropriate language to each other and corrected them.

Conclusion

This study proved to me, even more than before, that students need direct instruction in group dynamics and small group communication in order for collaborative learning to be successful. Students do not have the skills to be able to function in group settings because these skills are not intuitive. Teaching group dynamic skills in communication (Expressing Feelings and Criticizing ideas, not people), accountability (Group Pledge), higher level thinking (group reflections) and by assignment of group roles, only then can cooperative efforts begin. These roles create positive role interdependence when each member is assigned complementary and interconnected roles that specify responsibilities that the group needs in order to complete a joint task. Students can themselves to a mutual purpose and coordinate and integrate their efforts to achieve their goals. Once students actually know how to work together the will do so.

Future Consideration

Several studies pointed out that when students are taught group dynamic small group communication skills, group dynamic and communication skills are retained by students and do
not need to be reemphasized. Further, students who have learned skills in group dynamics and small group communication retain these skills and take them into their professional lives beyond their formal education. It will be interesting to see how well my 7th graders will retain their group dynamic skills as they become 8th graders next year or will I have to revisit these skills at the beginning of the next academic year?
Appendix A

Example of board placements, transfer of energy and task for study group's class.

Task: ring a bell
Appendix B

Sequencing of days and activities for the study.

Day 1: Expert Survey, group roles discussion and introduction, brainstorm – What are simple machines?

Day 2: Group member announcement from survey results, “What makes a good group?” activity (individual, within group), group poster with top 5 characteristics that each group decides on, creation of group name, introduction of group reflection sheet, (tape study group)

Day 3: Completion of group pledge, “Criticizing ideas, not people” group activity, share ideas as whole group, group reflection, (tape study group)

Day 4: Rube Goldberg history, Rube Goldberg cartoon examples, Rube Goldberg project sheet, notes on levers (teacher directed)

Day 5: Lever notes, Lever activity (individual), Pulley, Wheel and Axle, Incline Plane, Wedge, Screw notes (teacher directed)

Day 6: Complete notes, board placements, brainstorm ideas for task to complete (whole group), Rube Goldberg cartoon activity (individual, homework)

Day 7: Mini-quiz on group roles, Rube Goldberg homework review (turned in for a grade), eliminate impossible ideas, decide upon task, initial brainstorming within groups on how machines can fit together, group reflection

Day 8: Group activity – “Expressing Feelings”, move into thumbnail sketches, groups meet with neighboring group to confirm/ negotiate transfer of energy, group reflection, (tape study group)
Day 9: Introduction of anchor activities on each simple machine (completed by each individual), thumbnails into final drawing (to scale), new group reflections, (tape study group)

Day 10: Final drawings are due, anchor activities, group reflections, (tape study group)
Appendix C

Example of the Expert Survey

Rate Your Expertise

<table>
<thead>
<tr>
<th>Skill</th>
<th>Writer (stories/essay)</th>
<th>Builder</th>
<th>Leader</th>
<th>Note Taker</th>
<th>Talker</th>
<th>Planner</th>
<th>Teammate</th>
<th>Clean-up</th>
<th>Manager</th>
<th>Brainstormer</th>
<th>Creative</th>
<th>Thinker</th>
<th>Problem Solver</th>
<th>Speaker (group rep)</th>
<th>Computers</th>
<th>Drawing</th>
<th>Measuring</th>
<th>Researcher</th>
<th>Journal</th>
<th>Listening</th>
<th>Encourager</th>
<th>Explainer</th>
<th>Constructive Criticism</th>
</tr>
</thead>
</table>
| Expert | Very Good | Good | Fair | So-So | No Way | Very Good | Good | Fair | So-So | No Way | Very Good | Good | Fair | So-So | No Way | Very Good | Good | Fair | So-So | No Way | Very Good | Good | Fair | So-So | No Way | Very Good | Good | Fair | So-So | No Way | Very Good | Good | Fa...
Appendix D

Group Role Sheet

During this unit, you will be asked to follow the following roles during any group activity we do in class. These roles are important and each of you will have an opportunity to become an expert at each role during the Rube Goldberg Unit. These roles will rotate for each class. You will have the opportunity to practice each role once every four classes. If a person is absent, the remaining group members will split the role of the individual who is missing for that day.

1. **Facilitator**: this student will be the leader and will delegate responsibilities for the whole group. The facilitator will be the one who keeps the group on task and working toward its goals for the period.

2. **Scribe**: this student will be responsible for any note taking and note sharing among the members of the group. They will also be responsible for picking up any handouts for the whole group and distributing them to each member. This student will also be responsible for turning in the group's daily journal sheet to the teacher.

3. **Monitor**: part of this student's job is to see that ideas and not people are criticized. This student will also work to make sure that all members are participating and invite any silent members to participate. They will also be responsible to alert the group when they are getting off task and to get focused on the goals of the day.

4. **Materials Handler**: this student is responsible for getting any tools or materials that the group needs, keeps track of them and puts them away at the end of the work period. This person can also ask for help within the group if a lot of materials are needed for a specific goal for the day.
Appendix F

Example of group dynamics activity, “Criticizing ideas, not people.”

Technology 7
Activity 1: Criticizing Ideas, Not People

We have been discussing the characteristics of a good group and how we function within our groups. In this activity, we will practice the skill of Criticizing Ideas, Not People. Below you will find some statements that are not constructive criticism. Your group’s responsibility is to make two (2) ways to constructively make each remark without criticizing a person.

<table>
<thead>
<tr>
<th>Constructive Criticism</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Looks Like</strong></td>
</tr>
<tr>
<td>Pointing to a particular answer on a worksheet.</td>
</tr>
<tr>
<td>Looking to find the answer in the textbook.</td>
</tr>
<tr>
<td><strong>Remark Example:</strong></td>
</tr>
<tr>
<td>“No, stupid! That’s not right.”</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Group Exercise

Remarks: Your Group’s Responses:

Shut up!

1. Can you please be quiet?

2. We aren’t supposed to be talking right now... please be quiet.

How stupid can you get?

1. That’s good, but I’m not sure it’s correct.

2. That’s not the best idea. Let’s try again on a few different ways.
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Response 1</th>
<th>Response 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give me the worksheet before you mess up.</td>
<td>Let me help you with the worksheet.</td>
<td>I'll do the worksheet for you, okay?</td>
</tr>
<tr>
<td>You are going to make us get an “F”.</td>
<td>Let's work a little harder on this, okay?</td>
<td>Try a little harder to work, please?</td>
</tr>
<tr>
<td>You don't know how to do anything.</td>
<td>Do you need a little help working on that?</td>
<td>Here! Let me help you on this.</td>
</tr>
<tr>
<td>You don't know anything.</td>
<td>You probably need help on this, may I?</td>
<td>Let me help you.</td>
</tr>
<tr>
<td>You always mess up.</td>
<td>Maybe you could try to be a little more careful.</td>
<td>Try to be more neat, please.</td>
</tr>
<tr>
<td>Don't listen to his/her crazy idea.</td>
<td>That is a nice idea, but it's not what we're looking for.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix G

Rube Goldberg Biography

Rube Goldberg, (1883-1970), was a Pulitzer Prize winning cartoonist, sculptor, and author.

Reuben Lucius Goldberg (Rube Goldberg) was born in San Francisco. His father, a practical man, insisted he go to college to become an engineer. After graduating from University of California, Rube went to work as an engineer with the City of San Francisco Water and Sewers Department.

He continued drawing, and after six months convinced his father that he had to work as an artist. He soon got a job as an office boy in the sports department of a San Francisco newspaper. He kept submitting drawings and cartoons to his editor, and finally was published. An outstanding success, he moved from San Francisco to New York drawing daily cartoons for the Evening Mail.

Through his 'inventions', Rube Goldberg discovered harder ways to achieve easy results. His cartoons were as he said, symbols of man's capacity for exerting maximum effort to accomplish minimal results. Rube believed that there are two ways to do things, the simple and the hard way, and that a surprisingly number of people preferred doing things the hard way.

Rube Goldberg's work will endure because he gave priority to simple human needs and treasured basic human values. He was sometimes skeptical about technology, which contributed to making his own mechanical inventions primitive and full of human, plant and animal parts. While most machines work to make difficult tasks simple, his inventions made simple tasks amazingly complex. Dozens of arms, wheels, gears, handles, cups, and rods were put in motion: by balls, canary cages, pails, boots, bathtubs, paddles and live animals for the simple tasks of squeezing an orange for juice, or closing a window if it should start to rain before one gets home.

Goldberg's drawings of absurdly-connected machines accomplishing by extremely complex, roundabout means what seemingly could be done simply has meant that his name
RUBE GOLDBERG has become associated with any convoluted solution to perform a simple task.

Rube's inventions are a unique commentary on life's complexities. They provide a humorous diversion into the absurd that lampoons the wonders of technology. Rube's hilarious send-ups of man's ingenuity strike a deep and lasting chord with today's audience caught in a high-tech revolution but seeking simplicity.

Hardly a day goes by without The New York Times, National Public Radio, The Wall Street Journal some other major media player invoking the name Rube Goldberg to describe a wildly complex program, system or set of rules such as our "Rube Goldberg-like tax system" The annual National Rube Goldberg Machine Contest, at Purdue University and covered widely by the national media, brings Rube's comic inventions to life for millions of fans.

The work of Rube Goldberg connects with both an adult audience well versed in the promise and pitfalls of modern technology (can anyone over 40 program their VCR?) and younger fans intrigued by the creativity and possibility of invention.

RUBE GOLDBERG is ™ and © 2001 Rube Goldberg Inc.
Picture Snapping Machine

As you sit on pneumatic cushion (A), you force air through a tube (B) which starts ice boat (C), causing lighted cigar butt (D) to explode balloon (E). Dictator (F), hearing loud report, thinks he's been shot and falls over backward on bulb (G), snapping picture!

RUBE GOLDBERG is ™ and © 2001 Rube Goldberg Inc.
Rube Goldberg stands in front of an x-ray and sees an idea inside his head showing how to keep shop windows clean.

Passing man (A) slips on banana peel (B) causing him to fall on rake (C). As handle of rake rises it throws horseshoe (D) onto rope (E) which sags, thereby tilting sprinkling can (F). Water (G) saturates mop (H). Pickle terrier (I) thinks it is raining, gets up to run into house and upsets sign (J) throwing it against non-tipping cigar ash receiver (K) which causes it to swing back and forth and swish the mop against window pane, wiping it clean.

If man breaks his neck by fall move away before cop arrives.

RUBE GOLDBERG is ™ and © 2001 Rube Goldberg Inc.
Appendix I

Rube Goldberg Project Sheet

Pittsford School District

Name ____________________________
Partner’s Name: ___________________
Partner’s Name: ___________________
Section: _______ Handout #: _______
Date: _______ Period: _______

“Rube Goldberg Activity”

Purpose:
- Work in groups (small 3-4) (large – whole class)
- Problem solve
- Design, drawing, and construction
- Communication – among group members – between groups
- Troubleshooting
- Understand energy transfer
- Incorporate 4 simple machines into the solution

Problem:
As you know, Rube Goldberg was a prize winning cartoonist, sculptor, and author who made wacky cartoons of inventions which went through a complex procedure to accomplish an otherwise simple task. As a class, you will decide on a simple task for your machine to accomplish. The class will then be divided into groups of 3 or 4, with each group being responsible for designing and building a piece of the machine. Through continuous communication of the groups, each piece of the machine will fit together and allow energy to be transferred from the beginning to the end without interruption, ultimately causing the machine to perform a simple task.

Restate the problem in your own words:

(On the back)
Appendix J

Simple Machine Notes – Levers

Science of Technology

Name: ______________________

Class: ____________

Simple Machine Notes

Motion: The change of position or place

Force: Strength or energy that causes motion or change

Work: The use of force to create movement

LEVERS

Parts of the Lever:

1. Fulcrum

2. Load

3. Effort

Class 1 Lever: The fulcrum is in between the effort and load.

Examples:

Class 2 Lever: The fulcrum is at one end of the lever and the effort is at the other end. The load falls in between them both.

Examples:
Class 3 Lever: The fulcrum is at one end of the lever and load is at the other end. The effort is in between them both.

Examples:
Appendix K

Simple Machine Notes – Continued

Name

Section

Handout #

Date

Period

Simple Machine Notes Cont.

Without looking at your notes define:

Load:

Effort:

Wheel and Axle:

Examples:

Inclined Plane:

Examples:

Wedge:

Examples:
Screw:

Examples:

Single Pulley:

Examples:

Double Pulley:

Examples:
Appendix L

Rube Goldberg Homework Activity

Inventing Rube Goldberg Style

Use any six action components to create an imaginative Rube Goldberg style sequential design invention for these ideas:

Automatic Fanning Machine For Hot Days
Bedroom Burglar Alarm
Remote Control TV Channel Changer
Around the Block Dog Walker
Garbage Disposal Device
Your Own Invention Idea

A Better Mousetrap

Mouse comes out of hiding for submarine sandwich (bait) left on counter. Mouse follows line of bread crumbs. Mouse walks into path of fan and is blown across counter... into false teeth. Teeth clamp shut to hold mouse... also pulling a string... which tilts water can to drown mouse.
Appendix M

Small group communication skills activity – “Expressing Feelings”

EXPRESSING FEELINGS—PRACTICE

Name __________________________

Read the following situation descriptions. Put yourself in the main character’s place. What would you think? How would you feel? What action would you take?

Situation #1
Susie is in your new cooperative group. She is very quiet. If she speaks, it is only a whisper. The other people in the group are beginning to ignore her.

What do you think about Susie? __________________________________________

How would you feel if you were Susie? ____________________________________

What action could you take to help Susie? _________________________________

Situation #2
James is such a pain. He acts angry all the time. He makes fun of everybody in the group. He won’t do his share of the work. Now everybody else in the group is beginning to argue all the time.

What do you think about James? __________________________________________

How would you feel if you were James? ____________________________________

What action could you take to help James? _________________________________

Situation #3
Sean thinks he is so smart. He calls everybody “stupid.” He won’t listen to anyone. He won’t explain his answers. He thinks he is a genius.

What do you think about Sean? __________________________________________

How would you feel if you were Sean? ____________________________________

What action could you take to help Sean? _________________________________


46
# "Rube Goldberg" Drawing Rubric

<table>
<thead>
<tr>
<th>Actual Size of Drawing</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
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<tr>
<td>-Excellent Representation -All parts are very close to actual size -Obvious attention to detail</td>
<td>-Excellent representation -Most parts appear actual size -Good attention to detail</td>
<td>-Fair representation 50% of the parts appear actual size -Fair attention to detail</td>
<td>-Poor representation -Drawings are too small to rep. actual size -Little att. To detail</td>
<td>Not Complete</td>
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</tbody>
</table>

| Quality of Drawing | -Excellent quality of drawing -Lines are straight -Circles are round -Parts are labeled | -Good quality of drawing -Some free hand -Obvious use of straight edge but some lines not straight -Some labeling -Lines are a bit light | -Fair quality of drawing -Much free hand but lines are straight -Some use of drawing aids but much freehand -Little labeling -Most lines too light | -Poor quality of drawing -All freehand -No use of drawing aids -No labeling -All lines difficult to recognize |

| Communication Of Design | -Excellent communication -No questions as to how the device works -Solid workable solution -All detail explained fully | -Good communication -Some minor questions as to how it works -Good solution with some potential problems -Some minor details questionable | -Fair communication -Some serious questions as to how it works -Fair solution with one or more major problems -At least 1 major detail questionable | -Poor communication -Many serious questions as to how it works -Many missing details -Difficult or impossible solution -Poor likelihood of it actually working | Not Complete |


Appendix 0.1

Anchor Activity – Levers
Appendix O.2

Anchor Activity – Pulley

Name

Pulleys

A pulley is a simple machine made up of a chain or rope wrapped around a wheel.

A fixed pulley is a pulley attached to a support. This type of pulley does not decrease the amount of effort needed to do work. It simply changes the direction of the force and allows a worker to add his or her own weight to the effort.

A movable pulley, on the other hand, decreases the amount of force needed to do work. On a movable pulley, the load hangs from the pulley. One end of the rope is attached to a support above the load. A worker pulls the other end of the rope in the direction he or she wants the load to move. Since the rope will carry half the load's weight, the worker will only need to apply a force that is half the weight of the load.

1. Imagine that you want to lift a bale of hay off the ground. Without machines, you would simply have to use your strength to lift it. Explain how using a fixed pulley would change the direction of the force you would use and help you do the job more easily.

2. How is the design of a fixed pulley different from the design of a movable pulley?

3. How are the effects of a fixed pulley different from the effects of a movable pulley?

Write how much force is needed to lift the objects in the pictures below.

4.  

Force = _____________

5.  

Force = _____________

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PHYSICAL SCIENCE
Appendix O.3

Anchor Activity – Wheel and Axle

Name

Wheels and Axles

A wheel and axle is a simple machine used to lift loads. It is made up of two circles. The larger circle is the wheel. The smaller circle is the axle. Together the two circles multiply force to make work easier.

The wheels on a car are turned by an axle. Think about how difficult it would be to pull a car without wheels across the ground. Imagine the friction you would have to work against! Wheels would make the job much easier.

A gear is a wheel with teeth around its edge. The teeth of a gear always fit between the teeth of another gear. One gear is attached to an axle that is forced to turn by some kind of power. As the gear turns, its teeth force the second gear and its axle to turn in the opposite direction. In a pair of gears, one gear is always smaller than the other and has fewer teeth.

Gears make things work more quickly or more slowly. If a large gear turns a small gear, the speed increases. If a small gear turns a large gear, the speed decreases.

1. When one gear turns another, do both gears turn in the same direction?

To determine how much speed will change because of gears, divide the number of teeth on one gear by the number of teeth on the other gear. For example, imagine a large gear with 50 teeth turning a small gear that has 25 teeth. Since 50 ÷ 25 = 2, the speed will increase by 2, or double. If the small gear turns the large one, the speed will decrease by half because 25 ÷ 50 = .5 or $\frac{1}{2}$.

Study the gears below to fill in the blanks.

2. These gears could increase speed by

3. These gears could decrease speed by
Appendix 0.4

Anchor Activity – Inclined Plane

Name

Inclined Planes

An inclined plane is a simple machine with a smooth, slanted surface. A ramp is a good example of an inclined plane. Inclined planes decrease the amount of force needed to raise a heavy load. It is easier to push a heavy object up an inclined plane than it is to lift the object to the same height.

There is a simple formula for figuring out how much force is needed to move a load up a ramp (when friction is ignored). Multiply the weight of the load by the height it needs to be raised. Then divide that number by the length of the ramp (the distance the load will be moved).

\[ \text{force} = \frac{\text{load} \times \text{height}}{\text{distance}} \]

The steeper the slope of an inclined plane, the harder it is to move a load on it. This means that as the length of a ramp increases, the force needed to move a load on the ramp decreases.

\[ \frac{100 \text{ lbs.} \times 5 \text{ ft.}}{10 \text{ ft.}} = 50 \text{ pounds of force} \]
\[ \frac{100 \text{ lbs.} \times 5 \text{ ft.}}{15 \text{ ft.}} = 33.3 \text{ pounds of force} \]

1. The Egyptian pyramids were built of huge blocks of stone that each weighed thousands of pounds. Historians believe that the ancient Egyptians created ramps in order to construct the pyramids. Explain how using inclined planes would have made the workers' job easier.

Use the formula above to determine the force needed to move the following loads up the ramps.

<table>
<thead>
<tr>
<th>Force Needed</th>
<th>Load</th>
<th>Height</th>
<th>Distance (ramp length)</th>
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<tbody>
<tr>
<td>3.</td>
<td>200 lbs.</td>
<td>25 feet</td>
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<td>4.</td>
<td>500 lbs.</td>
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<td>5.</td>
<td>2,000 lbs</td>
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<td>100 feet</td>
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Wedges

A wedge is a piece of metal or wood that has one or more inclined planes. Wedges can be used for two purposes. Sometimes they are forced under the edge of a heavy load in order to lift it slightly. At other times, wedges are driven into a material in order to force the two side surfaces apart or to pierce the material. When wedges are used to split material in this way, a hammer or mallet is often used to force the wedge into the material. Whichever way a wedge is used, the smaller the angle of its sharp end is, the less force will be needed to move it forward.

1. Circle the items listed below that can be considered a type of wedge.
   axe  wheel  wrench  chisel
   hammer  knife  nail  sandpaper

2. Circle the wedge below that would require less force to use. Explain why.

   A   B

3. Describe a situation when you might use a wedge.

4. Why might the end of a straight pin be considered a wedge?

5. How does the hardness of the material being split or pierced affect the force needed to use a wedge?
Appendix O.6

Anchor Activity – Screw

Name

Screws

A screw combines the usefulness of an inclined plane and a wedge. Screws are designed so that they twist into a surface easily but are difficult to pull out. A screw is driven into a surface with a tool such as a screwdriver or wrench.

A screw is actually an inclined plane wrapped around a pole. Its tip is a type of mini wedge.

The spiral edge that wraps around the pole of a screw is called the thread. The distance between the threads is called pitch. One turn of a screw will force it into a surface a distance equal to the pitch.

To see the part an inclined plane plays in the construction of a screw, complete this activity:

A. Cut out the picture of the inclined plane to the right.

B. Use a pencil to represent the center pole of a screw. Note that the pencil's point is shaped much like the end of a screw.

C. As shown, wrap the inclined plane around the pencil. You will see that the threads on a screw are actually an inclined plane.

Simple Machine Review

Fill in the blanks below to show what you know about simple machines.

1. A simple machine with one or two sloping sides is a _____________.

2. The simple machine that changes the direction of a force but does not reduce the amount of force needed to lift a load is a _____________.

3. A seesaw is an example of a _____________.

4. Jar lids that are twisted on and off are designed like a _____________.

5. A wheel with teeth around its edge is a _____________.

6. The simple machine that can be used to lift a load slightly or to split a material is called a _____________.

7. The greater the slope of an inclined plane, the _____________ it is to move items on it.

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Everyone is good at something. I, for example, am very good at writing stories but I cannot balance my checkbook. Below you will find a survey that will allow me to see what you are good at, what you are fair at and what you are not so good at. This survey will help me to put you into groups for our next unit. Please answer the following for yourself only and not based upon what you might think your friend(s) will say. Be honest with your answers.

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Name the three people you can work with best.

1. __________________  2. __________________  3. __________________

Name the three people you cannot work with best.

1. __________________  2. __________________  3. __________________
Rate Your Expertise

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Name the three people you **can** work with best.

1. **Joe Creek**  
2. **Karen Fisch**  
3. **Eddy Quinn**

Name the three people you **cannot** work with best.

1. **Michael Stell**  
2. **Chris Gamboa**  
3. **Tony Latigan**
Rate Your Expertise

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Name the three people you **can** work with best.

1. **Ashley Maybery**  2. **Khalid Billah**  3. **Tiffanie Brown**

Name the three people you **cannot** work with best.

1. **Mike Still**  2. **Jimmy Johnson**  3. **Chris Guma**
Expert Survey for Study Group – Jimmy

Rate Your Expertise

Everyone is good at something. I, for example, am very good at writing stories but I cannot balance my checkbook. Below you will find a survey that will allow me to see what you are good at, what you are fair at and what you are not so good at. This survey will help me to put you into groups for our next unit. Please answer the following for yourself only and not based upon what you might think your friend(s) will say. Be honest with your answers.

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<th>Very Good</th>
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Name the three people you can work with best.
1. Royce  2. Ashley  3. Casey

Name the three people you cannot work with best.
1. Mike D  2. Mike R  3. Bobby
Appendix Q

Group Reflection – Day Two

Group Journal: Group Name: Sea Monkeys

1. To operate as an effective group, we need to do the following things:
   1. Stay on task
   2. Not fool around.

2. To operate as a more effective group, we need to start doing the following things: listen to Jimmy more why?

3. To operate as an effective group, we need to stop doing the following: puttin each other down remember activity!

4. To carry out these actions, here are the steps we need to take to accomplish 1, 2, 3: we will try to gradually perform this
Appendix R

Group Reflection – Day Three

Group Journal  Group Name: Sea Makers

1. To operate as an effective group, we need to do the following things:
   We need to start accepting ideas & stay on task.

2. To operate as a more effective group, we need to start doing the following things: we need to stay on task more.

3. To operate as an effective group, we need to stop doing the following: talkin' about stuff other than tech.

4. To carry out these actions, here are the steps we need to take to accomplish 1, 2, 3:
   - Follow directions
   - Keep on task
   - Accomplish tasks

Good work today! Be sure to stay on task. Your group can be successful!
Appendix S

Group Reflection – Day Seven

Group Name: Sea Munkys

1. To operate as an effective group, we need to do the following things: work harder and concentrate.

2. To operate as a more effective group, we need to start doing the following things: stop wasting too much.

3. To operate as an effective group, we need to stop doing the following: messing around.

4. To carry out these actions, here are the steps we need to take to accomplish 1, 2, 3:

   - Listen to each other
   - Communicate
Appendix T

Study Group’s Drawing
Appendix U

Study Group's "Expressing Feelings" Activity Sheet

EXPRESSING FEELINGS—PRACTICE

Read the following situation descriptions. Put yourself in the main character's place. What would you think? How would you feel? What action would you take?

Situation #1
Susie is in your new cooperative group. She is very quiet. If she speaks, it is only a whisper. The other people in the group are beginning to ignore her.

What do you think about Susie? I think she is shy.

How would you feel if you were Susie? I would like being ignored.

What action could you take to help Susie? I would try to talk to her.

Situation #2
James is such a pain. He acts angry all the time. He makes fun of everybody in the group. He won't do his share of the work. Now everybody else in the group is beginning to argue all the time.

What do you think about James? I think James would keep his comment to himself.

How would you feel if you were James? I would feel angry.

What action could you take to help James? I'd try to talk to him and compromise.

Situation #3
Sean thinks he is so smart. He calls everybody "stupid." He won't listen to anyone. He won't explain his answers. He thinks he is a genius.

What do you think about Sean? I think Sean is free of himself.

How would you feel if you were Sean? I would feel better than everyone.

What action could you take to help Sean? I would ignore him and his comments. Would this help to make the group stronger?
GROUP PROCESSING—EXPRESSING FEELINGS

When we are working in a cooperative group, these are the things that make us feel happy:

Things we do: help each other

Things we say: saying nice things

When we are in a cooperative group, these are the things that make us uncomfortable and unhappy:

Things we do: make fun of each other

Things we say: put downs
Appendix W

Group Reflection – Day Eight

1. To operate as an effective group, we need to do the following things:

2. To operate as a more effective group, we need to start doing the following:

3. To operate as an effective group, we need to stop doing the following:

4. To carry out these actions, here are the steps we need to take to accomplish 1, 2, 3:

   - Work harder
   - Pay attention
   - Ask: What if...
Appendix X

Group Reflection – Day Nine

Name: Lea Hunter

Facilitator: Kaynine
Scribe: Daniel
Materials Handler: Jifim
Monitor: Nicole

1. These are the things that our group did well today:
   Stay on task (Finally) excellent!

2. These are the things that our group did not do well today:

3. These are the things our group has perfected as a group:
   Drawing Skills + Teamwork

4. These are the things we still need to work on:
   Communication
Appendix Y

Group Reflection – Day Ten

Group Reflections

Name: Seakunyus

1. These are the things that our group did well today: worked well, accomplished our "mission" today, stayed on task.

2. These are the things that our group did not do well today: everything went pretty well today.

3. These are the things our group has perfected as a group: As of today, staying on task was perfected.

4. These are the things we still need to work on: cooperating as a group.


