Comparing Individualized Instruction in the Form of a Differentiated Jigsaw to Cooperative Learning in the Mathematics Classroom

Jessica Corrine Roth
The College at Brockport

Follow this and additional works at: http://digitalcommons.brockport.edu/ehd_theses
Part of the Education Commons

To learn more about our programs visit: http://www.brockport.edu/ehd/

Repository Citation
Roth, Jessica Corrine, "Comparing Individualized Instruction in the Form of a Differentiated Jigsaw to Cooperative Learning in the Mathematics Classroom" (2010). Education and Human Development Master's Theses. 82.
http://digitalcommons.brockport.edu/ehd_theses/82

This Thesis is brought to you for free and open access by the Education and Human Development at Digital Commons @Brockport. It has been accepted for inclusion in Education and Human Development Master’s Theses by an authorized administrator of Digital Commons @Brockport. For more information, please contact kmyers@brockport.edu.
Comparing Individualized Instruction in the form of a Differentiated Jigsaw to Cooperative Learning in the Mathematics Classroom

by

Jessica Corrine Roth

August 2010

A thesis submitted to the

Department of Education and Human Development of the

State University of New York College at Brockport

In partial fulfillment of the requirements for the degree of

Master of Science in Education
Comparing Individualized Instruction in the form of a Differentiated Jigsaw to Cooperative Learning in the Mathematics Classroom

by

Jessica Corrine Roth

APPROVED BY:

Conrad Van Voert
Advisor 8/2/10

Director, Graduate Programs 8/12/10
Acknowledgements

I would like to thank my family and friends for their support throughout my educational journey. I could not have survived on my own, and I owe a great deal of my success to each and every one of you.

I would like to thank my classmate and lifesaver, Jennifer Hayward, for always being just a phone call away whenever I needed her.

I would like to thank my parents, Bob and Nancy, for their unconditional love and support throughout my life. You are amazing parents and I hope to be as supportive to my future children.

I would also like to thank my fiancé, Ian Duthie, for being continually patient with me while I finish my Master’s Degree.

Lastly, I would like to thank my advisor, Dr. Conrad VanVoorst, for his constant assistance, education, and guidance over the past six years. You are the reason I, and so many others, have continued on at the College at Brockport to pursue our graduate degrees.
Table of Contents

Acknowledgements ........................................................................... i
Table of Contents ........................................................................... ii-iii
Chapter One: Introduction ................................................................ 1
  Problem Statement .................................................................... 1
  Purpose .................................................................................... 2
  Rationale .................................................................................. 3
  Summary .................................................................................. 4
Chapter Two: Literature Review ...................................................... 6
  Why Teachers Create Opportunities for Individualized Instruction ..... 6
  Why Teachers Create Opportunities for Cooperative Learning .......... 8
  The Benefits of Using Individualized Instruction and Cooperative Learning in the Classroom .......................................................... 11
Chapter Three: Methods .................................................................. 18
  Participants ........................................................................... 18
  Materials ............................................................................ 20
  Data Collection ....................................................................... 21
  Data Analysis ......................................................................... 23
  Justification ........................................................................... 23
Chapter Four: Results ..................................................................... 26
  Research Question One ............................................................ 26
  Research Question Two ............................................................ 27
  Themes .................................................................................... 27
  Pros ....................................................................................... 27
  Cons ...................................................................................... 28
  Possibility for Void or Unreliable Results ..................................... 29
  Action Plan ............................................................................ 29
  Recommendations ................................................................... 30
Chapter Five: Discussions and Conclusions ........................................ 32
  Figure One ............................................................................. 37
  Figure Two ............................................................................. 38
  Figure Three ............................................................................ 39
  References .............................................................................. 40
  Appendix A ............................................................................. 42
  Appendix B ............................................................................. 44
  Appendix C ............................................................................. 49
  Appendix D ............................................................................. 52
Chapter One: Introduction

Cooperative learning and differentiation are both tools which can be used to further the education and development of students in any classroom. Whether assigning students into their cooperative learning groups or differentiating students based on ability, students are the ones who benefit from maximizing the amount of knowledge they gain and practicing the social skills they need for everyday life. Since teachers, including myself, like to vary their method of instruction, the study aims at looking at two different types of instruction (Kapp, 2009).

Problem Statement

According to research by Ysseldyke & Tardrew (2007), "School personnel... face the difficult task of meeting the needs of an increasingly diverse population of students, especially in urban environments" (p.2). By using individualized instruction, the educators are able to reach the needs of the students and cater to their personal needs. As mentioned by Rock et. al. (2008), differentiating instruction helps meet the needs of a diverse classroom containing students with different readiness levels, cultural and linguistic backgrounds, and disabilities.
Similarly, Koutselini (2008) states that cooperative learning “results in higher achievement, supportive and committed relationships, greater social competence, and higher self-esteem” (p.35). Her research is supported by many other articles which reiterate the benefits of cooperative learning including the information processing and positive social outcomes. Although both types of instruction are deemed important by educators, we must take a look at the overall benefits in the students’ academic lives, along with their attitudes towards the two types of teaching.

Purpose

The purpose of this study is to compare the similarities and differences between the two types of instruction, focusing on whether one shows a higher level of student success than the other. This study is going to put forth many new ideas in the minds of educators. When planning to incorporate an activity into the curriculum, there are many factors consider. One thing to keep in mind is grouping of students within an assignment. Even in homogeneous groups it is important to remember that competition and competence within the group can result in a threatening learning environment (Buchs & Butera, 2009). It is also important to promote dialogue
within the groups of students, ensuring that they are on-task and working in an environment advantageous to learning (Webb, 2009).

**Rationale**

This study is important to the society of educators because it shows the benefits of using varied types of instruction, keying in on the progress of a select group of students. If we do not research this area of instruction, students may be educated solely by direct instruction or a type of instruction which is not favorable towards their personal learning style. It is also important to give students the opportunity to speak their mind, using an attitude survey (Kapp, 2009). As the research around this area under discussion continues, it will focus on the following:

a. How do cooperative learning and differentiated jigsaws differ in the performance of students?

b. What do students think of the two types of instruction and is there one that best matches with that they think their learning styles might be?

**Definition of Terms**

Individualized instruction is a form of education where the needs of all students are met. Each student has a different pace which they are
comfortable working at, and different learning styles which best benefit them (Gagne et al, 1992). This type of education puts the students in charge of their own education, making sure their personal needs are met. Cooperative learning is a strategy used when students are placed into groups to complete an activity together, achieving a common goal. Throughout the cooperative learning experiences, the students are responsible for helping one another gain an understanding and also promoting a positive learning environment (Kagen, 1994). Students must work through all hitches in their assignment, whether confusion or disagreement, allowing for a sense of academic and social triumph.

Summary

Each student has different needs and those needs should be met in order to ensure maximum success in the classroom. If the teacher has enough support within their school, grade level, and department, the ability to use individualized instruction and cooperative learning can be proven beneficial for both the students and teachers alike. In saying this, I will take a class and incorporate a mini-unit of each differentiated instruction and cooperative learning. The students will be pre- and post-tested on each mini-unit and the
results will be compared, looking further into which activity has a higher level of success.
Chapter Two: Literature Review

*Why Teachers Create Opportunities for Individualized Instruction*

There are many reasons behind the usage of individualized instruction in the classroom. Many studies reveal the benefits of teaching students with their individual learning styles in mind. According to an article by Latz, et al (2009), differentiated instruction is one form of individualized instruction that benefits the students and the teachers alike. The article discussed the student benefits, saying that all students were engaged in the learning and worked at their own comfort levels and pace. In a similar study by Lewis and Batts (2005), teachers who changed their lessons from traditionally teaching students by means of direct instruction to using differentiated instruction raised their proficiency ratings on state-mandated tests from 79% to 94.8% in just five years (as cited in Rock et al, 2008).

Differentiated instruction is a way for students to work individually towards their own level of mastery. Teachers have a tendency to center their lesson on the average student, leaving behind the lower-level children and not challenging those who are higher-achieving (Haager and Klinger, 2005, as cited in Rock et al, 2008). By creating lessons which use differentiation, the students were able to demonstrate their abilities at different times, using their
own pace to learn. This allows student frustration levels to stay at a minimum, and gave teachers the chance to work with students on a personal level.

Differentiated instruction not only allows students to work at an individual pace, but also experience an alternative delivery of the content. According to Bailey and Williams-Black (2008), teachers can adapt the content, activities or the evaluation of the content. This allows the teachers to place an emphasis on exactly what the students should be mastering. Teachers may also change the process or activities used to reinforce the material learned. A common technique includes using the five senses to explore the topic (Bailey and Williams-Black, 2008). This exploration of material can help students with reasoning and higher level thinking. Lastly, differentiating the evaluation of this new material will help students present what they have mastered learning in a way which they are comfortable. For example, some students may perform well on a written examination, while others build a project or add something to a portfolio to showcase their understanding. This self selection builds confidence, success, and understanding of their individual learning styles.
Individualized instruction provides a way for teachers to accommodate to the needs of both gifted students and students with special needs. Latz (2009) states that differentiated instruction allows the students to work at their own pace, leading to a higher level of engagement and less instances of student behavior problems. With a higher level of achievement, Rock et al (2008) reminds the readers that higher engagement will lead to lower dropout and unemployment rates. While it may seem like something minor that educators would incorporate into their lessons, it could have a major impact on society in the near future.

Why Teachers Create Opportunities for Cooperative Learning

Cooperative learning is often misconceived as group work. The two techniques are completely different and provide students with different learning opportunities. For the sake of this study, the focus is on cooperative learning and how it works in the classroom. Much research is based around the five key elements of cooperative learning, as outlined by Gabbin and Wood (2008). These elements include positive interdependence, face-to-face promotive interaction, individual accountability, social skills, and group process. Without these elements, the level of success within a cooperative learning activity will be compromised. It is important to mention and stress
the need for both student and teacher training in cooperative learning activities to ensure success (Corcoran and Silander, Spring 2009). Without student understanding of the processes and teacher understanding of the details, all parties can suffer.

When students work together, they are apt to have a lower anxiety level. Koh, et al (2009) stated that students who work together show a higher level of competence, an increase in their intrinsic motivation, and a higher output of effort. Students who work together in a collaborative atmosphere are able to share ideas and teach one another, all while working towards a common goal. When they work cooperatively, the students were more likely to benefit from constructive feedback and recognition of their individual input (Koh et al, 2009). Corcoran and Silander (Spring 2009) write that group learning has been successful in improving academic achievement, as well as producing higher levels of social tolerance and acceptance among classroom and cultural differences.

Cooperatively learning is beneficial when it is performed apart from any type of competition. In an article published by the European Journal of Psychology of Education, Buchs and Butera (2009) discussed the benefits of students working on complementary information as opposed to identical
information. When students worked on identical information, they were threatened by one another’s responses (Buchs and Butera, 2009). Students who worked on identical information were also more likely to report a negative outcome of their educational experience, which may be due to the lack of one or more of the five essential elements of cooperative learning.

Aside from a positive cooperative learning activity, the students could also benefit by building a student-teacher relationship. During cooperative learning activities, the students contribute to the group members by communicating about the subject. The teacher’s responsibility during this time is to ensure proper communication among group members as well as mediate the conversations and debates of the group members (Webb, 2009). As mentioned in Webb’s article, many teachers play the role of a disciplinarian during cooperative learning activities, but they lack the knowledge on how to build the mathematical discourse within the groups. With the proper training and understanding, the level of communication can be maximized by both the students and the teachers, allowing the activity to be of great success.

Cooperative learning can present itself in many different forms. As outlined by Slavin (1980), one example of a cooperative learning activity
would be in a Team Tournament setting. Here students work together in heterogeneous groups to study and participate in a weekly tournament. The benefits include peer interaction and peer tutoring with different levels of student achievement present within each group. Secondly, Slavin talked about a more common method known as the Jigsaw. This allows the students to split into groups and become experts on their topic. Students then join members from other groups to teach everyone else about their material. This allows students to feel a sense of pride in their subject area and also serve as a peer tutor to others. Lastly, the author talked about Small Group Teaching, which is similar to the Jigsaw. Here the students work together to teach each other the new material. With any of the activities mentioned by Slavin (2009), the students need to use the five essential elements of cooperative learning, namely face-to-face promotive interaction and social skills, to make certain the activity is a success.

*The Benefits of Using Individualized Instruction and Cooperative Learning in the Classroom*

Individualized instruction, known as differentiated instruction, is beneficial to the students because it allows for all students to be challenged at a level which is independently appropriate. In a study performed by Hite
(1996), the students were placed in heterogeneous groups and the study had positive results (as cited by Gabbin and Wood, 2008). There have been various other research studies performed, including that noted in the article by Rock et. al. (2008), that warns educators about the general tendency teaching to the average student within a classroom. Frequently gifted students, students with special needs, or students with a lower ability level are ignored while teachers focus on getting the average student to understand the material. With differentiation, a more individualized instruction is possible and students can be pushed to reach their highest individual potential.

Other important reasoning for the support of differentiation in the classroom includes bridging the readiness gap and overcoming diversities among students (Lapkoff and Li, 2007 and Voltz and Fore, 2006, as cited in Rock, et al 2008). Differentiated instruction can help build the knowledge base for all students, which in turn lowers the dropout rates, unemployment rates and raises the standardized testing scores (Lipsky, 2005 as cited in Rock et al, 2008).

Although it sometimes may seem to be additional work for the teacher in the initial stages, it is beneficial for all parties involved as they are able to
learn from one another. Many teachers avoid activities that deviate from traditional instruction due to the fears of what differentiation may produce, including ill preparedness for standardized tests and unfair workloads among students (Rock et al, 2008). Latz, et al (2009) mentioned that the amount of work done by teachers in preparation for an individualized lesson is different more so than more difficult. These lessons take on a more self-directed approach, centering the learning on each individual’s aptitude.

Students benefit from differentiation because it allows them to receive the support from their teachers, pushing them to a higher level which they can obtain by working independently. This allows for a period of time when the students can individually interact with teachers, strengthening their learning experiences (Tomlinson, 2000 as cited by Rock et. al., 2008). Bailey and Williams-Black (2008) mentioned the differentiation used during delivery, exploration, and evaluation of the content. This allows for the students and the teachers to express themselves in an individual manner, showcasing their creativity and mastery of the subject matter.

Cooperative learning has five crucial elements: positive interdependence, face-to-face promotive interaction, individual and group accountability, interpersonal and small group skills, and group processing.
(Gabbin and Wood, 2008). With these skills, the students are able to learn about themselves, each other, and the material at hand. The cooperative learning elements are essential for a successful educational experience. Without one or more of the elements, the students could turn the cooperative assignment into a group assignment, not focusing on the common goal. For example, without interpersonal skills, the group members would not possess the proper communication, trust, leadership, decision-making, and conflict resolution to complete their assignment. Despite the different activities, the students still maintain focus on the same end product, individualizing their learning processes along the way (Voparil, 2008).

It is important to note that students who work cooperatively are not simply dividing their work to “finish it faster.” In an article by Koh, et al (2009), students who are not given instructions on working cooperatively may not participate in a cooperative learning activity the way in which it was designed. The author said that the students are likely to just break up an assignment and collect answers from one another, while the activity is meant to work in a manner almost opposite that. Koh, et al discussed the necessity for teachers to lead a conversation with the students in regards to their
assignment and the general outcomes and expectations of the assignments. This will allow for all parties to be on the same level.

There are many research articles written about cooperative learning that contain positive end results. In an article by Kapp (2009), a group of 20-24 year old students showed an 86% positive teamwork result and 93% positive academic experience by using cooperative learning in their coursework. (It is important to note that this result occurred after a random placement of a small group of students, despite the fact that some students may have met each other at a previous occasion.) The students also noted that the collaborative atmosphere allowed for more effective group work. The article itself showed that team building can lead to positive collaboration and more effective team work.

Slavin’s article (1980) also notes many positive cooperative learning results. First, he states that cooperative learning techniques are more effective in terms of academic achievement than that of traditional techniques. Next, he write that low level learning outcomes are more effective because of structure and schedule, individual accountability, and a group reward system (when implemented). Slavin also mentions the benefits for higher level cognition, using analysis and evaluation to reach the highest levels of Bloom’s
taxonomy. The research surrounding cooperative learning shows consistent results for Caucasian, African America, and Mexican American students, as well as consistency between all cooperative learning structures. Lastly, Slavin notes that cooperative learning builds self-esteem and a general likeness for education.

Cooperative learning has been shown in many research articles to benefit students’ levels of motivation. Johnson (2008) did research on adolescent student engagement and found that interactive instruction, rather than lecturing, created an engaging academic atmosphere. With engagement came higher levels of concentration, interest, and enjoyment. Some researchers feel that the higher concentration levels help with the overall raise standardized test scores. The higher levels of motivation are only present when teachers use cooperative learning and collaboration on a frequent and regular basis. The increased amount of collaboration and student-teacher interaction will lead to an increased level of academic achievement and higher goal setting.

When choosing individualized instruction or cooperative learning, there are many benefits for students in the classroom. Once the misconceptions are overcome and students are familiarized with each type of
activity, the learning process can be more engaging, leaving a long lasting impact. The importance of the key elements in cooperative learning should not be overlooked, nor should the individual attention for students when working on differentiated assignments.
Chapter Three: Methods

Participants

This study took place at a Western New York high school, in an Algebra 2 with Trigonometry mathematics class. This school had an enrollment of 1,001 students; 72% of these students qualify for free and reduced lunches, demonstrating the low socioeconomic status of the school. Three percent of the students in this school have a limited English proficiency, but there were no school-wide programs in place for English Language Learners, English Immersion, or students who have English as a Second Language. This school also boasted an 85% attendance rate and a 58% graduation rate, which was one of the higher graduation rates within the district.

This study took place in a first period mathematics class. This course was new to the students, school, and the state. Most of the students, including the 15% of the students who were retained from the previous year, have seen only a limited quantity of this material before this class. This course carried a Regents examination, a New York State standardized test, at the end of the school year. It also followed a curriculum and pacing chart provided from the school district and mathematics department lead teachers.
Despite the strictness of the course, there was no textbook used in the classroom and many of the materials were supplemented from various texts and websites.

This class contained 26 students: 54% African American, 23% Caucasian, 19% Hispanic, and 4% Asian; 58% female and 42% male. The students varied in grade between 10th and 12th, which put them between the ages of fifteen and eighteen. These students were the only students enrolled in a class covering this material. The classroom where the students are educated contains a class set of TI-84 graphing calculators and a SMART Board mounted on the front wall with an LCD projector connected to it for daily usage.

I am the researcher in this study. This is my fourth year teaching, all years completed at this particular school. I have experience teaching grades nine through twelve, including honors, regular and inclusion courses. I studied mathematics and education at SUNY Brockport before getting hired at this district and possess New York State Certification to teach grades five through twelve. I am currently studying to complete my master’s degree in Adolescent Mathematics Education at SUNY Brockport.
Materials

Algebra 2 with Trigonometry is a Regents course, which made it a state regulated course with a state-issued test at the conclusion of the year. The course is the third of three units required in order to obtain a Regents diploma. This study followed the curriculum pacing chart provided by the school district and lead teachers within the school district. The pacing chart and district curriculum follow two different textbooks, a Prentice Hall Mathematics B textbook and an Amsco Algebra 2 and Trigonometry textbook, neither of which were available to the students due to quantity issues. The teacher used both texts as resources in addition to free websites, such as Jefferson Math Project (jmap.org), E-Math (emathinstruction.com) and Regents Prep (regentsprep.org) as supplements.

The instruments the researcher used to conduct my research consisted of two separate pre-tests, two post-tests, and a concluding attitude survey. The pre-tests consisted of eight problems on each of the two topics we would be covering, all problems coming from past Regents Examinations. The post-tests were of the same format, with different questions covering the same material. Since all questions were from Regents Examinations, their scoring guides had the same standards. Some questions were multiple-choice while
others were short-answer, varying between two-point, four-point, and six-point difficulties. Lastly, the students were given a short attitude survey at the end of the study, collecting their opinions on the different types of lessons they experienced. Most questions were based on a Likert scale but a few required a written response.

Data Collection

This study consisted of two one-week sessions during the final units in the school year. In the first of the two units, the students were given a pre-test (Appendix A) on the first day, followed by some introductory notes. During the second and third days the notes went further in depth, allowing the students to build their individual skill sets necessary in order to participate in cooperative learning activities. The fourth day was a differentiated activity (Appendix B), where the students were split into predetermined ability level groups by the teacher. Once they completed work within their ability groups, they presented their assigned problem. The fifth day was a post-test (Appendix C) on the material covered during that week.

The second unit was similar in that it started on day one with a pre-test (Appendix D) and introductory information. The second through fourth days contained formal instruction. The fifth day contained a cooperative learning
activity (Appendix E), allowing the students to split themselves into four separate groups where each student would then be randomly assigned a role. The fifth day also allowed the students to present their problems to the class, instructing the whole group about their specific problem. On the last day, the students were given a post-test (Appendix F) on the second topic, along with the attitude survey (Appendix G).

Throughout the study, I collected data during the pre-test, post-test, and survey. I was also able to conduct one-on-one and small group informal interviews with students along the way. The informal interviews were able to give me primary accounts of the students’ attitudes at that present moment as well as their feelings about each activity. The survey at the end of the two units was meant to give me a more collective thought of the individuals involved, as they were able to reflect on the whole process.

My data was collected using Regents examination questions and ones of similar form. This was done to make sure that my rating scales and question selection was fair and varied based on levels of thinking. The Regents examination also provides scoring guides for each of the short-answer questions, ensuring consistency within grading. The pre-test and post-test also covered similar topics and had comparable questions. This
allowed for the data to be compared easily and results to be shared in ways that are similar in format.

Data Analysis

I organized the data for each test and each unit separately. During the first unit, the students studied the Law of Cosines, Law of Sines and Area of a Triangle using Trigonometry. They were given a pre-test consisting of three questions and post-test of seven questions, each with a similar format. The second unit consisted of material covering Arithmetic and Geometric Sequences and Series. The pre-test contained six questions, while the post-test had seven. Again, these questions were of similar wording and content. The questions were graded on the same standards as those of the New York State Regents Examination, using any accessible scoring guide and answer key connected to the assessed problems.

After organizing the data, I used Microsoft Excel, to analyze it. I carried out statistics including the mean, median, mode, and standard deviation of correct problems in the pre- and post-assessments for each unit.

Justification

The methods used were selected due to their ease of construction and ease of comparison once the study was completed. Despite the comparable
assessments and presumed ease of study, the methods did have some advantages and disadvantages. One advantage held was the ease and accessibility to Regents examination questions. Also, when using the Regents questions offered an assessment of different levels of thinking. Some of the questions, which are worth two-points or are multiple-choice, assess a lower level of thought that those rated on a four or six-point scale.

Despite the advantages of the method I choose, there are still disadvantages. One major disadvantage to giving a pre-test is that the students do not always put forth their best effort. A pre-test was given to measure what prior knowledge the students possess, serving as a baseline to measure success. Since it was unfair to use this assessment in the students’ marking period grades, they were not always trying their hardest to perform and complete each question. Another disadvantage was the level of questioning. Since the students were assessed using all Regents Examination questions, the levels of thinking were not extensively varied. The questions varied in point levels, those levels directly correlating with the level of thinking, but only gave a general idea of the students’ progress.

There were alternative methods considered in this process, but they were not used because of their invalidity and unreasonableness. First, the
cooperative learning and differentiation jigsaw activities could be assessed and used as a method of data collection. This was not done because these were exactly what the study was based upon. Also, the activities could have been used more often than just once. The problem with implementing this procedure was that students would have gotten frustrated with the amount of activities that took place instead of the direct instruction that they were used to. This would have caused the students to shut down, hindering their education. This also deters the study because it would have limited the amount of time the students had to spend on improving and mastering their individual skill sets.
Chapter Four: Results

Conducting this study has provided some results that both answer the original research questions and also provide some more for the researcher. The research shows that the activities were beneficial for the sample of students used. Although the unit containing the differentiated jigsaw activity showed a greater increase in mean score, it is the cooperative learning activity which had the greater decrease in standard deviation. This could be skewed based on topic of study, but looking further into the data will help decipher.

Research Question One

How do cooperative learning and differentiated jigsaws differ in the performance of students?

The mean, median, mode, and standard deviations were compared between pre-test and post-test for both the cooperative learning activity and differentiated jigsaw activity. For the cooperative learning activity, the mean test score increased 24.66% from the pre-test ($\bar{x} = 10.69$ out of 19) to the post-test ($\bar{x} = 20.23$ out of 25). For the differentiated jigsaw activity, the mean test score increased 51.90% from the pre-test ($\bar{x} = 3.77$ out of 17) to the post-test ($\bar{x} = 28.89$ out of 39).
Research Question Two

What do students think of the two types of instruction and is there one that best matches with what they think their learning styles might be?

Looking through responses from the attitude survey, students generally enjoyed the activity. Some of the comments included, “We should do this more often” and “I liked being able to teach my friends.” The students also stated that they enjoyed working in groups of their own choosing. When discussing learning styles, many students agreed that they were visual and kinesthetic learners, so doing an activity is better than just listening to a teacher lecture. The students also enjoyed the presentations, using the time as a chance to showcase their mathematical aptitude to other members of the class.

Themes

The themes from this research can be gathered from the open-ended questions on the attitude survey, asking the students to give a pro and a con to this type of activity.

Pros

The most common response from students regarding these activities was the chance to work together in groups. Many students enjoyed working
in groups, while some specifically mentioned that during the cooperative learning activity they were able to choose their group. Working in groups allowed the students to share ideas and teach one another when difficulties or conflicts arose. The students also enjoyed the presentations, both presenting to the class and learning from the classmates. Presenting gives the students a chance to display their knowledge and describe the steps and methods in a way other than that done by the teacher. Using other vocabulary or terms may allow students to understand topics that they did not before. The same goes for listening to the presentations; students gain extra knowledge when spoken to by their peers by means of peer-tutoring or peer-instruction.

Cons

Many students expressed their discontent with having to do a presentation at the end of their assignment. On the attitude survey they stated that they did not like speaking in front of the class due to nervousness or lack of confidence. Students also expressed concerns for working in assigned groups, due to the fear of individuals not acting out their assigned role or group members not agreeing on the assignment. These comments came from some of the higher achieving students, those who have had this happen to them before.
Possibility for Void or Unreliable Results

Due to the pre-test and post-test having occurred within the class, some students had to make-up the test, causing the assessments to occur after some instruction was given. The attendance was not consistent during the research study, which lead student to miss instruction on one or more days. The inconsistency in attendance can cause for an unreliable set of data. The sample was 26 students in the researcher's classroom, so it would be considered to be a convenience sample. The pre-tests were never returned to the students, allowing the teacher to use the data for a comparison. Had the students been given this assessment back, it could have been useful for a study tool. Lastly, the unit of study containing the cooperative learning activity was much simpler than that with the jigsaw. Some restriction on the change in data might have to do with the fact that the students were gaining understanding of the material at a higher rate than usual.

Action Plan

As a member of a mathematics department at the school where this research was done, the researcher will share this study, along with the results, with the department at the beginning of the next school year. These meetings are held a few weeks prior to the start of school and contain all mathematics
teachers from grades seven through twelve. During this meeting, the researcher will share the study and results with these faculty members. For those members not familiar with the activities used by the researcher, this will provide an opportunity for that discussion. As a department, the researcher hopes to spread this information in hopes of introducing alternative activities to be used in class.

Recommendations

After completing the research, the researcher has developed more questions that could be answered by repeating the study a second time. First, the researcher would like to consider the changes that may take place statistically if the cooperative learning groups were assigned. Many students stated that they enjoyed the activity and were able to focus more when working with their friends and peers of their own choice. How would this change, and would their performance change if they were not given that option? Secondly, the researcher would like to think about doing activities as pre-tests and post-tests as opposed to having them in the middle of the studied unit. The pre-test can be more of a student discovery lesson and the post-test can be a group assessment, both alternative methods of instruction and/or assessment. Would this change of instruction impact the student
grades, or would the assessment be less valid since the students are not individually completing it? Lastly, the researcher would like to test the students' learning styles and use activities that speak directly to them. This could help the students understand more about their individual education and assist the teacher with determining which methods of instruction are going to be most beneficial for the class. The researcher reminds us that not every student can be reach with each type of instruction, but creating a variance on how the educator uses instruction will help all students learn.
Chapter Five: Discussions and Conclusions

Cooperative Learning and Differentiated Instruction in the form of a Differentiated Jigsaw are things that teachers learn about in both their undergraduate and graduate studies programs. For me, this was an interesting place of study since I teach in a district where students vary in mathematic abilities. Often times, teachers neglect their gifted students and students with special needs because working with them on a level in which they are comfortable makes for “extra work.” Implementing these activities within a classroom will prevent the “extra work” and make for an environment conducive for all students to learn.

This study allowed me to take a look at the Algebra 2 with Trigonometry class and see how their performance would change using Cooperative Learning and Differentiated Jigsaws in their units. The Cooperative Learning activity showed growth for the majority of students in the class. Their pre-test scores averaged with 56% of the correctness, where as the post-test scores averaged an 80.92%. This jump was far greater for the Differentiated Jigsaw, with the pre-test scoring a 22% and the post-test scoring a 74%. As seen by in Figure 1 and Figure 2, the activities were shown to be useful and the students progressed a great deal using them both.
This study was done within the scheduled class time, allowing for a pre-test, a few days of direct instruction, an activity, and a post-test within each mini-unit. One part of the study that was uncontrollable was the student attendance. There were many students who were absent for one or more days of the mini-unit, some of those days including the testing and activity. While this is uncontrollable, the possibility for testing make-ups was taken into consideration. This helped the students see their progress and also make the study much more reliable.

As we think about students within a classroom, it is important to remember that each student is an individual and possesses a unique way of learning. As educators we need to be willing to work with these learning styles and teach to all students. Testing the learning styles of the students is a good way to start the year, gaining knowledge about the students and allowing the educator to gear their lessons towards the students rather than teaching however it is easiest for them to do. As an educator and the researcher in this study, I will take the responses from the students' attitude surveys and apply them to my teaching. Many students enjoyed the activities, so I will be sure to incorporate them into the units of instruction more often. I will also give the students more opportunities to showcase their
talents and teach their peers. In doing so, the students will gain the confidence of publicly speaking as others gain the knowledge of the lesson.

I hope to do another study like this in the future, using two units and comparing different teaching methods during the two. I would like to use longer units next time, as to allow the students a bit more time to grasp the knowledge and possibly give additional opportunities to perform the activities. I would also like to use the Cooperative Learning and Differentiated Jigsaw activities prior to doing another study. This would allow for both the students and the teacher to gain familiarity and understand the expectations of the activities. Lastly, the sample could be expanded as a study is done in a class where more students are enrolled. Even if this would require another teacher to be a co-researcher of the study, the study would be more reliable since the sample size would be larger.

Through this study, I have grown as a student of research and as an educator. The study has allowed me to put forth everything I have learned thus far in my higher education classes and apply it to my classroom. Through the use of a Cooperative Learning activity, I was able to watch students work together to complete a task. Their wealth of knowledge grew abundantly as they worked together, learning from one another and
collaborating to overcome obstacles along the way. Using the Differentiated Jigsaw allowed me to put the students in ability groups, so that they could tackle a portion of the assignment that challenged their academic abilities. This alternative method of instruction demonstrated student growth, but at a level which was not as statistically significant as the first. Regardless of that fact, the students gained knowledge and were able to produce higher test scores for both post-tests.

As a researcher, I hope to repeat this study, or one similar to it, and answer some of the newly developed questions which I have. I would like to investigate the students’ learning styles and see how teaching directly to those would change their individual performance. I would also like to see how the study would change if I did two longer units, or used two units where the students had little to no prior knowledge on the subject area. I feel as though these are both questions that could lead to further research and more investigations on my part to help the students involved.

In conclusion, it is fair to say that doing this study has helped myself, by learning about the students and taking part in activities that are different from those used on a daily basis, and has helped the students, by giving them a chance to have more input on the lessons and teaching style used in their
classroom. As educators, we need to keep in mind that this is done for the students and so we should plan lessons that will best benefit them, their learning styles, and forget about how much “extra work” it may make for us. As the words of an unknown author state, “A good teacher is like a candle – it consumes itself to light the way for others.”
Figure One:

Assessment Comparison:
Differentiated Jigsaw

![Assessment Comparison: Differentiated Jigsaw](image)

- Pre-Test
- Post-Test

Student

Assessment Score

0 20 40 60 80 100

1 3 5 7 9 11 13 15 17 19 21 23 25
Figure Two:

Assessment Comparison - Cooperative Learning

Assessment Scores

0 20 40 60 80 100

1 3 5 7 9 11 13 15 17 19 21 23 25

Student

- Pre-Test

- Post-Test
Figure Three:

**Attitude Survey Results**

<table>
<thead>
<tr>
<th>Score (0-5)</th>
<th>Question Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>2.58</td>
<td>2.85</td>
<td>2.54</td>
<td>2.31</td>
<td>3.12</td>
<td>2.62</td>
<td>2.65</td>
<td></td>
</tr>
</tbody>
</table>
References


Appendix A

Name: ___________________________ Date: ___________________

Pre-Test Trigonometry

Law of Sines: \( \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \)

Law of Cosines: \( a^2 = b^2 + c^2 - 2bc \cos A \)

Area of a Triangle: \( K = \frac{1}{2} ab \sin C \)

Solve the following for \( x \) and find their areas. Use the formulas above for help.

1. \[
\begin{array}{c}
30 \\
60^\circ \\
15 \\
x
\end{array}
\]

2. \[
\begin{array}{c}
30^\circ \\
35 \\
30 \\
x
\end{array}
\]
Appendix B

Differentiated Activity: Law of Sines

Background Information: Students will be split into 6 groups, labeled Group A – Group F. Group A has the lowest ability level and Group F has the highest ability level. The groups are homogeneous for the hope that this activity will build their confidence and understanding of the material. The groups will work on their individual problem for a given time period, then present their problem to the class.

Assignments: Group A – Problem 3
Group B – Problem 4
Group C – Problem 5
Group D – Problem 6 (part A only)
Group E – Problem 7
Group F – Problem 8

Warm up: Students will complete two problems using the Law of Sines. Teacher will review the problems before starting the activity.

Mini-Lesson: Students will be split into their groups and assigned their problem. Teacher will spend a few minutes with Groups E and F to ensure their understanding of the problem assigned.

Guided Practice: Students will be given ~10 minutes to complete the problem assigned to them. Once completed, the teacher will check the problem for correctness. Once the
Closure: Students will present their problems to the whole class. Each student must take part in the presentation and explanation. If necessary, classmates are urged to ask questions to help further their personal understanding.
Law of Sines

1. In \( \triangle ABC \), \( \sin A = \frac{2}{3} \), \( \sin B = \frac{1}{2} \), and \( b = 9 \). Which of the following represents the value of \( a \)?
   a. 15
   b. 18
   c. 12
   d. 6

2. In \( \triangle DEF \), \( DE = 8 \), \( DF = 14 \), and \( \sin E = \frac{3}{4} \). Which of the following represents the value of \( \sin F \)?
   a. \( \frac{2}{7} \)
   b. \( \frac{7}{8} \)
   c. \( \frac{3}{14} \)
   d. \( \frac{3}{7} \)

3. In \( \triangle PQR \), \( m \angle Q = 112^\circ \), \( m \angle R = 35^\circ \), and \( PR = 28 \). The length of \( PQ \) is closest to
   a. 17.3
   b. 45.3
   c. 8.8
   d. 27.4
4. In acute \( \triangle DEF \) it is known that \( m \angle D = 72^\circ \), \( DE = 7 \), and \( EF = 12 \). To the nearest degree, \( m \angle F = \)
   a. 62°  
   b. 34°  
   c. 42°  
   d. 51°

5. A triangle has angles that measure 25°, 48°, and 107°. If the shortest side of this triangle has a measure of 12 inches, find the length of its longest side to the nearest \textit{tenth} of an inch.

6. In \( \triangle MNP \), \( m \angle M = 42^\circ \), \( m \angle N = 33^\circ \), and \( MP = 16 \) inches.
   a. Find the length of \( \overline{PN} \) to the nearest \textit{tenth} of an inch.
   b. Using your answer from (a), determine the area of \( \triangle MNP \) to the nearest square inch.
7. In the diagram shown below it is given that points B, C, and D are collinear. It is also known that \( m \angle BAC = 35^\circ \), \( m \angle BCA = 130^\circ \), \( m \angle D = 90^\circ \) and \( BC = 50 \). Determine the length of \( AD \) to the nearest tenth.

8. In quadrilateral \( ABCD \), \( m \angle A = 100^\circ \), \( m \angle ADB = 22^\circ \), \( m \angle CBD = 94^\circ \) and \( m \angle C = 35^\circ \). If \( AB = 24 \), find \( CD \) to the nearest tenth.
Appendix C

Name: ___________________________ Date: ____________________
Laws and Area Quiz

Use the formulas below to help you solve the problems. DO NOT USE YOUR NOTES!!!

Law of Sines: \[ \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} \]

Law of Cosines: \[ a^2 = b^2 + c^2 - 2bc \cos A \]

Area of a Triangle: \[ A = \frac{1}{2}ab \sin C \]

1. Solve for x:

   ![Diagram of a triangle with angles 74°, 36°, and side length 21 cm]

2. Steve and Ray are each 10 feet from a telephone pole. The angle between them is 97°. Find the distance between the two boys.
3. Solve for x:

![Triangle diagram with sides 7 m, 12 m, and 18 m]

4. Jamie is going for a walk. At point A on the ground, the angle of elevation to the top of a tree is 47°. She walks 100 feet closer, to point B, and the angle of elevation is not 71°. Find the height of the tree.

5. Find the area of the triangle:

![Triangle diagram with sides 10 in and 20°]
6. Find the area of the triangle:

7. Sam and Joe walk away from school, each taking 10 strides. Sam ends up 12 meters from school and Joe ends up 8 meters from school. Then angle between them is 115°. Find the distance between the two boys and find the area of the triangle they form.

**Bonus Question:**
Solve for all possible values of $x$: $\sqrt{3} \tan^{-1} 1 = 0$
Arithmetic Series:
The difference between two terms is constant.

Geometric Series:
The ratio between two terms is constant.

Directions: Answer the following questions, using the definitions and formulas for help.

1. If \( a_n = 2n - 1 \), find:
   a. \( a_1 \)
   b. \( a_2 \)
   c. \( a_7 \).

2. Find the first three terms in the sequence, given \( a_1 = 2 \) and the difference between terms is 3.
3. If $a_1 = 9$ and the difference between terms is $-2$, find $a_{20}$.

4. Find the 9th term in the sequence $2, 7, 12, 17, 22, ...$

5. If $a_1 = 8$ and the ratio between terms is $\frac{1}{2}$, find $S_{16}$.

6. If $a_1 = 5$ and the ratio between terms is $2$, find the first 4 terms of the sequence.
Appendix E

Cooperative Learning Activity: Sequences and Series

Background Information: Students will be split into 4 groups, labeled Group A – Group D. The groups are heterogeneous in the hopes that students will be able to teach one another. The groups will work on their individual problem for a given time period, then present their problem to the class.

Assignments:  
Group A – Arithmetic Series  
Group B – Arithmetic Sequence  
Group C – Geometric Series  
Group D – Geometric Sequence

Warm up: Students will choose their groups. Within each group, the students will choose which type of problem they would like to work on. They will also choose their group roles.

Mini-Lesson: The teacher will review the roles for today’s assignment.

Librarian: The student that chooses a textbook and helps find the section dealing with today’s assignment.

Secretary: The student that writes the rules and formulas for that type of problem.

Mathematician: The student that oversees the completion of two problems.

Artist: The student that puts the work onto chart paper.
Janitor: The student that makes sure everything is packed up and put away at the end of the period.

Clock Watcher: The student that makes sure the group is staying on task during the class period.

Guided Practice: Students will be given a choice of 6 different textbooks to use, each covering material from the Algebra 2 with Trigonometry course. The students will look up their topic and write down any information they deem important. They will also choose two problems to model. All information will be put onto chart paper.

Closure: Students will present their problems to the whole class. Each student must take part in the presentation and explanation. If necessary, classmates are urged to ask questions to help further their personal understanding.
Appendix F

Name: ___________________________ Date: ______________________
Series and Sequences Quiz

Arithmetic Sequence: \[ a_n = a_1 + (n-1) \cdot d \]

Arithmetic Series: \[ S_n = n \left( \frac{a_1 + a_n}{2} \right) \]

Geometric Sequence: \[ a_n = a_1 \cdot r^{n-1} \]

Geometric Series: \[ S_n = \frac{a_1 (1 - r^n)}{1 - r} \]

Directions: Answer the following questions, showing all work.
1. Find the 6th term of the geometric sequence for which \( a_1 = -7 \) and \( r = 2 \).

2. Find the sum of the first 12 terms of the sequence \(-9, -5, -1, 3, \ldots\)
3. A series of jars containing marbles has the following pattern:

   Jar #1    2 green, 1 red, 3 yellow
   Jar #2    4 green, 1 red, 6 yellow
   Jar #3    8 green, 1 red, 9 yellow
   Jar #5    32 green, 1 red, 15 yellow

   How many marbles would be in Jar #4?

4. Find the sum of the first 12 terms of the sequence \(-11, -6, -1, 4, \ldots\)

5. What is the common ratio between numbers in the geometric sequence starting with \(9, 6, 4, \ldots\)
6. Find the 9th term of a geometric sequence if it is defined by \( a_1 = 2 \) and \( r = 3 \).

7. A geometric sequence is defined by the recursive definition given by

\[
a_n = a_{n-1} \cdot \frac{3}{2}.
\]

Find \( a_7 \) if \( a_1 = -3 \).
Appendix G

**Attitude Survey:**

*_Jigsaw Activity vs. Group Activity with Presentations*

1. I enjoyed the jigsaw activity.
   a. Strongly disagree
   b. Disagree
   c. Agree
   d. Strongly agree
   
   [Age: __________
   Grade: ________]

2. I enjoyed working with the different groups of students.
   a. Strongly disagree
   b. Disagree
   c. Agree
   d. Strongly agree

3. I liked working on separate problems and learning from my peers.
   a. Strongly disagree
   b. Disagree
   c. Agree
   d. Strongly agree

4. I enjoyed the group activity with presentations
   a. Strongly disagree
   b. Disagree
   c. Agree
   d. Strongly agree

5. I like it when I am assigned groups to work in.
   a. Strongly disagree
   b. Disagree
   c. Agree
   d. Strongly agree
6. I work better when I am working in groups that I choose.
   a. Strongly disagree
   b. Disagree
   c. Agree
   d. Strongly agree

7. I enjoyed presenting our work to the class.
   a. Strongly disagree
   b. Disagree
   c. Agree
   d. Strongly agree

8. I enjoy watching the presentations of my classmates.
   a. Strongly disagree
   b. Disagree
   c. Agree
   d. Strongly agree

9. What is one thing that could have made these activities more engaging?

10. Please tell me one thing you like **AND** one thing you dislike from each of these activities.