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The Impact of Students' Attitudes After Implementing a Leadership Collaborative
Grouping Method in a Collegiate Technical Mathematics Class

Robert J. Belin

Masters of Education, DePaul University, 1995

A thesis submitted in partial fulfillment of the requirements

For the Degree of Master of Science with a Major in Mathematics

Governors State University

University Park, IL 60484

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Author's Note

Robert J. Belin, limited time lecturer of mathematics, Purdue University Calumet.

Robert Belin is also a secondary mathematics educator at Thornton Fractional High School in Lansing, Illinois.

This essay is in support of a master degree in Mathematics at Governors State University.

Correspondence concerning this article should be addressed to Robert Belin, Department of Mathematics, Purdue University Calumet, 2200 169th St, Hammond, IN 46323.

Contact: robert.belin@purduecal.edu

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Abstract

This research paper explored students' attitudes towards mathematics before and after the implementation of an experimental instructional method. The measurement tool that was used is the Mathematics Attitude Inventory for Students (ATMI). The experimental methodology implemented in the collegiate class is a leadership based cooperative learning model. Students were surveyed twice. The first installment of the ATMI was conducted prior to a mathematics unit that spanned three classes. The second installment of the ATMI survey was conducted after the unit was completed. Student surveys were assessed and determined if the experimental model had any impact of students' attitudes towards mathematics.

The findings were unexpected. The students' overall view of mathematics went down 0.34 of a 5-point Likert score from the pre and post surveys of the ATMI. However, three additional questions were added to the second installment of the ATMI survey and uncovered most students found the experimental cooperative leadership model beneficial.

The Impact of Students' Attitudes after Implementing a Leadership Collaborative
Grouping Method in a Collegiate Technical Mathematics Class

Introduction

Carnegie said: "If you believe in what you are doing, then let nothing hold you up in your work. Much of the best work of the world has been done against seeming impossibilities. The thing is to get the work done" (Spainhour, 2007, p.126). There has been a significant amount of research done on students' negative attitudes of mathematics and their direct unfavorable impact on student mathematical achievement (Tapia, 1996; Gal, et al., 1994; Asante, 2012; Hannula, 2002; Ma, et al., 1997). Additionally, Wigfield and Meece (1988) found in their research that math anxiety started with sixth grade students and amplified as students reached twelfth grade. The research implied that anxiety has a negative impact on student learning. Thus, students with mathematics anxiety do not approach the discipline of mathematics with enthusiasm and rigor but rather approach it with a spirit of passivity giving marginal effort and often times have a negative outlook in their scholarship in mathematics. The extensive research of Betz (1978) found that mathematics anxiety occurs frequently among college students especially those with inadequate pre-college math backgrounds. This research discovered that higher levels of mathematics anxiety led to lower mathematics achievement test scores, higher levels of test anxiety, and higher levels of trait anxiety. Carnegie (1948) emphasized the thing is to get the work done but a multitude of students are hindered by math anxiety and their disapproving view of mathematics.

Importance of the Study

While there is a multitude of research examining the benefits of cooperative or collaborative learning, little to no studies measure the effectiveness of cooperative learning articulated in a student leadership designed classroom. Therefore, this paper examined if a leadership driven collaborative classroom has any effect on student attitudes of mathematics.

Purpose Statement

The purpose of this study is to discover the impact of an implemented leadership collaborative learning structure in a collegiate technical mathematics classroom and assess if this mechanism has any impact on students' attitudes and academia.

Research Questions

The main research questions explored in this action research study were:

1. Does the experimental strategy of leadership collaboration learning enhance students' attitudes and understanding of the mathematical concepts covered in this paper?
2. Did the experimental cooperative learning leadership model impact students' academia?
3. Who will benefit more from the experimental instruction – the leaders or the participants from the group, or both?

Literature Review

This chapter discusses the review of literature in this study. The first section articulates the Students Attitudes Towards Mathematics (ATMI) measurement instrument implemented in the study. The following two sections presents the research related to the analysis and application of the mathematical topic of complex numbers. The fourth section presents literature related to collaborative and cooperative learning mechanisms while the last section is a discussion of a leadership including a model that was implemented in a secondary mathematics classroom.

Student Attitudes Towards Mathematics

According to Chamberlin (2010), it is difficult to measure a student's attitude towards mathematics because it is a construct. A construct is a subjective measurement and is not based on empirical evidence. The complexity of constructs is that they are non-measurable attributes. Measuring a students' growth by comparing test scores is an easier feat than measuring the levels of anxiety of a student in a mathematical class. Research over the years has focused on the development of instruments to analyze students' attitudes and preconceptions of the discipline of mathematics. One of the mathematical instruments that incorporates anxiety and other psychological constructs is called the Attitude towards Mathematics Inventory.

Tapia (1996) developed an attitudinal survey to measure students' attitudes towards mathematics after witnessing scores of students' displeasure in the discipline. The model is called Attitudes Towards Mathematics Inventory (ATMI). Tapia created this model to articulate the underlying factors of why someone either liked or disliked mathematics and if they felt mathematics was a useful tool to them for everyday life.

Students were asked to measure their level of agreement by selecting strongly agree, agree, neutral, disagree and strongly disagree. The model's fundamental foundation identifies self-confidence, value, enjoyment and motivation as key factors when measuring the attitudes of students in mathematics. The model was reduced to 40 questions in 2004 and is one of the leading models used when measuring student attitudes towards mathematics.

The Attitudes Toward Mathematics Inventory (ATMI)

The ATMI survey is broken up into four categories. The first category is the enjoyment of math. This category measures how much students enjoy the subject of mathematics and the process of solving problems (Tapia & Marsh, 2004). Of the ten statements, nine are positive and one is negative. The statements in the enjoyment category labeled by the number of the survey are the following:

3. I get a great deal of satisfaction out of solving a mathematics problem.
24. I have usually enjoyed studying mathematics in school.
25. Mathematics is dull and boring.
26. I like to solve new problems in mathematics.
27. I would prefer to do an assignment in math than to write an essay.
29. I really like mathematics.
30. I am happier in a math class than any other class.
31. Math is a very interesting subject.
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.
38. I am comfortable answering questions in math class.

Tapia (1996)

The second category is designed to measure motivation, how interested a student is in mathematics and how likely they are to pursue a career involving mathematics (Tapia & Marsh, 2004). Of the five statements, four are positive statements and one is negative. The motivation statements are listed below:

23. I am confident that I could learn advanced mathematics.
28. I would like to avoid using mathematics in college.
32. I am willing to take more than the required amount of mathematics.
33. I plan to take as much mathematics as I can during my education.
34. The challenge of math appeals to me.

Tapia (1996)

There are 15 statements in the third category which is designed to measure self-confidence. These statements measure how a student feels about mathematics while taking a course and how they feel while working on mathematics (Tapia & Marsh, 2004). Of the 15 statements, nine are positive and six are negative statements about mathematics. The self-confidence statements are:

9. Mathematics is one of my most dreaded subjects.
10. My mind goes blank and I am unable to think clearly when working
with mathematics.
11. Studying mathematics makes me feel nervous.
12. Mathematics makes me feel uncomfortable.
13. I am always under terrible strain in math class.
14. When I hear the word mathematics, I have a feeling of dislike.

15. It makes me nervous to even think about having to do a mathematical problem.
16. Mathematics does not scare me at all.
17. I have a lot of self-confidence when it comes to mathematics.
18. I am able to solve mathematical problems without too much difficulty.
19. I expect to do fairly well in my mathematical class.
20. I am always confused in my mathematical class.
21. I feel a sense of insecurity when attempting mathematics.
22. I learn mathematics easily.
40. I believe I am good at solving math problems.

Tapia (1996)

The fourth category contains ten statements all of which are positive statements about mathematics. The statements are designed to determine how useful a student perceives mathematics to be (Tapia & Marsh, 2004). The ten value statements are:

1. Mathematics is a very worthwhile and necessary subject.
2. I want to develop my mathematical skills.
4. Mathematics helps develop the mind and teaches a person to think.
5. Mathematics is important in everyday life.
6. Mathematics is one of the most important subjects for people to study.
7. High school math courses would be very helpful no matter what I decide to study.
8. I can think of many ways that use math outside of school.
35. I think studying advanced mathematics is useful.

36. I believe studying math helps me with problem solving in other areas.

39. A strong math background could help me in my professional life.

Tapia (1996)

Farooq and Shah (2008) found that students' attitudes towards mathematics plays a crucial role in the teaching and learning processes of mathematics. Thus, these researchers' findings found that students' success in learning mathematics is contingent upon their attitudes towards the discipline. If they had a positive attitude towards mathematics, then they were more likely to be successful in mathematics. And similarly, if students had an unfavorable view of mathematics, then students were prone to be less successful in the area of mathematics. One study found where a student lives impacted their attitudes towards mathematical disciplines. George (2000) found that students in metropolitan and rural schools have less positive attitudes toward mathematics and science in the seventh grade compared to students in suburban schools. Midgley, Feldlaufer and Eccles (1989) found that students' perception of the practicality and importance of mathematics hinged on their achievement level in the discipline. Students' attitudes towards mathematics dramatically decreased when students transitioned from more supportive to less supportive educators whereas for achieving students there was not as much impact on the children's attitudes towards mathematics.

Loucks-Horsley, Stiles, Mundry, Love and Hewson (2010) found that teachers can influence students' views of mathematics and science while increasing the achievement gap for all types of learners. One way for teachers to accomplish this task is to articulate lectures that engage students. Group projects, collaborative learning, real-life mathematical projects are some of the methodologies teachers can implement into

their lesson planning to make their lectures more engaging to students (Osborne, et al., 2003). Hassard (1997) conducted a research project and found that students enjoyed mathematical modeling in real-life scenarios. This particular study engaged students in a service-learning project where students excelled in mathematics and also enhanced their social awareness and social responsibility.

Researchers continue to find ways to engage students into the field of mathematics or related discipline fields. Bandura (1977) found self-efficacy can be a key predictor of achievement and retention in most academic subjects. Fencil and Scheel (2005) explained self-efficacy is a person's situation-specific belief that he or she can succeed in a given domain. Baldwin, Ebert-May and Burns (1999) found the implementation of cooperative learning in a classroom environment as an effective mechanism to enhance a student's overall self-efficacy. Willis (2010) encouraged teachers to reverse mathematics negativity by modeling a positive and engaging attitude. Her research found that this task is surmountable if teachers plan and execute achievable goals. She argued this can be done if the educator differentiates the instruction for each individual student to make them more self-efficient.

This section of the literature review explored student attitudes of mathematics and how educators can impact those attitudes. The next section of the literature review examines research on complex numbers. A complex numbers unit is the teaching material that this particular study examined of students' attitudes towards mathematics after the implementation of an experimental leadership cooperative learning model.

Application of Complex Numbers

There are several ways to model complex numbers in tangible and practical techniques for students to appreciate their functionality. Complex numbers enter into studies of physical phenomena in variety of ways. Most students understand that complex numbers are used to explain how certain polynomial functions behave. For example, if a quadratic equation does not intersect the x-axis, then students could surmise that the roots are imaginary. This understanding can be deeply expanded for students to have a fully developed skill set of complex numbers. From a realistic standpoint of this quadratic representation, this behavior could be the movement of a shock absorber of a car when it rolls over a bump. First, imagine a ball dropped from a high distance. The bounces act as an oscillation of a spring and damping characteristics much like a shock on a car. Bauer (2007) provides a quadratic equation to represent a shock absorber as the following: $s^2 + \frac{c}{m}s + \frac{k}{m} = 0$. Now implementing this model into the quadratic formula will generate this representation: $s = -\frac{c}{2m} \pm \sqrt{\left(\frac{c}{2m}\right)^2 - \frac{k}{m}}$, where c represents damping and k represents spring effect. From a simplistic look, one can analyze this quadratic as $\sqrt{\text{damping} - \text{spring effect}}$. Bauer clearly points out that if the damping is greater than the spring effect then the mathematical representation is a real number. However, if the spring effect is greater than the damping, then the mathematical analysis will render an imaginary representation.

One of the most important uses of complex numbers is found in the application of the electric field. The electrical field does not refer to the complex representation of a number by i but j . Imaginary numbers are a primary force for applications to alternating-current (ac) circuits. It is also used to find basic voltage. For example, in a particular

circuit, the current is $2.00 - 3.00j$ and the impedance is $6.00 + 2.00j$ ohms. The voltage of this part of the circuit is found by multiplying the current by impedance. Remember, j represents the imaginary part of the complex numbers in the electronic field instead of i .

The calculations then are as follows:

$$\begin{aligned} V &= (2.00 - 3.00j)(6.00 + 2.00j) \\ &= 12.0 - 14.0j - 6.00j^2 \\ &= 12.0 - 14j + 6.00 \\ &= 18.0 - 14.0j \text{ volts} \end{aligned}$$

Therefore the magnitude of the voltage is

$$\begin{aligned} |V| &= \sqrt{(18.0)^2 + (-14)^2} \\ &= 22.8V \end{aligned}$$

Analysis and Historicity of Complex Numbers

In most cases, a complex number is a number that has both a real and imaginary part and is represented by the algebraic form: $Z = a \pm bi$ or $Z = a \pm bj$. In this algebraic form, a is the real part while b is the imaginary part. Research indicates that electrical engineers use j instead of i when representing imaginary numbers. A reason for this is i almost always represents current in engineering equations (Takahara et al., 1997; Zill et al., 2011). Thus, an imaginary number is a real number multiplied by the imaginary unit of i generating bi of the previously mentioned algebraic form. Maxwell (1959) identified a common misconception of the science of imaginary numbers in the following reasoning in his research:

$$i^2 = -1 = \sqrt{-1}\sqrt{-1} = \sqrt{(-1)(-1)} = \sqrt{1} = 1$$

The real number mathematical rule of $\sqrt{x}\sqrt{y} = \sqrt{xy}$ only applies to the real numbers and does not carry over to the realm of complex numbers. Also, it is essential to note that $i^2 = -1$ is a foundational understanding of the study of complex numbers.

The scholarship of Hargittai (1992) and Roy (2007) attributed Greek mathematician Heron of Alexandria as the founder and pioneer of imaginary numbers. Furthermore, Rozenfeld (1988) meticulously described the development of imaginary numbers as slow and not widely accepted until the scholarship of Leonhard Euler in the late 1700s followed by the work of Carl Gauss in the beginning of the 19th century. The geometric component of complex numbers was developed by Caspar Wessel and William Hamilton in 1843 extended the idea of an axis of imaginary numbers in a plane to a four dimensional space of quaternion imaginaries.

Most students find the concept of imaginary numbers meaningless and cannot abstractly see its usefulness. In the middle school mathematics curriculum, Moss and Case (1999) found too much time was devoted to teaching procedures of rote application of rules and too little of time was devoted to teaching the conceptual meaning in a mathematical class examining representations of all types of numbers including the field of complex numbers. Furthermore, research by Campbell (1997) and Lester (2007) suggest that educators from secondary institutions to college classrooms have not properly explained the real world applications of imaginary numbers but rather just lectured the rote calculations of the these numbers like $\sqrt{-8} = 2i\sqrt{2}$ or how to properly simplify $\frac{7-5\sqrt{3}}{6-17i}$. These practitioners elegantly model several practical uses of the complex number plane of numbers. Conner, Rasmussen, Zandieh and Smith (2010) conducted research that examined prospective secondary mathematics educators and found these

prospective teachers had a marginal conception of the complex number field. The researchers' conclusion was that the candidates' conceptions of complex numbers often fails to extend past basic rote computational calculations of the field of complex numbers.

The timing of introducing complex numbers had shifted earlier in colligate mathematical programs. According to Ahmad and Shahrill (2014), the presentation of complex numbers was normally presented in the second or third semester of Electrical Engineering. The researchers found that the study of complex mathematics is now presented earlier and often times in a student's first semester mathematical course.

This section of the literature review explored complex numbers which was the curriculum used in this study. The complex numbers unit is the teaching material that this particular study examined to investigate students' attitudes towards mathematics after the implementation of an experimental leadership cooperative learning model. The next section of the literature review examined research on cooperative or collaborative learning methodologies.

Cooperative or Collaborative Learning Methodology

An extensive amount of research has been done on the subject of cooperative or collaborative learning. Millis (2009) found cooperative learning can lead students to deep learning and genuine paradigm shifts in their thinking if the methodology is implemented properly. Cooperative learning workshops for educators are now common professional development strands for teachers across the nation from kindergarten through collegiate educators (Kagan, 1989; Leamson, 2000; Rhem, 1995; Zinsser, 2009). One of the interesting strands of this learning mechanism is the misconception teachers have with it. Some teachers place students in groups and tell them to work

cooperatively on the following scenarios or problems without any meaningful directions or expectations of the group. Johnson (1991) described this structure as a traditional learning group and outlines six shortcomings of this structure. First, the focus is on individual performance. In this structure, students tend to compete and withhold information from each other in their learning groups because they do not know how to help or lead their learning group. Second, assignments are discussed with little commitment to each other's learning. Third, there is a lack of individual accountability and oftentimes students take the information in a marginal way not really knowing how the information was construed or articulated. Fourth, social skills in the learning group are assumed or ignored by the teacher. Often times, one student "takes charge" and does most of the meaningful work leaving other group members "off-task". Fifth, there is no processing on how the group is performing by the teacher or the group itself does not assess how it is functioning – questioning where improvements or adjustments can be made. And sixth, there is little to no attention pertaining to group formations. Teachers tend to allow students to pick whoever they want to work with causing groups to be too large and unproductive in the learning process.

Researchers Kagan (2001), Slavin (2013), and Johnson and Johnson (2009) all concurred that there should be some observable common elements or evidences to constitute whether a cooperative grouping exists in a teaching setting opposed to a traditional learning group. Other research focused on an academic discipline and offered a variety of ideas to enhance the cooperative learning experience whether students were in English class in middle school, history class in high school or a mathematics class in the collegiate setting (Davidson et al., 1991; Bruffee, 2010; Felder, 1994).

According to Holubec, and Johnson and Johnson (1998) cooperative learning (CL) is instruction that involves students working collaboratively in learning groups or teams to accomplish a common goal under conditions that include the following elements:

1. Positive interdependence. Team members are obliged to rely on one another to achieve the goal. If any member fails to do their part, everyone suffers consequences.
2. Individual Accountability. All students in a group are held accountable for doing their share of the work and for mastery of all the material to be learned.
3. Face-to-face positive and productive interaction. Although some of the group work may be parceled out and done individually, some must be done interactively, with group members providing one another with feedback, challenging one another's conclusion and reasoning, and perhaps most importantly, teaching and encouraging one another.
4. Appropriate use of collaboration skills. Students are encouraged and helped to develop and practice trust building, leadership, decision-making, communication, and conflict management skills.
5. Group processing. Team members set group goals, periodically assess what they are doing well as a team, and identify changes they will make to function more effectively in the future. (p.1:31)

These practitioners validated cooperative learning is not simply a synonym for students working in groups. A cooperative learning experience only qualifies, as CL to the extent of evidences of the listed elements is present.

This section of the literature review explored cooperative learning which was used in this study. The next section of the literature review examines research on student leadership.

Student Leadership

Cohen (1976) discussed in his study that an effective classroom correlates to a classroom that is built like a successful business organization. He pointed out that group formations have to be carefully articulated. He implied leaders need to be "recruited, motivated, controlled and rewarded" (p13). Thus, within a group setting, members must have clear and concise expectations. This will lead to groups having goals set, a structure of decision-making created and work allocated when and where necessary.

Foster and Carboni (2009) validated this idea by Cohen by addressing the concern that today's classrooms are not adequately developing the practical and needed leadership skills that are required in the real world of management. Their solution was to build a leadership paradigm within the walls of the classroom so students can develop those needed leadership skills and grow into effective leaders. These researchers duly note that today's instructors are very reluctant to articulate and implement this type of experimental teaching model.

Other researchers found that dividing a large classroom into subgroups can be an effective educational strategy. The common theme between these researchers was that a leadership model has to be structured within the classroom walls. Within the subgroups,

there was a delegation of leadership to assistants or capable students (Porrás, 2004; Graf and Couch, 1984; Bradford and LeDuc, 1975).

This section of the literature review explored student leadership which was used in this study. The next section of the literature review examines a leadership model implemented in a secondary classroom.

A Leadership Model Implemented into a Secondary Classroom

After 17 years of implementing cooperative learning in the classroom, Belin (1999) noted there was an essential piece missing. Thus, the educator observed students not collaborating effectively with each other, conflict with-in group structures causing the teacher to restructure groups over and over again, student achievement stagnant, and students simply not caring about each other and in some cases not even caring about themselves. The essential missing piece of the classroom environment was a structure of leadership in the classroom. The seasoned teacher came across the following three books by Dale Carnegie: *How to Win Friends and Influence People* (1936); *How to Stop Worrying and Start Living* (1948); and *The Leader in You* (1990). The books helped him to develop a three-part leadership training session making the classroom more effective.

The teacher first handed out a student leadership contract to every one of his students to solicit leadership candidates (see Appendix C). He reviewed every application and carefully selected 6 to 7 group leaders for each class. The group leaders then went through three brief leadership sessions that spanned from 10 to 15 minutes. The first leadership session addressed how to bring a spirit of humility to the cooperative groups (see Appendix H). The teacher encouraged and motivated his student leaders that these were their groups for better or worse. He did instruct his group leaders that he was

there for them to help resolve group conflict, unclear expectations or whatever else that might arise in their groups.

After implementing the student leadership paradigm into his classrooms, he noticed student achievement of particular assessments rose 3 to 10 percentage points in both an Algebra 2 and Geometry class in the fall of 2010. Students embraced their leadership roles and exceeded expectations demonstrated by test scores and the observation of an effective classroom environment. Students' positive attitudes about math and the class became infectious where other students wanted to be group leaders. Other students yearned to possess a leadership role within the classroom setting. During the school year, the teacher created new leadership roles to accommodate more students. These newly created roles were the following: supplies leader, calculator leader, door and greeter leader, classroom management leader, paperhanger leader, recorder leader and board leader. The at-risk student population (students with high failure rates in mathematics) within the classes was becoming more successful in math dwindling this particular teacher's failure rate to almost 0%. Three at-risk students went from dreading mathematics to becoming an effective student leader by the end of the 2010-2011 school year.

This section of the literature review explored a student leadership model which was used in this study. The next section of this paper examines the methods used in this study to address the following research questions:

1. Does the experimental strategy of leadership collaboration learning enhance students' attitudes and understanding of the mathematical concepts covered in this paper?

2. Did the experimental cooperative learning leadership model impact students' academia?
3. Who will benefit more from the experimental instruction – the leaders or the participants from the group, or both?

Methods

This study used a well-known instrument designed by Tapia (1996) called the Attitudes Towards Mathematics Inventory (ATMI). Tapia (1996) developed a model to measure students' attitudes towards mathematics after witnessing scores of students' displeasure in the discipline. Tapia created this model to articulate the underlying factors of why someone either liked or disliked mathematics. Students were asked to measure their level of agreement by selecting strongly agree, agree, neutral, disagree and strongly disagree. The model's fundamental foundation identifies self-confidence, value, enjoyment and motivation as key factors when measuring the attitudes of students in mathematics.

The next section of this essay is going to discuss the participants and location of the study. Instruments and materials will be discussed as well as the design and procedure implemented in this study.

Participants

Participants (N=36) were enrolled in one section of a college mathematics class called Basic Technical Mathematics. The class is a prerequisite for many fields of study but predominantly for Mechanical Engineering Technology (MET). The class met twice a week for an hour and a half each session. It was a semester long class meeting over a period of 17 weeks. Twenty-eight of the 36 students are MET majors with the other eight

majors spanned from Construction Management, Computer Graphics, Organizational Leadership Supervision and Electrical Engineering. All students were given a consent form (see Appendix A) prior to their involvement of the study. Most of the students are employed working from 20 to 40 hours a week.

Location

This study took place at a four-year university located in Hammond, Indiana. The school has a vastly diverse population drawing students from several parts of the world with a litany of several academic offerings. The university offers baccalaureate and master's degrees in 50 programs of study, plus professional certificates, in such traditional strengths as engineering; technologies; professional programs of nursing, management/business and education; natural, behavioral and social sciences; communication; and the liberal arts. More than 9,000 students are enrolled with over six hundred international students. The university has issued more than 50,000 degrees.

Instruments and Materials

Pre-leadership cooperative learning model survey. A pre-designed survey was used to assess students' attitude towards mathematics called Attitudes Towards Mathematics Inventory (ATMI). The ATMI survey (see Appendix B) was given to students on the end of the tenth week of the course. This took place after the tenth week's lecture. The Attitudes Towards Mathematics Inventory consists of 40 questions that measure four factors affecting student attitude---self-confidence, value, enjoyment and motivation. It has a validity of 0.97 with college students and the content validity has been established (Tapia, 1996). The survey is based on a 5-point scale that ranges from *Strongly Disagree*

(1) to *Strongly Agree* (5). Examples of questions that students were asked to agree or disagree include the following (see Appendix B):

Mathematics is important in everyday life.

I really like mathematics.

Mathematics is dull and boring.

Post-leadership cooperative learning model survey. The ATMI survey was given again after the experimental learning model was implemented in the class. The exact same questions were asked again but an additional three questions were added in the post-survey (see Appendix I) to gauge the impact of the experimental learning model.

The additional three questions were as follows:

41. Did the leadership cooperative learning model enhance your overall experiences in the class?
42. Did the leadership cooperative learning model enhance your attitudes towards mathematics?
43. Did you understand the complex number unit better than the other mathematical units taught in the course after the leadership cooperative learning model was implemented in the class?

Design and Procedure

This study took place during the end of the first semester of the 2015-2016 school year. On the ninth week of the course, students were given the opportunity to fill out a leadership application (see Appendix G) for the student leadership roles of the experimental cooperative learning model that was installed for the twelfth and thirteenth week classes. Nine students were selected based on the analysis of their applications.

The student leaders chosen were students who frequently or always attends class; got along with most or all students contingent on various circumstances; and leaders who received grades of at least a B or higher in their mathematical classes. The applications contained other open ended questions to help give a perspective of the future potential leaders.

During the eleventh week of the course, a leadership workshop session was conducted explaining the expectations of the leadership cooperative learning model (see Appendix H). The session took about a half hour and provided students some quotes on leadership and emphasized three tenants the leaders needed to embrace. The ideas and articulation of these tenants came from the scholarship of the author Carnegie (1936, 1948 and 1990). These three tenants are as follows:

1. Don't complain, criticize or condemn but bring a spirit of humility to your cooperative group.
2. Give honest, sincere appreciation and demonstrate the importance of each person in your group.
3. Creatively arouse in another person an eager want.

Also during the eleventh week of the course, the leaders were informed who was in their group. Leaders were implored and encouraged to get to know the people in their group. The leaders were also informed that they would be provided ice-breakers before each session of the experimental leadership cooperative learning model. Since the beginning of the course, students infrequently addressed each other by name. There was a litany of opportunities for students to engage with each other every class whether it was before or after class or when they worked on math problems at the classes' conclusion. The

teaching methodology before the experimental cooperative learning leadership model was the following:

1. Opened each class with general announcements and took questions from students about the previous lecture.
2. Introduced the new lesson providing perspective of its real world applicability.
3. Taught the mathematical lesson in a traditional setting with little to no student engagement.
4. Allowed the last fifteen minutes or so for students to do "like problems" in groups which was similar to what was presented. These activities were called cooperatives and done every lesson. The expectation was for students to check their answers with at least two or more students before they left the class.

Once they finished the cooperative task, they were excused from the class.

During the leadership training, the expectations were outlined for the group leaders. Leaders were inspired to have meaningful conversations of what they just learned in the lesson. Thus, group leaders were instructed to ask for reflection about the day's lesson and as a group to clarify any misconceptions or confusion that the lesson may have presented before they did the end of class cooperative learning problems.

Lastly, leaders made sure cooperatives were done correctly and checked for understanding before the class was dismissed.

The next section of this report discusses the findings in this study. The findings of the ATMI will be presented two-fold. First, the ATMI model will be presented pre-installation of the collaborative leadership model as well as post-installation of the model.

Findings

Findings of the ATMI. The purpose of this study was to examine whether an experimental learning mechanism would affect the attitudes of students in a collegiate mathematics course. Certain themes emerged from the data to support the use of a leadership collaborative grouping methodology. Several students found the new format of the classroom "unique, strategic and beneficial." All 36 students of the class agreed to take in part of the pre and post surveys as well as participate in the collaborative leadership-learning environment. All 36 students were able to participate in at least one of the cooperative leadership learning sessions that were conducted during the 12th and 13th week of the course. Thirty-three or 92% of the students were able to attend at least two of the sessions while twenty-nine or 85% of the students attended all of the sessions. However, due to factors beyond control of this study, only 32 or 89% were able to take both surveys due to absences in the class when the surveys were conducted.

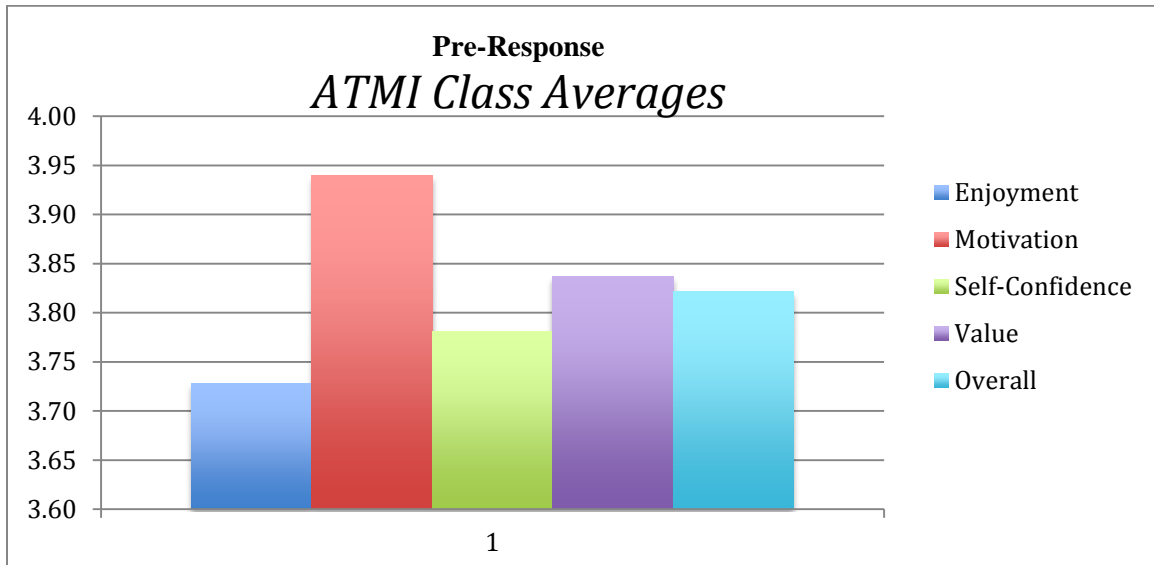
Pre-installation of the collaborative leadership model viewpoints. During the 10th week of the course, the pre-designed survey called the Attitudes Towards Mathematics Inventory (ATMI) was passed out and assessed by the students of the class (see Appendix B). Student responses from the initial ATMI survey revealed that 30 out of 32 students representing 94% of the survey respondents had a favorable over-all view of mathematics. The survey is based on a 5-point Likert Scale ranging from viewing mathematics negatively (1) to positively (5) where the inventory computes neutral (3) ground as well. However, 11 questions had to be adjusted to properly represent the measurement of the student attitude:

9. Mathematics is one of my most dreaded subjects.
10. My mind goes blank and I am unable to think clearly when working with mathematics.
11. Studying mathematics makes me feel nervous.
12. Mathematics makes me feel uncomfortable.
13. I am always under terrible strain in math class.
14. When I hear the word mathematics, I have a feeling of dislike.
15. It makes me nervous to even think about having to do a mathematical problem.
20. I am always confused in my mathematical class.
21. I feel a sense of insecurity when attempting mathematics.
25. Mathematics is dull and boring.
28. I would like to avoid using mathematics in college.

For instance, student 1, who enjoys mathematics, scored question 25 a 1 on the Likert score (*strongly disagree*) from the pre-test (see Figure 4). The score of 1 was changed to a 5 (*strongly agree*) to accurately reflect the student's positive attitude of mathematics.

Two students (6%) had a slightly negative attitude towards mathematics. Nine students (30%) tabulated a score over 4.00 meaning they have a strong favorable view of the overall mathematics experience. The individual results for each sub-category are summarized in Appendix J. The complete class results for each sub-category are represented in a graph in Figure 1.

Figure 1: Initial ATMI Complete Class Survey Overall Results - Conducted during the Tenth Week of the Course



The overall averages of the students' attitudes of the pre-survey was 3.73 for enjoyment, 3.94 for motivation, 3.78 for self-confidence, 3.84 for value and 3.82 for overall experience of mathematics.

It was not surprising that most students had a favorable view of mathematics given the fact that almost every student in the class had a major relating to a mathematics field. Several students expressed excitement prior to the installation of the leadership model. During the eleventh week of the course, four students questioned how the class was going to change and wanted clarity on how it was going to impact their grades. In terms of assessing grades, the leadership model did not attribute any points to the students' final grades. It was described to the students that the objective of the leadership model was to strengthen the student engagement towards mathematics during the

cooperatives. The point system of the cooperatives would remain the same prior to the installation of the model. Two students wanted to pick the group they were going to work with but it was explained that the distribution of the students was going to be random. One student said, "This really sounds cool." Another student voiced, "I hope these leaders know what they are doing." One of the leaders joked, "I don't know what I am doing but I did stay at a Holiday Inn Express last night." Most of the class laughed and seemed to embrace the new idea and direction the class was embarking on.

However, the anticipation of the newly modeled class did receive opposition by three students who expressed apprehension towards change.

Observations of the leadership collaborative learning model. During the twelfth week of the course, the first session was conducted. After the lecture of complex numbers, the students gathered into their assigned groups. The first few minutes the student leaders introduced themselves and asked each member to introduce him or herself as well. This process lasted about ten minutes. After ten minutes, the nine groups discussed how they were going to work out the collaborative problem. The problem was a mathematical model that required adding complex numbers. Seven of the nine groups dialogued throughout the entire calculation process. As mentioned earlier in this study, few students addressed each other by name prior to the installation of the leadership model. On this particular day, students were addressing each other by name something that was not present before the installation of this model. Conversely, two groups had very little discussion. All nine groups did the problem correctly. Each group leader turned their folder in before leaving the class. The two group leaders were encouraged to

engage the group more for the next lecture while the other seven group leaders were praised for implementing the model with enthusiasm and grace.

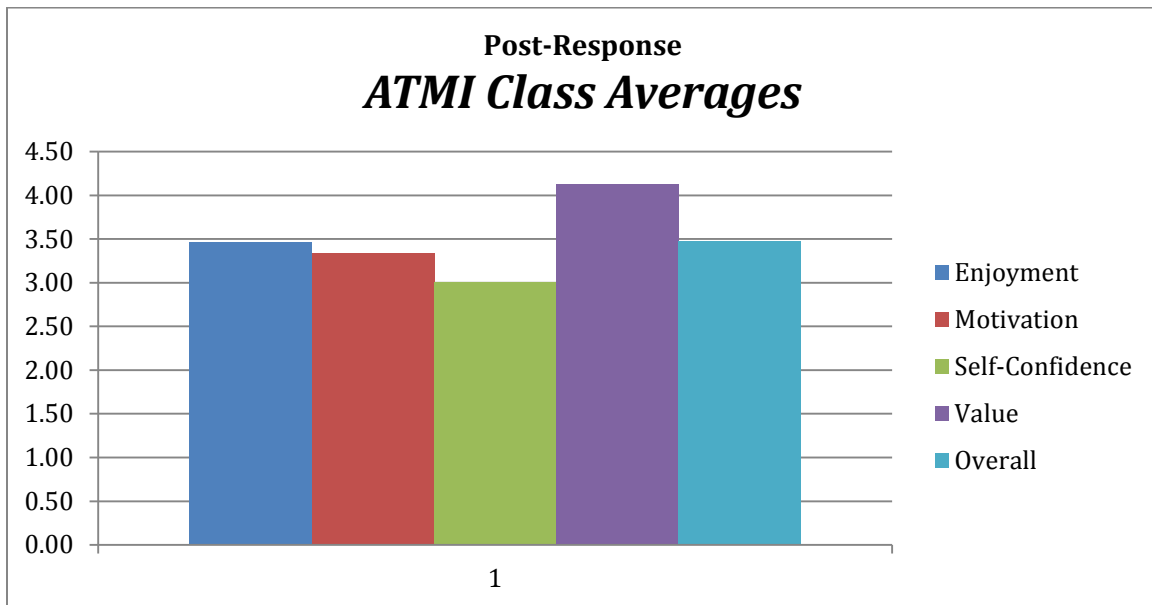
During the next lecture, the experimental model excelled. The lesson was simplifying complex representations. After the lesson, students gathered to their groups more quickly than the previous class. The groups did a quick icebreaker that was provided for them prior to discussing the collaborative problems. The icebreaker was sharing something bizarre about themselves that most did not know. After the groups conducted this task, they engaged in the cooperative. All 9 groups collaborating better than the previous class. From this particular class there was observed helping, clarifying and encouraging not only by the leaders but several other participants. This particular class cooperative was to multiply, divide and graph complex numbers. Six of the 9 groups (67%) completed the three rote problems with 100% accuracy. Seven of the 9 groups (78%) correctly completed two of the problems while all 9 groups (100%) did at least one of the problems correctly.

The following class posed some challenges. Six students needed clarification of the previous assignment before the next lecture was conducted. The lecture left only 7 minutes for students to discuss their cooperative. The icebreaker was cancelled due to the time constraints. Thus, the cooperative was reduced to one problem, which was a complex mathematical model where students had to multiply complex numbers to calculate the voltage of a certain electricity circuit. There was dialogue but it was in haste. Most students were attempting to get the problem done in the time span allotted for the remaining time in class. Again, the group members referred to each other by

name and clarification and encouragement by both leaders and others were observed in this class. Six of the nine groups (67%) did the problem accurately.

Post-installation of the collaborative leadership model viewpoints. After the last lecture of the experimental model, the ATMI survey was conducted again (Appendix I) with an additional three questions measuring the students' attitudes towards the experimental learning model. The individual results for each sub-category are summarized in Appendix K of the post ATMI survey. The complete class results for each sub-category of the post ATMI survey are represented in a graph in Figure 2.

Figure 2: Post ATMI Complete Class Survey Overall Results - Conducted during the Thirteenth Week of the Course



The next section of this essay is going to discuss the application of the findings of this experimental study. Analysis of t-scores will be discussed as well as limitations and future actions of this particular study.

Discussion and Extension

Application of Findings. The purpose of this study was to explore whether the implementation of an experimental leadership cooperative model would impact the attitudes of students in a collegiate mathematics class. A reputable researched-tested ATMI survey was the instrument used to measure the attitudes of the students. Table 6 includes students' pre- and post-ATMI findings including standard deviation and t-values.

Analysis of the t-scores. For the data analysis, a paired t-test was calculated. The null hypothesis is $\mu = 0$ because if the leadership groups did not make a difference, the pre-test and post-test would be the same. The alternate hypothesis is $\mu < 0$. When one subtracts the pre-test and post-results, the assumption is that the post-test scores are higher thus rendering a negative number. The conditions for performing a paired t-test include normality, independence, and a simple random sample. Normality can be used due to the Central Limit Theorem since the sample size was 30 or more. For independence, all 32 students' responses are independent observations. For simple random sample one can only make inferences on the entire population of students taking this class at Purdue Calumet. In order to make inferences about other math classes, one would need samples from other classes.

The paired t-test scores were calculated as follows:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} \quad t=3.76 \text{ with a p-value } .9996.$$

The analysis of pre and post-test. The ATMI was a pre- and post-survey assessment. The overall data showed that for 12 students (37.5%) the attitudes of

mathematics increased while for 20 students (62.5%) the attitudes shifted in an unfavorable direction.

Calculations of Responses to Questions

This next paragraph is going to describe and outline how the calculations were computed. A sample of assigned student 1 on post-test (see Figure 5) Likert score who enjoyed math was calculated as follows:

- 3. I get a great deal of satisfaction out of solving a mathematics problem - 5
- 24. I have usually enjoyed studying mathematics in school -5
- 25. Mathematics is dull and boring - 1
- 26. I like to solve new problems in mathematics - 4
- 27. I would prefer to do an assignment in math than to write an essay - 4
- 29. I really like mathematics - 5
- 30. I am happier in a math class than any other class - 5
- 31. Math is a very interesting subject - 4
- 37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math - 4
- 38. I am comfortable answering questions in math class - 4

First, question 25 score was changed from 1 to 5 to accurately measure assigned student 1 score. If 1 was calculated, then the student's enjoyment score would be lower and the data would not be accurately presented. All ten entries were added together and then divided by 10. As indicated in Figure 5, the student scored a 4.50/5.00 in the enjoyment section. A score above 3 (neutral) would generate a favorable attitude. Since 4.50 is

greater than 3, this indicated that assigned student 1 possess a favorable view of the enjoyment of mathematics.

In the overall enjoyment of mathematics category, 20 students' (62.5%) attitudes decreased from the first survey, eight (25%) stayed the same and only 4 (12.5%) students' attitudes increased.

The second category is the motivation factor of math. The statements in the motivation category labeled by the number of the survey are the following:

23. I am confident that I could learn advanced mathematics.
28. I would like to avoid using mathematics in college.
32. I am willing to take more than the required amount of mathematics.
33. I plan to take as much mathematics as I can during my education.
34. The challenge of math appeals to me.

Tapia (1996)

In the motivation of mathematics category, 26 students' (81.25%) attitudes decreased from the first ATMI survey and only 6 (18.75%) students' attitudes increased.

The third category is the self-confidence of math. The statements in this category labeled by the number of the survey are the following:

9. Mathematics is one of my most dreaded subjects.
10. My mind goes blank and I am unable to think clearly when working with mathematics.
11. Studying mathematics makes me feel nervous.
12. Mathematics makes me feel uncomfortable.
13. I am always under a terrible strain in a math class

14. When I hear the word mathematics, I have a feeling of dislike.
15. It makes me nervous to even think about having to do mathematics problem.
16. Mathematics does not scare me at all.
17. I have a lot of self-confidence when it comes to mathematics.
18. I am able to solve mathematics problems without too much difficulty.
19. I expect to do fairly well in any math class I take.
20. I am always confused in my mathematics class.
21. I feel a sense of insecurity when attempting mathematics.
22. I learn mathematics easily.
40. I believe I am good at solving math problems.

Tapia (1996)

In the self-confidence of mathematics category, 23 students' (71.875%) attitudes decreased from the first ATMI survey and 9 (28.125%) students' attitudes increased.

The final category is the students' value of math. The statements in this category labeled by the number of the survey are the following:

1. Mathematics is a very worthwhile and necessary subject.
2. I want to develop my math skills.
4. Mathematics helps develop the mind and teaches a person to think.
5. Mathematics is important in everyday life.
6. Mathematics is one of the most important subjects for people to study.
7. University math courses would be very helpful no matter what I decide to study.
8. I can think of many ways that I use math outside of school.

35. I think studying advanced math is useful.
36. I believe studying math helps me with problem solving in other areas.
39. Strong math background could help me in my professional life.

Tapia (1996)

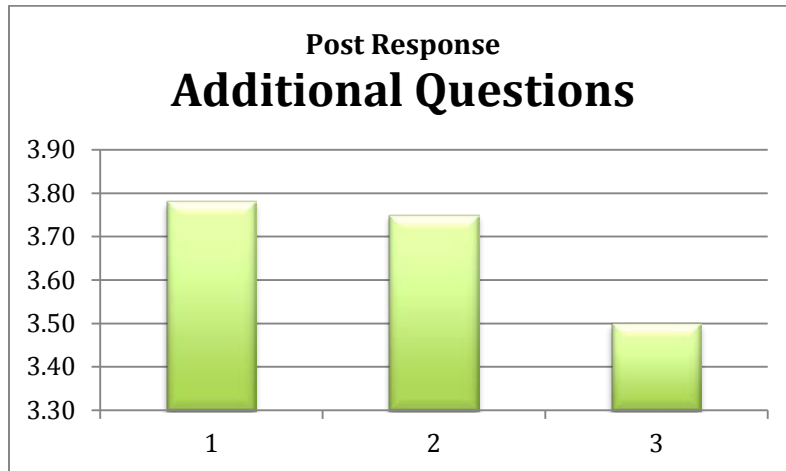
In the value of mathematics category, 11 students' (34.375%) attitudes decreased from the first survey and 21 (65.625%) students' attitudes increased.

There were some surprising findings on the additional three questions focusing on the experimental teaching methodology. Figure 3 analyzes the students' attitudes towards the implementation of the experimental leadership cooperative model. The survey is based on a 5-point scale that ranges from *Strongly Disagree* (1) to *Strongly Agree* (5). Examples of questions that students were asked ranging from strongly agreeing (5) to strongly disagreeing (1) with neutral being three (3) include the following (see Appendix I):

41. Did the leadership cooperative learning model enhance your overall experiences in the class?
42. Did the leadership cooperative learning model enhance your attitudes towards mathematics?
43. Did you understand the complex number unit better than the other mathematical units taught in the course after the leadership cooperative learning model was implemented in the class?

The complete class results of the implementation of the cooperative leadership model are represented in a graph in Figure 3.

Figure 3: Student Attitudes of the Leadership Cooperative Model - Conducted during the Thirteenth Week of Course



Articulations of the Findings

Most people dread change and that is applicable in the classroom as well. The research of Harris (2003) and Guskey and Peterson (1995-1996) concluded that students demonstrate anxiety and resistance to change when a new methodology or idea is incorporated in the classroom setting. There is evidence that is what occurred in this study.

During the first week of the course, students were notified that an experimental model was going to be implemented in the course. The model were outlined during that class and the students seemed indifferent about the research. There was no questions or concerns from the students. During the ninth week of the course, the research was approved from the Institutional Review Board (IRB) of Governors State University to begin collecting data. During that week, the class was informed about the approval and installation of the experimental leadership model. Three students raised some concerns. One student said, "I don't understand why you would change any aspect of the class."

“It’s a great class already, why change,” another student chimed in. Yet another student voiced concerns that the teacher was playing favorites for the leadership team. This particular student did apply to be a leader but was not selected to be part of the leadership team. It is possible that this student expressed her displeasure during the second ATMI survey. Appendix M indicated that Student 4 and Student 25 (6.25%) strongly opposed the experimental cooperative leadership model. Student 3, Student 16 and Student 19 (9.375%) trended in the unfavorable position of the model as well scoring 2.67, 2.67 and 2.33 respectfully. Consequently, five students (15.625%) had a negative view of the experimental model. However, the other 27 students (84.375%) had favorable views of the model with 4 students scoring it a 5.00 and 11 students scoring the methodology 4.00 or higher. With an overwhelming positive views of the leadership model, it is curious that the pre ATMI scored an overall 3.82 but the post score dropped 0.34 points to 3.48.

Limitations

It is hard to truly measure the impact and effectiveness of this experimental leadership cooperative learning model. For one, this mechanism was conducted for only three classes. A more effective approach would be to implement this strategy for the entire semester or a larger chunk of the semester, then measuring the attitudes of the students. A practical approach would be first to teach half the class in a tradition setting atmosphere, then implementing the experimental model. Students would take the ATMI surveys before the first teaching approach and then take the second survey after the experimental approach. This would be pragmatic because it would give the students more time to assess and articulate the two teaching approaches. This particular study did not allow a significant amount of time for the students to assess their attitudes towards

math validated through very little change from the two ATMI surveys conducted in the class.

Another limitation in this study was the lack of measuring students' academic growth. If the model spanned over more academic time, then measuring student growth could be a consideration.

Future Actions and Directions

Given the limitations discussed in the previous section, it might be beneficial to implement the experimental model much earlier in the course. Figure 3 and Figure 7 demonstrated that 27 of the 32 students (84.375%) had a favorable view of the experimental model. With this portion of support, it would seem probable that more students would reap benefits from this experimental method. Question 43 of the second survey asked the following:

Did you understand the complex number unit better than the other mathematical units taught in the course after the leadership cooperative learning model was implemented in the class?

This question scored a 3.50/5.00. This may validate the need for another study to measure if this type of model can have a positive impact on student growth.

Thus, another consideration is to span the ATMI survey over a longer period of time. In this study due to the constraints of the approval for the research, there was only a three week span between the surveys. Unfortunately, the survey was conducted over the most challenging and tedious mathematics academia – the unit of complex numbers. A more practical span would be a month or two in order for students to articulate their

attitudes about the discipline of mathematics taking in to account the experimental teaching strategy.

Conclusions

The data results found in Figure 3 and Figure 7 indicate that both leaders and participants benefitted from the experimental learning strategy. After the implementation of the model, students were comfortable interacting with their cooperative groupings. After the implementation of the experimental model, all nine groups engaged in effective cooperative group learning. This type of class demeanor was not present prior to the implementation of the experimental model. Students were engaged in the material and seemed to enjoy conversing among their groups. The group leaders embraced their appointment and conjectured with their groups with a spirit of grace and dignity.

It is inconclusive to determine whether the leadership model enhanced students' attitudes and understanding of the complex unit. The question on the post survey should have focused on just academia or students' attitudes, not both. Students' overall attitudes did dip from the pre and post ATMI surveys so a case can be articulated that student attitudes were not enhanced. It is also worth noting that perhaps the students just did not like the complex unit and it impacted their attitudes of math when taking the second survey.

The research found that students did have a favorable view of the experimental leadership model by evidence of question 43 which asked the following:

Did you understand the complex number unit better than the other mathematical units taught in the course after the leadership cooperative model was implemented in the class?

The 32 students scored it a 3.50/5.00. Thus, a case can be made that students felt that the model helped them understand the material better. However, as discussed in the limitations section of this study, it is difficult to measure student understanding unless a quantitative pre and post-test is conducted and even that has limitations. Based on the results from this study, there is need for further study using a student leadership model.

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Appendix A

Informed Consent Statement

Research Study: Measuring Attitudes Towards Mathematics

You have been selected to participate in a research study because you are enrolled in a mathematics class at Purdue University Calumet. The study is designed to measure the attitudes of students towards studying mathematics utilizing a leadership collaboration instructional technique. The study consists of a survey with multiple-choice questions, which you will be asked to answer. Your only commitment to the study is the completion of a survey before and after the study of complex numbers unit.

The survey results will be tabulated and analyzed. All data collected from the study will be kept in a secure file and destroyed upon the completion of the project. Your participation in this study is voluntary and you may refuse to participate or withdrawal at any time without penalty. All participation is anonymous.

The Governors State University Institutional Review Board (human subjects) has approved this research. Information on the Governors State University policy and procedures for research can be obtained from the Office of Sponsored Programs and Research at 708-235-3308. Questions about the study can be directed to Dianna Galante PH.D. at 708-534-4127 or by email dgalante@govst.edu

Sincerely,

Dianna Galante

- I acknowledge that I am at least 18 years old**
- I give my consent and wish to participate in the study**
Your printed name _____
Your signature _____
- I do not wish to participate**

Appendix B

Attitudes Towards Mathematics Inventory (ATMI)

Directions: This inventory consists of statements about your attitude towards mathematics. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel for each item. Choose the number that most closely corresponds to how each statement best describes your feelings and place it on the line next to the statement. Please answer every question.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

-
1. Mathematics is a very worthwhile and necessary subject. _____
 2. I want to develop my mathematical skills. _____
 3. I get a great deal of satisfaction out of solving a mathematical problem. _____
 4. Mathematics helps develop the mind and teaches a person to think. _____
 5. Mathematics is important in everyday life. _____
 6. Mathematics is one of the most important subjects for people to study. _____
 7. High school math courses would be very helpful no matter what I decide to study. _____
 8. I can think of many ways that use math outside of school. _____

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

9. Mathematics is one of my most dreaded subjects. _____
10. My mind goes blank and I am unable to think clearly when working
with mathematics. _____
11. Studying mathematics makes me feel nervous. _____
12. Mathematics makes me feel uncomfortable. _____
13. I am always under terrible strain in math class. _____
14. When I hear the word mathematics, I have a feeling of dislike. _____
15. It makes me nervous to even think about having to do a mathematical
problem. _____
16. Mathematics does not scare me at all. _____
17. I have a lot of self-confidence when it comes to mathematics. _____
18. I am able to solve mathematical problems without too much difficulty. _____
19. I expect to do fairly well in my mathematical class. _____
20. I am always confused in my mathematical class. _____
21. I feel a sense of insecurity when attempting mathematics. _____
-

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

-
- 22. I learn mathematics easily. _____
 - 23. I am confident that I can learn advanced mathematics. _____
 - 24. I have usually enjoyed studying mathematics in school. _____
 - 25. Mathematics is dull and boring. _____
 - 26. I like to solve new problems in mathematics. _____
 - 27. I would prefer to do an assignment in math than write an essay. _____
 - 28. I would like to avoid using mathematics in college. _____
 - 29. I really like mathematics. _____
 - 30. I am happier in a math class than any other class. _____
 - 31. Mathematics is a very interesting subject. _____
 - 32. I am willing to take more than the required amount of mathematics. _____
 - 33. I plan to take as much mathematics as I can during my education. _____
 - 34. The challenge of math appeals to me. _____
 - 35. I think studying advanced mathematics is useful. _____
 - 36. I believe studying math helps me with problem solving in other areas. _____

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

37. I am comfortable expressing my own ideas on how to look for solutions to a
difficult problem in math.

38. I am comfortable answering questions in math class.

39. A strong math background could help me in my professional life.

40. I believe I am good at solving math problems.

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Appendix C

Leadership Application

“If you have knowledge, let others light their candles by it.” Thomas Fuller

Name _____ Period _____

1. What are some of your strengths in school?

2. What are some of your weaknesses in school?

Check the following areas of leadership you are interested in applying for:

_____ Group Coordinator. The group coordinator is in charge of the folders. This person is responsible for reporting to me by the end of class about the assigned coops for the group.

_____ VP Person. This person would be assigned the seat next to my desk. Hence, this leadership position is in charge of the calculator and answering the phone if it were to ring. The phone must be answered, “Mr. Belin’s room, room 15, may I help you.” This person must have good interpersonal skills and be able to handle multiple tasks at one time. The VP may have to handle other tasks in the class if a student leader is not present in the class.

_____ Pass Person. This person would be assigned the seat by the door and intersect all passes for the class. This person will have a seating chart to verify if the person is in attendance or not. The main responsibility of this leadership position is to make sure Mr. Belin’s lecture is not interrupted. This person will give the student the pass **after** the lecture.

_____ Board preparer. This leadership role requires one to have extremely neat handwriting. The main responsibility of this position is to prep the boards for next class (i.e. warm-up, title heading...). Mr. Belin will give you supporting materials for this position.

_____ Material leader. The main responsibility of this position is to provide pencils or other material to students. There will be a tracking mechanism for accountability purposes.

_____ Homework Center fill-in person. This leadership position requires one to fill in for homework center when necessary.

_____ Warm-up fill-in person. This leadership position requires one to fill in for homework center when necessary.

_____ Sudoku Expert. This leadership position requires one to help others with their Sudoku puzzles. This person needs to understand the schematics of the puzzle and be able to communicate it to others in a clear and concise ways.

_____ I am interested and open to several leadership positions of the class. Please assign me accordingly to what you see fit.

_____ I am not interested in any leadership position at this time. If school attendance is an issue, please check this category.

Appendix D

Leadership Training Session #1

Based on the work of Dale Carnegie

Today's Focus: **How to effectively to lead people**

Character Tenet #1: Don't complain, criticize or condemn but bring a spirit of humility to your group.

World famous psychologist B.K. Skinner observed that animals rewarded for good behavior outperformed the animals that were punished for bad behavior.

President Lincoln after a life altering experience never criticized, ridiculed nor insulted another again. His motto: *Have malice for none but charity for all.*

"When dealing with people, let us remember we are not dealing with creatures of logic. We are dealing with creatures of emotion, creatures bristling with prejudices and motivated by pride and vanity." Carnegie

"I will speak ill of no man and speak all the good I know of everybody." Franklin

"A great man shows his greatness by the way he treats little men." Carlyle

"As much as we thirst for approval, we dread condemnation." Selye

"I have enough trouble overcoming my own limitations without fretting over the fact that God has not seen fit to distribute evenly the gift of intelligence." Wanamaker

Look over these quotes by people of legend. They inspired millions by what they said and did. Think about how you can contribute to their efforts by helping me lead my math class to an incredible experience of learning, fun and inspiring meaningful relationships. I thank you for your spirit and dedication on this endeavor we are about to take. R.Belin

(cut bottom and return to me ASAP)

Teacher signature _____

Student signature _____ **Period** _____

Parent signature _____

Appendix E

Leadership Training Session #2

Based on the work of Dale Carnegie

Today's Focus: **How to effectively motivate people, even those who don't want to be**

Character Tenet #1: Don't complain, criticize or condemn but bring a spirit of humility to your group.

"God Himself, sir, does not propose to judge man until the end of days." Dr. Johnson

Character Tenet #2: Give honest, sincere appreciation and demonstrate the importance of each person in your group.

Dale Carnegie believes there is only one way to get someone to do anything. The answer is to get the person to want to do it.

John Dewey, who is one of America's most profound philosophers, said "everyone has the desire to be important."

"The deepest principal in human nature is the craving to feel appreciated." William James

Multi-millionaire Charles Schwab struck it rich not by his knowledge base of the manufacturing industry but how he dealt with people. He said, "The greatest asset I possess is the ability to arouse enthusiasm among my people and the best way to develop that is by appreciation and encouragement."

Clinical therapists declare that people may actually go insane in order to find, in the dreamland of insanity, the feeling of importance that has been denied them in the harsh world of reality.

Look over these quotes by people of legend. They inspired millions by what they said and did. Think about how you can contribute to their efforts by helping me lead my math class to an incredible experience of learning, fun and inspiring meaningful relationships. I thank you for your spirit and dedication on this endeavor we are about to take. R.Belin

(cut bottom and return to me ASAP)

Teacher signature _____

Student signature _____ **Period** _____

Parent signature _____

Appendix F

Leadership Training Session #3

Based on the work of Dale Carnegie

Today's Focus: **How to motivate and lead people into greatness**

Character Tenet #1: Don't complain, criticize or condemn but bring a spirit of humility to your group.

"God Himself, sir, does not propose to judge man until the end of days." Dr. Johnson

Character Tenet #2: Give honest, sincere appreciation and demonstrate the importance of each person in your group.

Dale Carnegie believes there is only one way to get someone to do anything. The answer is to get the person to want to do it.

Character Tenet #3: Creatively arouse in another person an eager want

As a leader we need to be mindful of the following: much like hooking a worm to catch a fish, we need to find ways to hook people of what we think they need.

"The one secret of success is the ability to get the other person's point of view and see things from that other person's angle as well as from your own." Henry Ford

"The world is full of people who are grabbing and self-seeking; so rare the individual who unselfishly tries to serve others has an enormous advantage." Carnegie

Look over these quotes by people of legend. They inspired millions by what they said and did. Think about how you can contribute to their efforts by helping me lead my math class to an incredible experience of learning, fun and inspiring meaningful relationships. I thank you for your spirit and dedication on this endeavor we are about to take. R.Belin

(cut bottom and return to me ASAP)

Teacher signature _____

Student signature _____ **Period** _____

Parent signature _____

Appendix G

Purdue University Calumet

Student Leadership Application

Name of student _____

Circle the best answer that describes you for 1 through 3 and briefly explain for questions 4 through 9.

1. How often do you attend class?

A) Always (never miss a class)

B) Frequently (may miss 1 to 3 classes)

C) Sometimes (will miss 4 to 6 classes)

D) Seldom (will miss more than 6 classes)

2. How would you describe your collaboration skills?

A) I get along with everybody no matter how they treat me or perceive me

B) I get along with most contingent on circumstances

C) I have difficulty getting along with other students

D) I try to avoid interaction with other students

3. How would you describe your mathematical abilities?

A) Straight A's in all my math classes in high school & college

B) Mostly all A's in my math classes in high school & college

C) Mostly B's in my math classes in high school & college

D) Passed all my math classes in high school & college

4. What was your favorite math class in high school or college? Why?

5. What was your least favorite math class in high school or college? Why?

6. Briefly describe your strengths as a student.

7. Briefly describe the skills you need to work on as a student.

8. How do you personally handle stress?

9. How would you calm a contentious situation with a group of people?

Thank you for taking the time to consider and apply for a leadership position for my class.

Appendix H

Leadership Training Session – Purdue University Calumet

Based on the work of Dale Carnegie

Today's Focus: **How to effectively to lead people**

Character Tenet #1: Don't complain, criticize or condemn but bring a spirit of humility to your group.

"A great man shows his greatness by the way he treats little men." Carlyle

"As much as we thirst for approval, we dread condemnation." Selye

Character Tenet #2: Give honest, sincere appreciation and demonstrate the importance of each person in your group.

Dale Carnegie believes there is only one way to get someone to do anything. The answer is to get the person to want to do it.

Multi-millionaire Charles Schwab struck it rich not by his knowledge base of the manufacturing industry but how he dealt with people. He said, "The greatest asset I possess is the ability to arouse enthusiasm among my people and the best way to develop that is by appreciation and encouragement."

Character Tenet #3: Creatively arouse in another person an eager want

As a leader we need to be mindful of the following: much like hooking a worm to catch a fish, we need to find ways to hook people of what we think they need.

"The one secret of success is the ability to get the other person's point of view and see things from that other person's angle as well as from your own." Henry Ford

"The world is full of people who are grabbing and self-seeking; so rare the individual who unselfishly tries to serve others has an enormous advantage." Carnegie

Look over these quotes by people of legend. They inspired millions by what they said and did. Think about how you can contribute to their efforts by helping me lead my math class to an incredible experience of learning, fun and inspiring meaningful relationships. I thank you for your spirit and dedication on this endeavor we are about to take. R.Belin

Appendix I

Attitudes Towards Mathematics Inventory (ATMI)

Directions: This inventory consists of statements about your attitude towards mathematics. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel for each item. Choose the number that most closely corresponds to how each statement best describes your feelings and place it on the line next to the statement. Please answer every question.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

-
1. Mathematics is a very worthwhile and necessary subject. _____
 2. I want to develop my mathematical skills. _____
 3. I get a great deal of satisfaction out of solving a mathematical problem. _____
 4. Mathematics helps develop the mind and teaches a person to think. _____
 5. Mathematics is important in everyday life. _____
 6. Mathematics is one of the most important subjects for people to study. _____
 7. High school math courses would be very helpful no matter what I decide
to study. _____
 8. I can think of many ways that use math outside of school. _____

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

9. Mathematics is one of my most dreaded subjects. _____
10. My mind goes blank and I am unable to think clearly when working
with mathematics. _____
11. Studying mathematics makes me feel nervous. _____
12. Mathematics makes me feel uncomfortable. _____
13. I am always under terrible strain in math class. _____
14. When I hear the word mathematics, I have a feeling of dislike. _____
15. It makes me nervous to even think about having to do a mathematical
problem. _____
16. Mathematics does not scare me at all. _____
17. I have a lot of self-confidence when it comes to mathematics. _____
18. I am able to solve mathematical problems without too much difficulty. _____
19. I expect to do fairly well in my mathematical class. _____
20. I am always confused in my mathematical class. _____
21. I feel a sense of insecurity when attempting mathematics. _____
-

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

-
22. I learn mathematics easily. _____
23. I am confident that I can learn advanced mathematics. _____
24. I have usually enjoyed studying mathematics in school. _____
25. Mathematics is dull and boring. _____
26. I like to solve new problems in mathematics. _____
27. I would prefer to do an assignment in math than write an essay. _____
28. I would like to avoid using mathematics in college. _____
29. I really like mathematics. _____
30. I am happier in a math class than any other class. _____
31. Mathematics is a very interesting subject. _____
32. I am willing to take more than the required amount of mathematics. _____
33. I plan to take as much mathematics as I can during my education. _____
34. The challenge of math appeals to me. _____
35. I think studying advanced mathematics is useful. _____
36. I believe studying math helps me with problem solving in other areas. _____

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math. _____

38. I am comfortable answering questions in math class. _____

39. A strong math background could help me in my professional life. _____

40. I believe I am good at solving math problems. _____

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Additional Assessment

41. Did the leadership cooperative learning model enhance your overall experiences in the class? _____

42. Did the leadership cooperative learning model enhance your attitudes towards mathematics? _____

43. Did you understand the complex number unit better than the other mathematical units taught in the course after the leadership cooperative learning model was implemented in the class? _____

Figure 4: Initial Individual ATMI Survey Results - Conducted during the Tenth Week of Course

Assigned Student Number	Enjoy-ment	Motivation	Self-Confidence	Value	Overall
1	4.50	4.07	4.19	4.31	4.27
2	4.00	4.57	4.28	4.28	4.28
3	3.10	2.85	2.87	2.89	2.93
4	4.00	3.86	3.78	3.90	3.88
5	3.40	3.93	3.69	3.69	3.68
6	4.40	4.71	4.50	4.54	4.54
7	3.50	4.00	3.75	3.79	3.76
8	3.80	3.71	3.53	3.62	3.67
9	4.00	3.71	3.84	3.85	3.85
10	3.60	4.29	4.06	4.13	4.02
11	3.70	4.50	3.91	4.05	4.04
12	3.00	3.29	3.28	3.36	3.23
13	3.20	3.71	3.47	3.56	3.49
14	4.20	3.86	3.88	3.90	3.96
15	4.40	4.50	4.47	4.46	4.46
16	3.30	4.07	3.75	3.79	3.73
17	3.70	4.00	3.53	3.67	3.72
18	3.30	3.93	3.78	3.87	3.72
19	3.40	3.79	3.50	3.49	3.54

20	4.80	5.00	4.78	4.82	4.85
21	4.80	4.79	4.59	4.67	4.71
22	4.60	4.29	3.97	4.10	4.24
23	3.70	4.50	4.03	3.95	4.04
24	3.70	3.93	3.88	3.87	3.84
25	3.70	4.36	3.88	3.92	3.96
26	3.10	3.21	3.13	3.28	3.18
27	3.50	3.36	3.41	3.54	3.45
28	3.20	2.71	3.16	3.10	3.04
29	3.10	3.93	3.59	3.62	3.56
30	3.80	3.57	3.63	3.69	3.67
31	3.90	3.86	4.06	4.05	3.97
32	2.90	3.21	2.84	3.00	2.99
TOTALS	3.73	3.94	3.78	3.84	3.82

Figure 5: Post Individual ATMI Survey Results - Conducted during the Thirteenth Week of the Course

Assigned Student Number	Enjoyment	Motivation	Self-Confidence	Value	Overall
1	4.50	4.29	3.87	5.00	4.41
2	3.90	3.43	2.47	4.38	3.54
3	2.00	1.86	2.93	3.00	2.45
4	2.10	2.29	3.53	1.88	2.45
5	3.00	2.71	2.73	3.75	3.05
6	4.30	4.00	2.47	4.88	3.91
7	3.50	3.71	3.87	4.00	3.77
8	3.40	3.29	2.20	4.38	3.32
9	3.90	3.14	2.73	4.00	3.44
10	3.60	3.71	2.33	4.63	3.57
11	3.70	3.86	4.00	4.63	4.05
12	3.20	3.00	2.67	4.00	3.22
13	3.50	3.57	2.67	4.38	3.53
14	3.40	3.14	2.87	4.13	3.38
15	4.40	4.14	4.60	4.63	4.44
16	4.00	3.57	3.60	4.88	4.01
17	3.30	2.71	3.60	4.13	3.43
18	3.30	3.71	4.00	4.50	3.88
19	3.00	3.71	3.07	4.50	3.57

20	4.60	4.43	2.60	5.00	4.16
21	4.40	4.00	2.47	4.88	3.94
22	4.40	3.86	2.67	4.75	3.92
23	4.00	3.00	2.33	4.13	3.36
24	4.00	3.71	2.20	4.13	3.51
25	2.20	2.43	2.20	4.13	2.74
26	3.10	3.29	2.93	3.75	3.27
27	3.10	3.00	3.53	4.25	3.47
28	3.20	3.43	3.07	2.63	3.08
29	3.10	3.29	3.60	4.50	3.62
30	3.30	2.86	2.60	3.75	3.13
31	2.30	2.43	2.67	2.50	2.47
32	3.00	3.00	2.93	4.00	3.23
Totals	3.46	3.33	3.00	4.13	3.48

Figure 6: Side by Side Pre & Post ATMI Complete Class Survey Overall Results -
 Conducted on the Tenth and Thirteenth Week of the Course

Assigned Student Number	Before		After		
	Overall Mean Score	SD	Overall Mean Score	SD	t-value
1	4.27	1.06	4.41	1.06	-0.62
2	4.28	0.59	3.54	1.34	3.21
3	2.93	1.26	2.45	1.18	1.75
4	3.88	1.17	2.45	1.18	5.48
5	3.68	0.87	3.05	0.87	3.23
6	4.54	0.59	3.91	1.62	2.30
7	3.76	0.72	3.77	0.72	-0.06
8	3.67	0.92	3.32	1.19	1.48
9	3.85	0.61	3.44	0.94	2.30
10	4.02	0.81	3.57	1.39	1.77
11	4.04	0.79	4.05	0.79	-0.03
12	3.23	0.76	3.22	0.84	0.08
13	3.49	0.83	3.53	1.11	-0.19
14	3.96	0.70	3.38	0.98	3.01
15	4.46	0.55	4.44	0.55	0.13
16	3.73	0.71	4.01	0.74	-1.74

17	3.72	0.82	3.43	1.00	1.42
18	3.72	0.75	3.88	0.75	-0.95
19	3.54	1.20	3.57	1.09	-0.11
20	4.85	0.67	4.16	1.79	2.30
21	4.71	0.65	3.94	1.65	2.77
22	4.24	1.05	3.92	1.47	1.12
23	4.04	0.91	3.36	1.44	2.53
24	3.84	0.51	3.51	1.50	1.33
25	3.96	1.14	2.74	1.35	4.37
26	3.18	0.92	3.27	0.98	-0.41
27	3.45	1.05	3.47	0.92	-0.09
28	3.04	1.13	3.08	1.13	-0.15
29	3.56	0.89	3.62	0.89	-0.31
30	3.67	0.60	3.13	0.77	3.53
31	3.97	1.07	2.47	0.87	6.86
32	2.99	0.96	3.23	0.89	-1.18
Totals - Mean	3.82		3.48		
Total - SD	0.47		0.51		

Figure 7: Students Attitudes Towards the Cooperative Leadership Model - Conducted during the Thirteenth Week of the Course

Assigned Student Number	41	42	43	AVE
				41,42,43
1	5	5	4	4.67
2	4	3	3	3.33
3	3	3	2	2.67
4	1	1	1	1.00
5	4	3	4	3.67
6	4	5	3	4.00
7	5	5	3	4.33
8	4	3	3	3.33
9	4	4	4	4.00
10	5	4	4	4.33
11	4	4	4	4.00
12	4	3	3	3.33
13	4	4	4	4.00
14	3	3	3	3.00
15	3	4	5	4.00
16	2	3	3	2.67
17	3	4	4	3.67
18	5	5	5	5.00

19	2	3	2	2.33
20	4	4	4	4.00
21	5	5	5	5.00
22	5	5	5	5.00
23	5	5	5	5.00
24	5	5	5	5.00
25	1	1	1	1.00
26	4	4	3	3.67
27	4	4	4	4.00
28	4	4	3	3.67
29	5	4	3	4.00
30	3	3	3	3.00
31	3	3	4	3.33
32	4	4	3	3.67
Averages	3.78	3.75	3.50	