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The Effects of Emotional and Instrumental Support on Students' Mathematical Attitudes

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THE EFFECTS OF EMOTIONAL AND INSTRUMENTAL SUPPORT ON

STUDENTS' MATHEMATICAL ATTITUDES

By

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Abstract

This study tests to see if a correlation exists between students' attitudes towards mathematics and teacher pedagogy through emotional and instrumental support. Emotional support is defined as an individual's perception of a mathematics teacher as being warm, friendly, caring, and empathic (Katz & Gueta, 2010). Instrumental support is defined by an individual's perception of a mathematics teacher's instruction, whether the teacher is considered to be helpful, and if the teacher provides guidance when needed (Spielberger, 1979). Two surveys were administered and three interviews were conducted to investigate this hypothesis. The first survey consisted of 12 Likert scale items, 5 open-ended responses and 9 mathematics problems for students to solve. Three students were chosen from the first survey to be interviewed in order to delve deeper into their past mathematical experiences. The second survey consisted of 35 Likert scale items that dealt with both emotional and instrumental support. The overall findings of this study illustrated that emotional and instrumental support did affect students' overall attitudes with mathematics.

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Introduction

When students think of mathematics, many think poorly of it. Students are becoming more inclined to have negative attitudes towards mathematics. Both emotional and instrumental support may be affecting the overall attitudes of students in mathematics. There is research depicting how lack of differentiating instruction and lack of teacher empathy may be one of the reasons students are acquiring negative attitudes (Zan & Di Martino, 2007). Students who acquire negative attitudes with mathematics also achieve lower scores on summative assessments such as homework and tests. By achieving lower scores, this causes students to dislike mathematics even more; this can create a spiral that causes them to feel anxious towards mathematics and to lower their self-efficacy beliefs.

Contributions

This study was conducted to contribute to the body of research dealing with mathematical attitudes. Specifically, this study aimed to see if there is a connection between college student's current overall attitudes regarding mathematics and their past experiences with both emotional and instrumental support from teachers prior to attending college.

Literature Review

Attitudes

In Lisa Medoff's article, *Getting Beyond "I Hate Math!"* she explains how a particular student dislikes mathematics and finds it difficult for many reasons (Medoff,

2009). The student does not always understand the material the teacher tries to explain, but she is too afraid to ask clarifying questions because she believes the teacher will become frustrated and upset with her. When she does manage to ask questions, the teacher rewrites the problem on the board and impatiently tells the student to pay attention and does not show concern for where the student may have gotten confused (Medoff, 2009). The student also feels anxious and nervous to ask her friends for help with mathematics because she feels like she will be judged for not understanding the material (Medoff, 2009). The student described in Medoff's scenario provides an example of how many people feel about mathematics. This student in Medoff's scenario is how many people feel about mathematics. Many students exhibit anxiety and negative attitudes towards mathematics, and this is partially due to the teacher's own attitudes and instructional practices (Sonnert et. al., 2014).

In order to justify the claim that students' attitudes towards math are influenced by teacher pedagogy, the construct of attitude needs to be defined clearly. However, in past research, attitude is not defined explicitly. The definition is often left up to the researcher's interpretation (Zan et. al., 2007) in order to be able to construct and use a more accurate definition that fits the posed question (Ruffell et. al., 1998). Zan et. al. (2007), separate the definition of attitude into three different categories that allow the definition of attitude to be used interchangeably within research The first category includes attaining a positive or negative opinion or disposition regarding mathematics. The second category includes developing an attitude based on an emotional response, in terms of the beliefs regarding the subjects and the behaviors demonstrated in

reference to mathematics. Finally, the last category refers to attitude becoming a pattern of beliefs and emotions about math (Zan et. al., 2007).

Positive and Negative Attitudes

An individual's attitude may be measured through different instruments. One common way is by surveys that use a Thurstone or Likert scale, but there are other methods that can be used to determine attitude such as observation and interviews. Through the added up scores from either method, an outcome is deduced to depict whether an individual's attitude is positive or negative (Zan et. al., 2007).

The items on questionnaires range from emotions, to beliefs, to those related to behavior (Zan et. al., 2007). One common challenge of questionnaires is that it can be hard to measure whether the negative attitudes students exhibit are how they feel about mathematics overall or if it is how they feel about a certain topic within mathematics such as geometry or algebra (Belbase, 2011).

Some variables that are seen on questionnaires involving attitudes can include motivation to learn mathematics, mathematics anxiety, and attitudes towards mathematics, which all significantly impact mathematical achievement (Ernest, 2004). There is also a positive relationship between students' attitudes towards mathematics and their achievement level (Cleary & Chen, 2009). These positive and negative reactions can be determined by knowing the individuals' specific beliefs and attitudes and having an exact definition of what classifies as a positive or negative attitude in the research of which it pertains-(Zan et. al., 2007).

Hannula (2002), separates a student's attitude towards math into four different categories: Emotions the students experience during mathematical activities; emotions

students experience when learning mathematics conceptually; mathematical evaluations; and the value of mathematics related goals in the students' global structure (Belbase, 2011). For the basic definition of attitude (Zan et. al., 2007), having a positive attitude can cause a positive emotional disposition towards mathematics, while having a negative attitude can cause a negative emotional disposition towards mathematics. The second and third definitions, which involve emotional responses, beliefs, and behaviors, do not have a definitive definition of a positive or negative attitude and as a result can have wavering definitions of the words within an individual's particular study (Zan et. al., 2007).

In order to define the results as positive, it depends if the positive attitude has a correlation with the emotions, beliefs, or behaviors of an individual's attitude regarding mathematics (Ma & Kishor, 1997). For instance, a positive emotional attitude is justified when someone perceives something as pleasurable, while anxiety would be seen as a negative emotional attitude. Positive attitudes based on beliefs are usually beliefs that are shared positively by the "experts" (Ma & Kishor, 1997). Positive behavioral attitudes refer to someone who is successful and has high achievement, but that poses a limitation on how to assess achievement and what is classified as high and low achievement (Middleton & Spanias, 1999).

Sam (1999) indicates that students who like mathematics are more inclined to choose mathematics as their course of study in college, while those who dislike mathematics tend to think of it as a difficult subject for many reasons such as problem solving or the class environment (Sternberg, 2008). Students who have negative attitudes towards mathematics tend to not pay attention during the lesson. This can cause a lack of knowledge of the material, which can result in deficiencies in students' mathematical

background and lack of prior knowledge going forward (Mumcu & Aktas, 2015). Also, if students are not given a strong mathematical foundation to begin with, this can be a contributing factor to an individual's negative attitude towards mathematics. Subsequently, from both scenarios, lack of mathematical knowledge can cause fears and anxieties, which would not allow a student to take the necessary steps to learn the information in the future due to a fear of failure (Mumcu & Aktas, 2015).

Anxiety

Someone's attitude is perceived as being negative towards mathematics when they are classified as having high anxiety (Belbase, 2011). Due to poor, negative attitudes with mathematics, this might cause individuals to avoid studying math and not using it in their daily life. Consequently, this can lower a student's self-efficacy and increase their mathematical anxiety, which can result in a student having low interest in learning mathematics (Sam, 1999). As Medoff states, it's important to help the students who have negative attitudes towards mathematics by creating a safe, comfortable class environment that is differentiated to the students' needs (Medoff, 2004). In order to prevent negative attitudes, anxiety, which can be a leading cause, needs to be reduced. However, is is important to define the relation of anxiety to mathematics in order to begin to understand it (Belbase, 2011).

One definition of anxiety is experiencing a lack of comfort when required to perform mathematically (McLeod, 1992). Anxiety can also mean the feeling of tension, helplessness, and mental disorganization with both numbers and shapes (Richardson & Suinn, 1972). Anxiety that creates dislike, worry, and fear, can be created through negative perceptions arising from mathematics class. Those who experience anxiety try to

get rid of the “problem” by avoiding it altogether. They may also develop negative attitudes about the cause of the problem - mathematics (Belbase, 2011). Students may begin mathematics because they struggle with understanding the material. They may have difficulties learning because of their anxiety, which can impact students’ visual working memory in math. This is different from anxiety seen in other subjects as it impacts the verbal working memory (Miller and Bichsel, 2004). The result is a student’s impacted visual working memory can cause trait or state anxiety in a student (Miller & Bichsel, 2004).

According to Miller and Bichsel (2004), there are two classifications of anxiety – trait and state. Individuals who experience trait anxiety have a tendency to feel anxious in all types of situations. Individuals who experience state anxiety tend to feel anxious in specific personal situations (Miller & Bichsel, 2004). Students who have mathematics anxiety tend to have state anxiety, which causes individuals to have a fear of mathematics due to class, homework, exams, or other situations. Individuals with high state anxiety had lower achievement performance than individuals with lower state anxiety (Belbase, 2011). Besides achieving lower than others, students who have anxiety with mathematics can have other hindrances as well. For example, a student may not major in mathematics or aspire for a career that involves mathematics. Subsequently, students who have mathematical anxiety tend to have issues doing mathematics, have a decline in their mathematics achievement, avoid mathematics, limit their choices of a college major and future career, and have feelings of guilt and shame (Richardson & Suinn, 1972).

Ma and Kishor (1997) believe there is a correlation between mathematics achievement, performance, and anxiety. Students who have positive attitudes

regarding math often have had positive experiences with the class environment, with teachers' dispositions, and with particular situations. As a result, these students are less likely to have mathematical anxiety. Cemen constructed a model of mathematical anxiety using those antecedents. Within those categories, environmental influences may have been due to negative mathematics experiences and lack of parental encouragement; dispositional influences may have been due to negative attitudes and lack of confidence; and situational influences may have been due to classroom factors and the instructional format that the teacher used. For students who do not experience these characteristics in a classroom, they may acquire negative attitudes and anxiety. Cemen, (1987 as cited by Belbase, 2011) addresses the issue of not seeing environmental, dispositional, and situational antecedents in a classroom.

Attitude Limitations

In a study conducted by Mumcu (Year) on the relationship between students' attitudes towards mathematics and their achievement level, there were two focal points (Mumcu & Aktas, 2015). First, there was a focus on students' attitudes and self-efficacy perceptions in regards to mathematics and the relation between the two concepts. Within the study, attitudes and self-efficacy were explored in terms of gender, grade (with high school), program, and mathematics achievement. The study depicted that the correlation between the two could not be determined and was rendered uncertain (Mumcu & Aktas, 2015). These studies were rendered uncertain due to certain limitations (Belbase, 2011) concerning students' beliefs and attitudes because of social status and gender.

Some studies examined these limitations to see if it would impact students' beliefs and attitudes and their performance at school and understanding of mathematics and

mathematical proofs. They saw a major difference between males and females. Male students thought mathematical understanding was achieved through procedures and the studying of conceptual understanding. Females tended to have less positive attitudes towards mathematics than males did (Swetz, 1983 as cited by Belbase, 2011). Hembree (1990), noted that gender often played a key role in there being a correlation between high anxiety and performance level with males having a lower performance level than females. In some studies there was a positive correlation between studying mathematics through understanding and a student's high performance at school and being able to understand mathematical proofs Belbase, 2011). Overall, gender and social status contribute to students' overall attitudes towards mathematics.

Attitudes Affected by Instructional Practice

There is considerable research regarding student's attitudes with mathematics, the teacher's pedagogical methods and behaviors, and whether that affects the student's achievement in mathematics (Ma and Kishor, 1997). Some research supports a correlation between the three, but according to Ma and Kishor (1997) there has only been speculations of such correlations. In their study the correlation was statistically significant, but not strong enough to make a case for an educational practice that warrants a change in how mathematics is taught in schools (Ma and Kishor, 1997). Belbase (2011) tries to prove that there is a correlation between student's anxiety levels and how the student learns through the teachers' instructional practices. In some research Belbase's (2011) hypothesis is proven, slightly, through the depictions of students' negative attitudes and the way a student learns mathematics (Zan et. al., 2007).

For students who tend to have math anxiety, there has also been a trend in their misbehavior during class time. Some methods that are being used to rectify the issue are modifying content, modifying task demands, and modifying delivery system (Mancil & Maynard, 2007). In order to modify content, a teacher should alter the type and the amount of information being presented to a student. To modify task demands, a teacher can have students respond to questions in different ways that can allow them to answer questions nonverbally. Lastly, modifying delivery system results in changing instructional agents, format, and context in order benefit the student (Mancil & Maynard, 2007).

Instruction

Instructional Methods

Instructional support is used to define whether a teacher's pedagogical practices have impacted a student's attitude towards mathematics positively or negatively. One type of instructional support, known as "instrumental," is defined as a student's perception of being provided with instrumental resources and practical help (Malecki & Demaray, 2003). This encompasses questioning, clarifying, correcting, elaborating, and modeling behaviors, which all contribute to understanding and developing skills for problem solving in mathematics. (Malecki 2003) Instrumental support goes beyond using textbooks to teach and does not place emphasis solely on memorizing formulas and applying rules. Yackel and Cobb (1996) posit a need for instrumental instruction in schools to change students' overall attitudes in mathematics

In many cases, mathematics instruction needs to provide students multiple opportunities to experience problem solving. These problems should teach individuals how to construct solutions to real-life situations that may require multiple steps (Carolina, 2003). Studies have shown in both Japan and the United States that the use of practical experiences and problems in mathematics can contribute to enjoying and learning mathematics (Daniel, 2005). Before this enjoyment can take place, individuals need to feel confident about their abilities to engage in these experiences. In order for them to feel confident, they need the tools and the resources to learn, which is done through different instructional practices.

In North Carolina, a mandated test requires students to integrate mathematical ideas with applications from other content areas. In addition, the test covers four domains – communication, processing information, problem solving, and using numbers and data (Carolina, 2003). Through the test, teachers are able to address each of the four main domains to try and use effective instructional strategies. For instance, to teach problem solving, teachers would give tasks for students to complete where the solution method is not known; where students would have to apply and adapt multiple problem-solving strategies; and teach a basic understanding of problem-solving tasks. Teachers also need to make sure they recognize and use connections among mathematical ideas and communicate understandings of how related concepts build on each other (Carolina, 2003).

There are many ways that teachers can approach the subject of problem solving so that mathematics can become a more enjoyable subject for students. One way is for students to work in cooperative pairs or groups and also for them to learn how to figure

out solutions for themselves. Daniel (2005), notes that students in both Japan and China typically ended up liking mathematics more due to these methods. Daniel (2005) also speculated that computer-based instruction might also have an affect on a student's overall attitude towards mathematics. It was discovered that computer-based instruction helped with a student's self-beliefs about mathematics as long as the students were working individually. Daniel (2005) noted, however, that there was no statistically significant data proving whether the computer-based instruction impacted the students' actual learning (Daniel, 2005).

Anxiety has also been connected to the teaching of mathematics and in shaping later attitudes concerning mathematics (Stenmark & Hall, 1983). A reason for this is that teachers tend to use traditional methods of instruction and don't promote the use of activities and experiences to learn. This in turn can create students who acquire a math phobia, or anxiety (Dodd, 1992). Gresham et. al. (1997), tried to implement new teaching strategies such as cooperative learning groups, journals, use of manipulatives, problem solving with real-life situations, calculators, and computers. As a result, some students found all of the new materials and methods to be beneficial and it gave them the resources and the confidence to problem solve individually at school and at home. However, implementing the new methods was a process that required deliberate planning, and many of the students feared working in groups for problem solving until they learned how to work cooperatively (Gresham et. al., 1997). Also, low-achieving students were more willing to work on difficult problems and theories (Finley, 1992).

Teacher Attitude

A teacher's attitude towards math can cause students to have negative attitudes towards learning mathematics and towards mathematics itself (Erskine, 2010). The quality of the classroom environment can also impact a student's attitude and beliefs towards mathematics (Kessel, 2005). Teachers who have a poor view of their students and their abilities can cause students to have mathematics anxiety and negative attitudes concerning mathematics (Erskine, 2010). For instance, teachers who believe mathematics is purely the study of numbers and procedures have a tendency to teach procedurally more than conceptually. This results is students being unaware of why certain concepts work in mathematics. Also, teachers who comment that not everyone is "good" at math are setting their students up to fail because of the Pygmalion effect, which means higher teacher expectations lead to an increase in student performance. As a result, there needs to be a change in elementary teachers' attitudes and dispositions towards mathematics and its pedagogy so it does not impact students later on in their lives (Erskine, 2010).

This theory of teacher expectancy goes hand-in-hand with the emotional support that can cause a student to have positive or negative attitude towards mathematics. Emotional support is considered to be a students' perception of trust, warmth, respect, and communications of empathy and care from the teacher. In instances where students are working through a tough problem, it is noted that it is beneficial when the student feels helped and supported (Federici & Skaalvik, 2014). In Federici and Skaavlvik's (2014) study, he noted that teachers who appeared to care for their students embodied and provided both emotional and instrumental support for their students. For struggling students to benefit from emotional support of a teacher, instrumental support needs to be

present as well. If emotional support is the only support present, it can cause more damage than good to some students (Federici & Skaalvik, 2014). For instance, teachers who had a high emotional support, but average instrumental support occasionally caused their students to have lower expectations for themselves. It also caused a negative trend in their achievement because they felt that the teachers were only being kind and empathetic towards them because they believed the student couldn't achieve the work (Federici & Skaalvik, 2014). For teachers that only showed instrumental support, such as promoting group work and clarifying and elaborating explanations, students tended to have less anxiety and more motivation to achieve.

It should be noted that although emotional and instrumental support cause positive attitudes, there are some instances where it does not. Teachers who use any of the modifications such as task demands or instrumental and emotional support can be classified as "ambitious teachers", which can result in negative attitudinal trends in their students (Sonnert et. al., 2014). Ambitious teachers are more likely to probe and ask questions to their students, which may be beneficial to some students, but may trigger mathematical anxiety instead. Ambitious teachers in Sonnert et. al.'s (2014), were not seen as the traditional "good" teacher, but instead were seen as an overbearing, strict teacher. This poses the question of what characteristics constitutes someone being a good or bad teacher, which goes beyond the scope of the present study.

Methods

Participants

The study sample consisted of 136 students in total from both a Pre-Calculus and Education Psychology course on campus. The first study sample consisted of 99 students enrolled in a Pre-Calculus course at the University of Maine during the fall semester of the 2015 academic year. All 99 of the students were 18 years of age or older and the sample was comprised of first, second, third, and fourth year students.

The Pre-Calculus class used in the participant sample was through the Math Den on campus, which is a facility that aids students who are taking College Algebra, Pre-Calculus, and Statistics. The Math Den provides support in a hybrid online format that utilizes a program called MathLab.

After the intial survey (SURVEY 1) was administered to the 99 students in Pre-Calculus, a second survey (SURVEY 2) was administered to 48 students who were enrolled in an educational psychology course at the University of Maine. Again, these 48 students were 18 years of age or older and were in their first, second, third, or fourth year of college. SURVEY 2 was administered to focus the questions specifically on students' attitudes and the different instructional practices they experienced.

Mathematics Attitudes Written Survey

SURVEY 1 was distributed among the Pre-Calculus students, and it dealt with students' attitudes towards math presently, the way they were taught math before college, and how they solved certain mathematical problems. The sample was volunteer-based and students who chose to participate in the survey were allowed to opt out of any of the

questions that made them uncomfortable or seemed too difficult to solve. The written survey was broken into two different sections – a Likert scale survey and open-ended response questions.

The first part of the survey consisted of twelve items that were rated on a 5-point Likert scale system with 5 being "Strongly Agree" and 1 being "Strongly Disagree." Participants were asked to rate items such as "I like learning math," and "I worked in groups to solve math problems." The participants were asked to do this in hopes of finding a correlation between their mathematical attitudes and their past experiences with different instructional practices. At the end of the Likert scale section, there was a box that asked for students to write additional comments if they wanted to mention anything the survey did not include.

The second part of the survey consisted of fourteen opened-ended response questions that either asked them how mathematics made them feel or asked them to solve certain mathematics problems. Examples of these types of questions included "Does math make you anxious? Please explain why or why not," and "Do $\frac{0}{2}$ and $\frac{2}{0}$ have the same answer? Why or why not?" Finally, two questions asked the students if they were given questions similar to those on the survey while there were in school, that led them to think deeply about their understanding of a mathematics concept.

SURVEY 2 was given to an educational psychology course, which many education majors take at the University of Maine, instead of a mathematics course in the hopes that there would be less bias with current mathematics experiences. It was conducted with more inclusive questions regarding attitudes towards mathematics and teacher pedagogy and emotional behaviors. There were 35 items on SURVEY 2 that were

rated on a 5-pont Likert scale system with 5 being "Strongly Agree" and 1 being "Strongly Disagree." The first twelve items of the second survey mirrored the first twelve items of the first survey to increase the amount of participants when analyzing the data later.

Interview

Three students were chosen to be interviewed based on their responses on the SURVEY 1. Similar to the written survey, the interview centered around students' attitude towards math, the way they were taught math before college, and the way they solved math problems. In addition, interviewees were asked questions based on their responses on the written survey. The interviews lasted between twenty and thirty minutes. The students selected were allowed to decline the invitation to be interviewed, and were permitted to stop at any point. Participants who agreed to be interviewed were offered an hour of one-on-one tutoring for their Pre-Calculus final as long as they completed the interview. They were allowed to opt out of any questions they did not want to answer. Sample questions from the interview consisted of questions such as, "I noticed in your survey that you mentioned that you don't like learning math. So I was just curious why you don't like math?" and "Was there a time you really enjoyed a math class and why do you think you really enjoyed it?"

Procedure

During the last twenty minutes of a Pre-Calculus class, SURVEY 1 was distributed among the 99 students in the class. Before they began, it was explained to them how the survey was volunteer-based and that they had to be 18 years of age or

older. Additionally, they were told that participants would be invited to be interviewed to help with the second part of the study and would be contacted through the University of Maine email system. The surveys were collected and put in a locked room afterwards to be analyzed later. Similarly, SURVEY 2 was conducted the same way with the students filling out the survey during the first 10 minutes of an Educational Psychology class. No interviews were solicited from this class.

The written responses on SURVEY 1 were used to categorize the participants into four sections – those who enjoyed mathematics and responded with correct answers on the given mathematics problems, those who enjoyed mathematics and were unable to answer the given mathematics problems correctly, those who did not enjoy mathematics, but were able to answer the given mathematics problems correctly, and those who did not enjoy mathematics and were unable to answer the mathematics problems correctly. After categorizing the students into the four groups, based on the open-ended questions and how they were answered, three students were chosen to be interviewed.

Five students were invited to be interviewed based on their written survey responses. Three students who responded with a "yes" were asked to come to the Math Den at a particular day and time to be audio recorded the entire time. They were asked about their attitude towards math and what may or may not have caused them to like math. Following those questions, they were asked questions based on their responses on the written survey. Finally, they were asked to solve mathematics problems and explain to the interviewer their thought process in what is often referred to as a "think-aloud." Initially, these data were going to show how the participants' achievement level might be impacted by their attitudes. However, it was later decided to not use those data due to the

nature of the study and the proposed hypothesis. Before the interview ended, participants were asked to add anything they wanted the interviewer to know about their experience and attitude with mathematics.

After the written survey and the three interviews, the data from the Likert scale part of they survey was entered into Excel to be used later to analyze for any correlations from the students' responses. The audio-recorded interviews were transcribed and later analyzed, along with the open-ended response questions in the written survey, using a qualitative software system called Dedoose.

Analysis

The Likert scale items from both surveys were analyzed using SPSS, a quantitative analysis software system. For the first twelve items of both surveys, a one-way ANOVA test was administered by gender and year. A one-way ANOVA test was also used to find a correlation between all twelve of the items to see if there were any positive or negative trends, which involved a Bivariate Pearson scale. Likewise, the second survey was analyzed the same way using a one-way ANOVA test for gender, year, and between all of the items.

Dedoose, a qualitative analysis software system was used for the written items on SURVEY 1. The first five items on the written section dealt with student's attitudes and experiences with mathematics. They were entered into Dedoose and using codes, the frequency of the words, or the codes created, were depicted within the written responses. From the frequency of the codes (i.e. emotional and instrumental support, teacher,

anxiety) it was possible to see positive and negative trends in students' attitudes regarding mathematics.

Results

Results from the one-way ANOVA analysis of correlations are presented in Tables 1-6 (See Appendix). These include correlations between students' year in college, gender, students' attitudes towards mathematics, and their past mathematical experiences. Data for the analysis are drawn from SURVEYS 1 and 2. The reason for administering SURVEY 2 after looking at the results from SURVEY 1 was to include more questions regarding attitudes and examples of instrumental and emotional support. This was distributed in order to find stronger correlations between the two inferences – students' attitudes and instructional strategies and behaviors.

Year in College

The analysis depicts 136 students on questions 1 through 12 from both SURVEY 1 and SURVEY 2. This first analysis was done according to year in college, with the fourth year eliminated because there were only four participants in that group. The results showed that first (M=3.68) and third (M=3.47) year students were more inclined to work in groups to solve math problems than second (M=3.22) year students with a significance of 0.04. No other results were significant.

Another analysis was done on the SURVEY 2 for questions 1 through 35 completed by 48 students. The analysis excluded years three and four because there were few students in each of those years and it skewed the data giving misleading results

(those results are in the appendix). The results showed that first (M=3.44) year students believed mathematics to be more boring than second (M=2.67) year students with a significance of 0.015. Results also showed that first (M=2.67) year students were less likely to enjoy math than second (M=3.48) year students with a significance of 0.022. Additionally, the results showed that first (M=3.49) year students practiced exercises over and over again more than second (M=3..48) year students with a significance of 0.034. No other results were significant.

Gender

The analysis depicts 136 students on questions 1 through 12 from both SURVEY 1 and SURVEY 2. This analysis was done by gender and excluded unknown genders so the results would not be skewed by unknown genders. The results showed that males (M=3.14) were more likely to come up with new ways to solve math problems than females (M=2.66) with a significance of 0.01. No other results were found to be significant.

Another analysis was done on SURVEY 2 for questions 1 through 35 completed by 48 students. The results showed that males (M=3.75) generally enjoyed math class more than females (M=2.84) with a significance of 0.012. Additionally, the results showed that males (M=2.44) were less nervous when given world problems than females (M=3.34) with a significance of 0.029. The results also showed that males (M=3.31) believed that they were born being good at math more than females (M=2.41) with a significance of 0.006. Lastly, the results showed that males (M=3.88) felt safer asking questions during math class than females (M=3.19) with a significance of 0.038. No other

results were found to be significant.

Attitude and Mathematical Experience Correlations

An analysis was conducted on the first twelve questions on SURVEY 1 and SURVEY 2 to see if there was a correlation between students' attitudes towards mathematics and their past mathematical experiences. There were a total of 136 participants, which excluded the unknown genders and the fourth year participants. The participants indicated their level of agreement with each item using a Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Although many correlations were found among the different questions that may be considered interesting and worthy of future inquiry, only a few of the questions were pertinent to the focused research questions of this study. See the discussion and the appendix for information on the other correlations.

Question 1 (M=3.93) correlated with Question 9 (M=3.875) with a Pearson correlation of 0.196 and a significance of 0.022. It showed that students who believed they could succeed in mathematics generally had teachers who would give them problems to figure out for themselves. Question 1 also correlated with Question 11 (M=3.838) with a Pearson correlation of 0.184 and a significance of 0.032. This depicted that students who believed they could succeed in mathematics had teachers who asked them to explain their reasoning behind their answers.

Question 3 (M=2.95) correlated with Question 12 (M=3.51) with a Pearson correlation of 0.211 and a significance of 0.014. This depicted that students who found math to be boring had more experience working in groups with math, which according to

other research seems to be inconsistent since working in groups is supposed to impact a student's attitude positively.

Students who liked to come up with new ways to solve mathematics problems (Question 5) had teachers who were interested in their work even if it was wrong (Question 10) and had teachers ask them their reasoning behind their answers (Question 11). Question 5 (M=2.86) and Question 10 (M=3.50) had a Pearson correlation of 0.184 and a significance of 0.032, while Question 5 and Question 11 (M=3.84) had a Pearson correlation of 0.171 and a significance of 0.046.

No other significant correlations were found in this study concerning questions 1-12. However, it is important to note that the use of technology seemed to not have any significance on the students' attitudes towards mathematics either positively or negatively.

A similar second analysis was conducted on 35 questions from SURVEY 2 to see if there was a correlation between students' attitudes towards mathematics and their past mathematical experiences. There were a total of 48 participants. The participants indicated their agreement with each item using a Likert-type scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Table 6 in the Appendix shows that there is a correlation between students' positive attitudes towards mathematics and what is considered to be "good" pedagogical practices from teachers (Spielberger, 1979). For instance, students who enjoyed mathematics class (M=3.15) had a positive correlation with many different pedagogical strategies that depicted emotional and instrumental support from the teachers. One example of such support is having a teacher that always had a positive attitude about

math. It is important to note that students who generally had positive attitudes towards math were negatively correlated with questions concerning anxiety. For instance, Question 13 (M=3.15) and Question 34 (M=3.77) had a Pearson correlation of -0.608. No other results were found to be significant.

Written Surveys and Interviews

A qualitative analysis was done on the written responses from SURVEY 1 and the interviews using theme based codes (i.e. teacher, anxiety, tests, instrumental support, emotional support, positive attitudes, and negative attitudes) on Dedoose, which can be found in Table 7 and Figure 1.1 in the appendix. Questions 1 through 5 were used for the analysis because those questions dealt with students' attitudes and their opinions on their past mathematical experiences.

Through the analysis, it was illustrated that students who tended to have positive attitudes towards mathematics had positive mathematical experiences attributed to the teacher. The participants described their teachers as embodying the characteristics of emotional and/or instrumental support. Such characteristics include: positive attitudes, helpfulness, and different instructional strategies including promoting group work. Likewise, students who mostly had negative attitudes towards math experienced classes with teachers lacking these characteristics. It is also important to note that while the majority of students who had mathematics anxiety generally displayed negative attitudes towards mathematics, anxiety was seen in a few students who mostly had positive or neutral attitudes towards mathematics. One of the main causes of the anxiety was tests and grades. No other results were found to be significant to the study.

Discussion

This study was conducted to investigate whether a correlation exists between students' attitudes towards mathematics and teacher pedagogy. Through the use of both a quantitative and qualitative analysis, results demonstrate that teacher pedagogy impacts students' beliefs and attitudes concerning mathematics.

There are two dimensions to teacher pedagogy that have been discussed in this research – emotional and instrumental support. Emotional support is characterized by an individual's perception of a mathematics teacher as being warm, friendly, caring, and empathic (Katz & Gueta, 2010). Instrumental support is characterized by an individual's perception of a mathematics teacher's instruction and whether they consider the teacher to be helpful and if the teacher provides guidance when needed (Spielberger, 1979).

The first twelve questions of both SURVEY 1 and SURVEY 2 depicted that teachers had impacted students' attitudes towards mathematics either through emotional or instrumental support. Students who believed that they could succeed and were confident in their abilities to achieve in mathematics were more likely to experience instrumental support. They were given support in order to problem solve and truly understand why their solutions were accurate. By being given the tools necessary to achieve success in mathematics, the participants acquired a positive attitude towards mathematics. Additionally, students who were more likely to come up with new ways to solve mathematics problems were more likely to have teachers who were interested in their work and their reasoning behind their solution. The teacher's instrumental support most likely contributed to this, but the teacher's emotional support probably did as well.

Although it cannot be determined for certain, the teacher may have been caring and curious about how a student acquired an answer, and instead of immediately telling the student s/he is wrong, the teacher tried to understand the student's work. This promotes a positive atmosphere so that students do not become anxious and worried about getting wrong answers during mathematics classes. If a class is facilitated in this manner, the students likely will feel comfortable and attribute positive attitudes towards mathematics to the teacher.

Another example of instrumental support is allowing students to work in groups together. However, surprisingly, it was depicted that students who found mathematics to be boring were more likely to work in groups during class. Interestingly, one of the students who was interviewed discussed working in groups.

V: Were you able to work with people in groups in order to complete those sheets or did you have to work on it yourself?

J: Sometimes you were allowed to work with others. I usually did not. But that was more of a personal choice.

V: Okay. So you like working by yourself instead of with other people. Is that more beneficial to you or?

J: Sometimes. It was also because I usually was smarter than a lot of my peers so I didn't just want to give away the answers for some of it.

From this interview, it could be said that students did not find group work to be beneficial because developmentally they may not have been capable of working in groups in a manner where everyone contributed to figuring out the solutions together. Also, it appears there had been a lack of communication and support from the teacher. This

participant should not associate working in groups with giving answers to his/her peers. The teacher could have provided suitable support to show that working in groups could be used as a tool in order to use everyone's strengths to figure out solutions to problems. However, the student being interviewed could have been given practice exercises instead of problem solving questions, which in turn may have caused the participant to give answers to him/her peers.

Within the first survey, no other correlations were applicable to the particular study's question. However, participants who had positive attitudes generally had positive attitudes throughout the survey. Likewise, participants with mostly negative attitudes had correlations with other negative attitudes. It is not unusual for students to have consistent attitudes towards mathematics, but it is unusual that there doesn't seem to be any impact as to why that is the case. In some instances emotional support had a positive impact on the students' attitudes towards mathematics, while other times it had a negative affect.

Likewise, students who had good instrumental support, like figuring out problems together in groups and having teachers who were interested in their reasoning, show instrumental support throughout their mathematical experience. Participants who had indicated that they mostly learned from copying down notes from the board did not experience any other type of instrumental support. This was consistent with the second survey as well. Students who experienced lecture type classes were also taught mathematics more formulaically than conceptually. This shows that participants were taught instrumentally (formulaically) more than relationally (conceptually), which is a type of teaching strategy (Skemp, 2006). The instrumental teaching strategy that Skemp (2006) discusses is different from instrumental support. Teachers who want to teach

mathematics formulaically and do not delve into understanding how something works use instrumental teaching. Instrumental support, however, is different from instrumental teaching because teachers who exhibit instrumental support guide students into higher thinking and do not teach only through lecture.

Although some participants didn't acquire negative attitudes because they were taught instrumentally, it's important to note that many of the participants had been taught in that manner. Many teachers choose to teach instrumentally for a variety of reasons. For instance, instrumental mathematics is easier for students to understand, the rewards are immediate, and a student is able to get an answer quicker because less higher thinking is involved (Skemp, 2006). Relational teaching also has benefits, but many teachers choose not to use this method because it takes more time (Skemp, 2006). However, once a student understands a concept presented to them relationally, they are able to remember it far longer than they would if they were taught instrumentally (Skemp, 2006). One participant who was interviewed had said, "I wish I would have learned in different ways because sometimes I would have to look it up on the Internet and I just felt like taking notes straight off the board wasn't enough for me." The participant is accurate in their assessment. If they had been taught relationally instead, they may have learned and understood the material better.

Some students in the written survey attributed their negative experiences with mathematics with not understanding the material fully, which hints at the possibility that they may have been taught instrumentally. When asked if they have had a bad experience with mathematics, one participant wrote, "Yes, when the topic was poorly explained and I didn't understand it." Otherwise, the student wrote about positive experiences where the

teacher provided both instrumental support through relational learning and emotional support. This was also illustrated in their Likert scale responses.

A second survey was conducted and given to another set of participants. The second survey included more concise questions specifically relating to both positive and negative mathematical attitudes such as anxiety and different pedagogical practices.

Participants who had positive experiences with mathematics such as having teachers care about their answers, being able to work in groups, and being in a classroom that allowed them to be comfortable to ask questions, caused them to have positive attitudes towards mathematics. They tended to have higher self-efficacy beliefs and had more favorable attitudes towards mathematics. Additionally, they did not exhibit traits of anxiety in general or even with word problems. The same can be said about students who had negative attitudes towards mathematics. They did not have much differential teaching and had more anxiety. The trends that were seen for both groups were expected from the posed question for the study.

According to (Federici & Skaalvik, 2014), emotional and instrumental support are strongly correlated. Although this correlation was not the focus on the present study, with the written responses on the first survey, it is valuable to note that whenever students perceived a teacher as being instrumentally supportive, more than likely the teacher also exhibited characteristics of emotional support. This correlation was stronger when negative attitudes were present. Students who experienced “bad” math teachers considered them to be “bad” because of lack of emotional and instrumental support. In turn, their primary experiences with mathematics were negative, causing them to have negative attitudes towards mathematics as seen in their written words. This may be the

case because when students notice that a teacher's instruction and helpfulness is poor, they may also start to believe that their attitude is seen as uncaring and not empathetic. In some instances, students who perceive a teacher as having less than ideal instrumental support often view the lack of emotional support as a teacher having low expectations and may exhibit a lack of effort when teaching (Skaalvik, E. M. & Skaalvik, S., 2013). This was depicted during one participant's interview when they were asked about a bad math experience.

> V: Can you explain your worst experience with a math class and why that was?
>
> F: I think it was my freshman year. I didn't like the teacher much and for me it's best for me to learn if I like the teacher and if I don't like the teacher right off the vat then it's just going to be a bad class for me even if I try to ask for help. I just will get this divide from the teacher that I don't want to be there and I just have a bad feeling with them. It's just a bad experience.

However, it should be noted that this was only one experience that the participant had. S/he also explained how s/he had many teachers who took the time to explain concepts and used various methods such as manipulatives to teach resulting in him/her having positive attitudes towards mathematics. Perhaps, if his/her experience had mainly been similar to the one she described above, s/he may have had negative attitudes instead.

Interestingly enough, one of the main causes of why students have negative attitudes with mathematics was not from teacher pedagogy, but from anxiety caused by either tests or grades. Students who claimed to have positive attitudes said they were

often anxious with mathematics because of tests. One student wrote, “I have always enjoyed math. Tests make me anxious, but that is common through all of my classes.” A possible reason for this may be because the written survey was given to pre-calculus students at the University of Maine, which may be considered a remedial course since many students have taken pre-calculus previously. Due to it being a remedial course, it impacts the student’s mathematical achievement greatly, which in turn affects the student’s attitude and anxiety level (Green, 1990). This was not depicted too much within the study, but some students were unable to do basic computations with fractions.

The nature of the study does not focus on gender or year, but some important findings concerning gender arose within the study. First year students were more likely to practice exercises over and over again and attributed mathematics to being boring. Although it is not certain, this could perhaps be a result of the push on standardized testing and testing in general in schools. There is a need to practice exercises over and over in the classrooms to assure that students will pass, but as a result, it may be causing students to like mathematics less.

The biggest difference between males and females in the study was that males tended to have more positive attitudes with mathematics and higher self-beliefs than females. Males believed that they were born being good at math more than females did. There is a stigma around mathematics and that males have higher achievement than females do. For females that truly believe this, they may end up having lower self-esteem, more anxiety, and as a result negative attitudes towards mathematics. It was shown in the second survey that females were more likely to have anxiety towards mathematics, but it was not a significant finding.

Other studies (Daniel, 2005; Hannafin & Scott, 2001), mention how technology, such as computers, can be used to help students and can cause students to have better positive attitudes towards mathematics. In my study, technology hardly had any correlations with the questions in either the first or the second survey. However, there was one correlation dealing with technology that was present in the second survey. Students who worked in groups also thought that technology had helped them learn mathematics. This is interesting because earlier in the same survey, another question, question 7, parallels question 22, which was correlated with technology, but question 7 does not have any significant correlation with it. Thus, the statement, "Technology helped me to learn math", appears to be unreliable in this study, and nothing can be said about it. However, for future studies, it may be important to note that having specific questions regarding technology may be more valuable instead of having one broad question concerning it. This study's focus was not on technology though, and the question was placed on the survey as a possible teaching strategy used to support students through instrumental support.

Limitations

There were a few limitations involved with the study that are important to note. The surveys were all given to college students who were at least 18 years or older. They were asked to remember their mathematics experiences before college, which included elementary education. The first survey was given to a Pre-Calculus course, which may have influenced their answers. Many discussed their current experiences with mathematics instead of discussing their prior experiences, which resulted in more

participants saying favorable things about the course and its instruction. Similarly, although the second survey was given to students who were not in a mathematics course, many had previously taken a mathematics course in college or were currently enrolled in one. This too could have caused students to draw on their current experiences rather their past experiences. This could have further become a problem because in the surveys they needed to indicate both their current attitudes towards mathematics and also their past experiences. Although this was stated in both the directions and out loud to them before they filled out the surveys, students may have forgotten and either filled the survey out to reflect their current mathematics experiences or to reflect their past mathematics attitudes.

Additionally, the majority of the participants from both surveys had been female (78 out 136), while the minority had been male. This could cause the data to depict common themes that are found in gender differences concerning mathematics. Females are more likely to exhibit anxiety over testing situations, which can interfere with their working memory, and their overall attitude with mathematics (Goolsby, 1988). This would contribute to the common theme of test anxiety seen throughout the written surveys. Females are also more likely to exhibit negative attitudes towards mathematics in general because of the stigma that females are not capable of doing mathematics as well as males (Leder et. al., 2014).

Another limitation is that all of the information is acquired from the students, but none of the data is observed firsthand. Some of the data among the students contradicts itself because many students on the Likert scale section of the surveys considered themselves to have overall positive attitudes towards mathematics. However, on the

written section of the first survey and during the interviews, many students discuss negative experiences and negative attitudes associated with it more than their positive experiences. This may have been caused by confusion on how to answer the Likert scaled questions or the participants may have felt more comfortable divulging their negative experiences with written or spoken words instead.

There were also questions on the written survey and during the interview that were originally intended to be beneficial to the study. However, upon further reflection as the study continued, it was apparent that many of the questions were unnecessary for this particular study. Some of the questions dealt with students' achievement and whether the students thought conceptually or procedurally. Although this can be a sign that students may have been taught with proper instrumental support, it does not coincide with the true nature of the study. The main focus is to see if there is a relationship between emotional and instrumental support and students' current mathematical attitudes. For this reason, questions were omitted from the results section because they were not pertinent.

Conclusion

The results of this study show that students' attitudes towards mathematics can be impacted by both emotional and instrumental support from teachers. However, students who generally had positive attitudes remembered negative experiences invoked by lack of emotional support from teachers more than the instrumental support that may have been provided by them. It was also shown that one of the highest contributing factors of a teachers' negative attitude was caused by anxiety from tests or the content area such as algebra.

For future iterations of this study, it would be valuable to survey students who are currently in elementary, middle, and high school. By surveying all three of these grade levels, it could be possible to detect when students begin to acquire negative attitudes towards mathematics. It also would be important to observe firsthand the characteristics the teachers exhibit and whether emotional and instrumental support impacts students' attitudes. It is also important to do this with a wide range of students who are equally male and female. The questions would be more closely related to emotional and instrumental support and common mathematical attitudes. A Likert scale survey and written responses could be used, but more data could be obtained from the observations as well. Lastly, future studies that delve more into gender bias, technology, and the effects of group-work would be interesting to explore based on preliminary results from this study.

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Appendix A

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board, 114 Alumni Hall, 581-1498

PRINCIPAL INVESTIGATOR: Victoria Calabrese

EMAIL: victoria.calabrese@maine.edu TELEPHONE: 520-508-2206

CO-INVESTIGATOR(S): Eric Pandiscio

FACULTY SPONSOR (Required if PI is a student): Eric Pandiscio

TITLE OF PROJECT: The Way Math is Taught Impacts Students' Attitudes Towards Math

START DATE (mm/dd/yyyy): 12/01/2015 PI DEPARTMENT: Education and Human Development

MAILING ADDRESS: 43 Tamarack Ridge RD, APT 4D Orono, ME 04473

FUNDING AGENCY (if any):

STATUS OF PI:

FACULTY/STAFF/GRADUATE/UNDERGRADUATE Undergraduate Student

1. If PI is a student, is this research to be performed:

- ☑ for an honors thesis/senior thesis/capstone?
- ☐ for a doctoral dissertation?
- ☐ other (specify)
- ☐ for a master's thesis?
- ☐ for a course project?

2. Does this application modify a previously approved project? No If yes, please give assigned number (if known) of previously approved project:

3. Is an expedited review requested? Yes

Submitting the application indicates the principal investigator's agreement to abide by the responsibilities outlined in *Section I.E. of the policies and Procedures for the protection of Human Subjects.*

Faculty Sponsors are responsible for oversight of research conducted by their students. The Faculty Sponsor ensures that he/she has read the application and that the conduct of such research will be in accordance with the University of Maine's *Policies and Procedures for the Protection of Human Subjects of Research*. REMINDER: if the principal investigator is an undergraduate student, the faculty sponsor MUST submit the application to the IRB

10/26/2015
Date

****

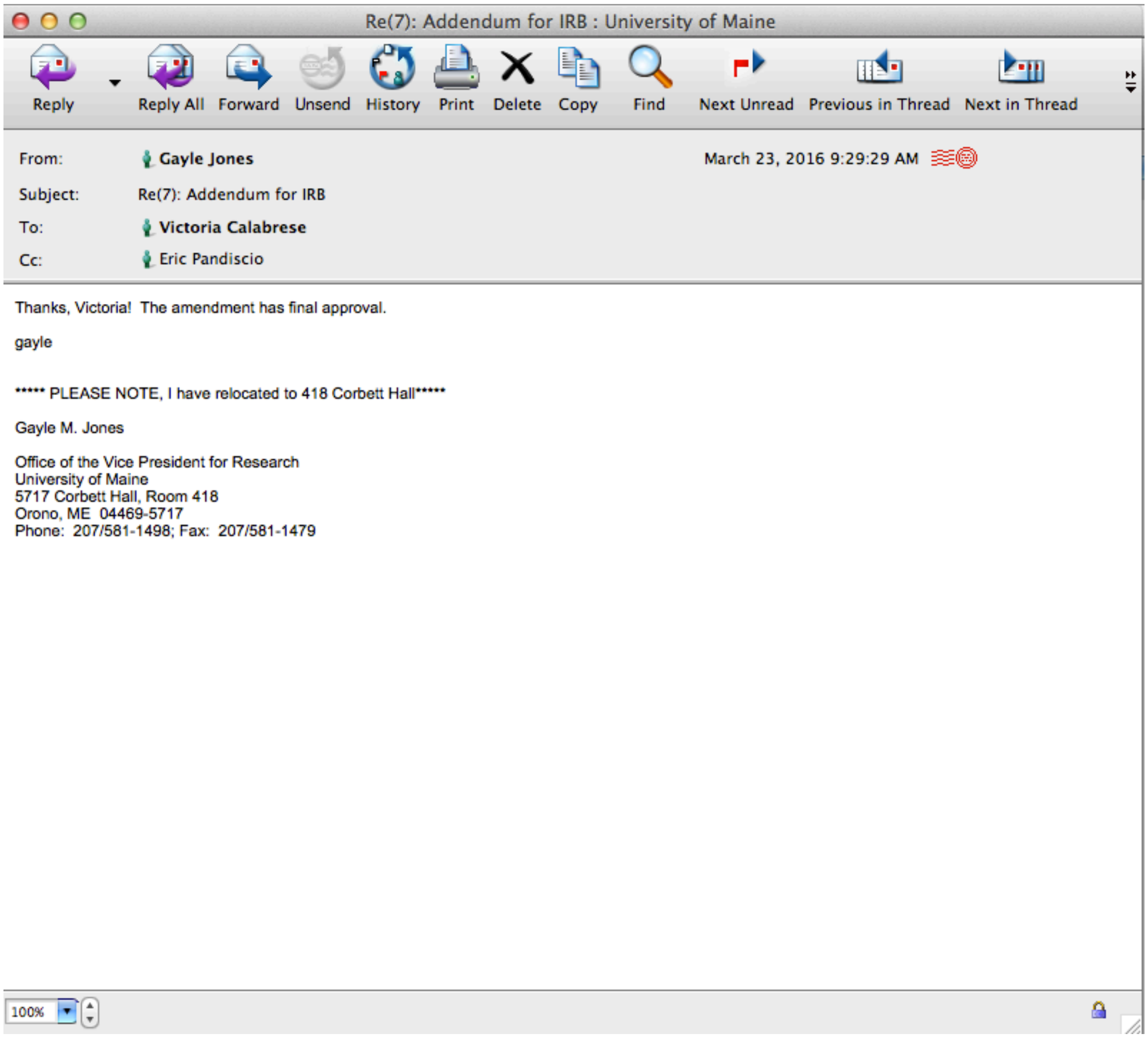
FOR IRB USE ONLY Application # 2015-10-21 Date received 10/29/2015 Review (F/E): E

ACTION TAKEN: Expedited Category: ______

- ☑ Judged Exempt; category 2. Modifications required? Yes Accepted (date) 12/01/2015
- ☐ Approved as submitted. Date of next review: by ____________. Degree of Risk: ____________
- ☐ Approved pending modifications. Date of next review: by ____________. Degree of Risk: ____________
  Modifications accepted (date): ____________.
- ☐ Not approved. (See attached statement.)
- ☐ Judged not research with human subjects

FINAL APPROAL TO BEGIN: 12/1/15 8/2015

Approval of IRB addendum for the second survey:



Re(7): Addendum for IRB : University of Maine

From: Gayle Jones — March 23, 2016 9:29:29 AM
Subject: Re(7): Addendum for IRB
To: Victoria Calabrese
Cc: Eric Pandiscio

Thanks, Victoria! The amendment has final approval.

gayle

***** PLEASE NOTE, I have relocated to 418 Corbett Hall*****

Gayle M. Jones

Office of the Vice President for Research
University of Maine
5717 Corbett Hall, Room 418
Orono, ME 04469-5717
Phone: 207/581-1498; Fax: 207/581-1479

Appendix B

SURVEY CONSENT FORM

You are invited to participate in a research project being conducted by Victoria Calabrese, an undergraduate student in the College of Education and Human Development at the University of Maine and her Honors thesis advisor, Eric Pandiscio, from the College of Education and Human Development. The purpose of the research is to determine how students were taught mathematics before college and the attitudes they now display towards mathematics. You must be at least 18 years of age to participate.

What Will You Be Asked to Do?

If you decide to participate, you will be asked to complete a written survey exploring your attitude about mathematics and how you were taught mathematics before college. Additionally, the survey includes short-answer mathematics problems. This survey will take you about 15 minutes to complete. Some students may be contacted to participate in a follow up interview. The interview will be voluntary.

Risks

Except for your time and inconvenience, there are no risks to you from participating in this study.

Benefits

-You may learn how your attitude about math has been affected by the teaching style you have experienced before college.

- This project will contribute to the body of educational research on student learning by investigating the link between attitudes towards mathematics and early instruction in mathematics.

Confidentiality

Your name will remain on the survey in order to contact you to participate in a follow up interview. Surveys will be kept in the investigator's locked office and only Victoria Calabrese and Eric Pandiscio will look at the surveys. Your instructor, Todd Zoroya will NOT have access to your responses. The data from the survey will be entered into a password-protected computer and kept until June 30, 2016. Your name or other identifying information will not be reported in any publications. The paper surveys with your name will be destroyed by March 31, 2016.

Voluntary

Participation is voluntary. If you choose to take part in this study, you may stop at any time and/or skip any questions.

Contact Information

If you have any questions about this study, please contact me at victoria.calabrese@maine.edu. You may also reach the faculty advisor on this study at eric.pandiscio@umit.maine.edu. If you have any questions about your rights as a research participant, please contact Gayle Jones, Assistant to the University of Maine's

Protection of Human Subjects Review Board, at 581-1498 (or e-mail gayle.jones@umit.maine.edu).

MATH ATTITUDE SURVEY

NAME:

☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior

Below are a number of statements regarding attitudes in math and the way you were taught. Pease read each one carefully and indicate to what extent you agree or disagree.

Attitude About Math	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I believe that I can succeed in math.	1	2	3	4	5
2. I like learning math.	1	2	3	4	5
3. Math is boring.	1	2	3	4	5
4. Math is important throughout my life.	1	2	3	4	5
Problem Solving in Math					
5. I like to come up with new ways to solve math problems.	1	2	3	4	5
6. I believe there is usually only one right way to solve math problems.	1	2	3	4	5
How You Were Taught in Grade School					
7. Technology helped me to understand math.	1	2	3	4	5
8. We only copied down notes from the board.	1	2	3	4	5
9. My teacher introduced math problems to us that we had to figure out the solution to.	1	2	3	4	5
10. My teacher was interested in my work even if it was wrong.	1	2	3	4	5
11. My teacher asked me to explain how I got my answers to math	1	2	3	4	5

problems.					
12. I worked in groups to solve math problems.	1	2	3	4	5
Additional Comments:					

SHORT ANSWERS:

1. Was there ever a time when you did not enjoy a math class? If so, what were the reasons for this?

2. Was there ever a time when you did enjoy a math class? If so, what led to this enjoyment?

3. Does math make you anxious? Please explain why or why not.

4. What confuses you in math? Give an example.

5. What is easy for you in math? Give an example.

6. Order from greatest to least. How did you know the order?

$$\frac{2}{5}, \frac{1}{4}, 0.5, 0.7$$

7. Solve for x. Please show any relevant work.

$$2x + 4 = 12 + 4x$$

8. Solve.

a). $\frac{1}{4} + \frac{2}{3} =$

b). $\frac{1}{3} \times \frac{6}{7} =$

c). $\frac{4}{2} - 1 =$

d). $\frac{7}{2} \div \frac{6}{2} =$

9. Do $\frac{0}{2}$ and $\frac{2}{0}$ have the same answer? Why or why not?

10. Multiply 645x786. Show your work and explain.

11. If you wanted to order fractions from least to greatest, how would you determine the order without turning the fractions into decimals?

12. Multiply 12x18 mentally (without paper or pencil). Explain how you would multiple the two numbers mentally.

13. Was it a common occurrence for you to be given questions like those above while you were in grade school?

14. Do you think similar questions would have been beneficial to you in order to get a clearer understanding of mathematics? Why or why not?

INDIVIDUAL INTERVIEW CONSENT FORM

You are invited to participate in a research project being conducted by Victoria Calabrese, an undergraduate student in the College of Education and Human Development at the University of Maine and her honors thesis advisor, Eric Pandiscio, from the College of Education and Human Development. The purpose of the research is to determine how students were taught mathematics before college. You must be at least 18 years of age to participate.

What Will You Be Asked to Do?

If you decide to participate, you will be interviewed individually to discuss your responses from the survey you completed a few weeks ago. You will be voice recorded during the interview session. The interview will take anywhere from 30 minutes to 1 hour to complete. Some example questions might include telling about your experience with math, how math makes you feel, and multiplying 255 by 350.

Risks

- Except for your time and inconvenience, there are no risks to you from participating in this study.

Benefits

- You may learn how your attitude about math has been affected by the teaching style you have experienced before college.
- This project will contribute to the body of educational research on student learning by investigating the link between attitudes towards mathematics and early instruction in mathematics.

Compensation

- You will receive one hour of one-on-one tutoring for your next test if the interview is completed.

Confidentiality

Your name will not be linked to any of the interviews. Voice recordings will be kept in the investigator's locked office and only Victoria Calabrese and Eric Pandiscio will be the ones listening to the voice recordings. Your instructor, Todd Zoroya, will NOT have access to students' responses. All voice recording from the interviews will be destroyed by March 31, 2016. Recordings will be transcribed and transcriptions with be kept on a password protected computer. Transcriptions will be destroyed by June 30, 2016.

Voluntary

Participation is voluntary and you may skip any questions. If you choose to take part in this study, you may stop at any time. If you withdraw or do not complete the interview you will be ineligible for the one-on-one tutoring.

Contact Information

If you have any questions about this study, please contact me at victoria.calabrese@maine.edu. You may also reach the faculty advisor on this study at eric.pandiscio@umit.maine.edu. If you have any questions about your rights as a research participant, please contact Gayle Jones, Assistant to the University of Maine's Protection of Human Subjects Review Board, at 581-1498 (or e-mail gayle.jones@umit.maine.edu).

SURVEY CONSENT FORM

You are invited to participate in a research project being conducted by Victoria Calabrese, an undergraduate student in the College of Education and Human Development at the University of Maine and her Honors thesis advisor, Eric Pandiscio, from the College of Education and Human Development. The purpose of the research is to determine how students were taught mathematics before college and the attitudes they now display towards mathematics. You must be at least 18 years of age to participate.

What Will You Be Asked to Do?

If you decide to participate, you will be asked to complete an anonymous survey exploring your attitude about mathematics and how you were taught mathematics before college. This survey will take you about 10 minutes to complete.

Risks

Except for your time and inconvenience, there are no risks to you from participating in this study.

Benefits

-You may learn how your attitude about math has been affected by the teaching style you have experienced before college.

- This project will contribute to the body of educational research on student learning by investigating the link between attitudes towards mathematics and early instruction in mathematics.

Confidentiality

The survey is anonymous; do not write your name on the survey. Surveys will be kept in the investigator's locked office and only Victoria Calabrese and Eric Pandiscio will look at the surveys. Your instructor will NOT have access to your responses. The data from the survey will be entered into a password-protected computer and kept until June 30, 2016. The paper surveys with will be destroyed by April 30, 2016.

Voluntary

Participation is voluntary. If you choose to take part in this study, you may stop at any time and/or skip any questions.

Contact Information

If you have any questions about this study, please contact me at victoria.calabrese@maine.edu. You may also reach the faculty advisor on this study at eric.pandiscio@umit.maine.edu. If you have any questions about your rights as a research participant, please contact Gayle Jones, Assistant to the University of Maine's Protection of Human Subjects Review Board, at 581-1498 (or e-mail gayle.jones@umit.maine.edu).

MATH ATTITUDE SURVEY

Preferred Gender:

☐ Female ☐ Male

Year:

☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior

Have many math courses have you taken while in college?

☐ 0 ☐ 1 ☐ 2 ☐ 3 or More

Are you currently taking any math courses?

☐ Yes ☐ No

Directions: Below are a number of statements regarding your attitudes in math and the way you were taught math before college. Pease read each one carefully and indicate to what extent you agree or disagree. Please note that the statements regarding your attitudes are your attitudes towards math **NOW**, while the statements about your experiences are from your experiences with math **BEFORE** college.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I believe that I can succeed in math.	1	2	3	4	5
2. I like learning math.	1	2	3	4	5
3. Math is boring.	1	2	3	4	5
4. Math is important throughout my life.	1	2	3	4	5
5. I like to come up with new ways to solve math problems.	1	2	3	4	5
6. I believe there is usually only one right way to solve math problems.	1	2	3	4	5
7. Technology helped me to understand math.	1	2	3	4	5
8. We only copied down notes from the board.	1	2	3	4	5

9. My teacher introduced math problems to us that we had to figure out the solution to.	1	2	3	4	5
10. My teacher was interested in my work even if it was wrong.	1	2	3	4	5
11. My teacher asked me to explain how I got my answers to math problems.	1	2	3	4	5
12. I worked in groups to solve math problems.	1	2	3	4	5
13. I enjoyed math class.	1	2	3	4	5
14. Math is easy for me.	1	2	3	4	5
15. I was told it was okay to ask questions during class.	1	2	3	4	5
16. I listened and paid attention during math class.	1	2	3	4	5
17. I understood what was taught during class, but then forgot how to do it when I got home.	1	2	3	4	5
18. I have had a bad experience with math because of a teacher.	1	2	3	4	5
19. Word problems make me nervous.	1	2	3	4	5
20. My teacher made me practice exercises over and over again.	1	2	3	4	5
21. My teacher was more concerned with how I got the answer than if the answer was correct.	1	2	3	4	5
22. I worked in groups to try and solve math problems.	1	2	3	4	5
23. My math experience was more formulaic than problem solving.	1	2	3	4	5
24. I was taught one way to	1	2	3	4	5

solve a math problem.					
25. If I didn't understand something, my teacher taught the process again and didn't explain the reasoning behind it.	1	2	3	4	5
26. I was actively involved when learning math.	1	2	3	4	5
27. My math teacher always had a positive attitude towards math.	1	2	3	4	5
28. When the teacher called on me during math class, I was anxious.	1	2	3	4	5
29. I dislike math.	1	2	3	4	5
30. I believe that people are born being good at math.	1	2	3	4	5
31. Math isn't really useful outside of school.	1	2	3	4	5
32. I don't understand math.	1	2	3	4	5
33. I felt safe asking questions during math class.	1	2	3	4	5
34. I felt respected during math class.	1	2	3	4	5
35. Math gives me anxiety.	1	2	3	4	5

List of Tables and Figures

Table 1. *Descriptive Statistics Among Year in College on Survey One*

	Year	*Mean*	*Standard Deviation*
Q1	Year 1	3.919	.698
	Year 2	3,956	.878
	Year 3	3.941	1.345
	Total	3.934	.854
Q2	Year 1	3.196	1.016
	Year 2	3.289	1.100
	Year 3	3.529	1.463
	Total	3.268	1.104
Q3	Year 1	3.008	1.018
	Year 2	2.844	.952
	Year 3	2.647	1.222
	Total	2.952	1.029
Q4	Year 1	3.703	1.155
	Year 2	2.578	1.011
	Year 3	3.471	1.125
	Total	3.632	1.101
Q5	Year 1	2.926	1.019
	Year 2	2.822	1.051
	Year 3	1.706	1.359
	Total	2.864	1.071
Q6	Year 1	2.297	.872
	Year 2	2.133	1.217
	Year 3	2.118	1.054
	Total	2.221	1.016
Q7	Year 1	3.203	1.271
	Year 2	3.578	.941

	Year 3	3.412	1.064
	Total	3.353	1.152
Q8	Year 1	2.905	1.100
	Year 2	2.711	1.014
	Year 3	2.588	1.064
		2.801	1.067
	Total		

Table 1. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q9	Year 1	3.865	.881
	Year 2	4.000	.707
	Year 3	3.588	1.228
	Total	3.875	.881
Q10	Year 1	3.459	.982
	Year 2	3.378	.812
	Year 3	3.412	1.004
	Total	3.493	.927
Q11	Year 1	3.838	.811
	Year 2	3.889	.775
	Year 3	3.706	1.047
	Total	3.838	.828
Q12	Year 1	3.689	.843
	Year 2	3.222	1.064
	Year 3	3.471	1.179
	Total	3.507	.981

Table 2. *Descriptive Statistics Among Gender on Survey One*

	Year	*Mean*	*Standard Deviation*
Q1	Female	3.897	.783
	Male	3.983	.946
	Total	3.934	.854
Q2	Female	3.160	1.083
	Male	3.414	1.124
	Total	3.268	1.104
Q3	Female	3.032	1.058
	Male	2.845	.988
	Total	2.952	1.029
Q4	Female	3.526	1.066
	Male	3.776	1.140
	Total	3.632	1.101
Q5	Female	2.660	1.071
	Male	3.138	1.017
	Total	2.864	1.071
Q6	Female	2.167	.999
	Male	2.293	1.043
	Total	2.221	1.016
Q7	Female	3.423	1.134
	Male	3.259	1.178
	Total	3.353	1.152
Q8	Female	2.756	1.059
	Male	2.862	1.083
	Total	2.801	1.067

Table 2. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q9	Female	3.833	.710
	Male	3.931	1.074
	Total	3.875	.8881
Q10	Female	3.538	.785
	Male	3.431	1.094
	Total	3.493	.927
Q11	Female	3.769	.772
	Male	3.931	.896
	Total	3.838	.828
Q12	Female	3.551	.962
	Male	3.448	1.012
	Total	3.507	.981

Table 3. *Correlations and Descriptive Statistics Among Questions on Survey One*

	M (*SD*)	Q1 Sig.	Q2 Sig.	Q3 Sig.	Q4 Sig.	Q5 Sig.	Q6 Sig.
Question 1	3.93 (.85)		.616**	-.358**		.290**	
Question 2	3.27 (1.10)	.616**		-.680**	.198*	.421**	-.225**
Question 3	2.95 (1.03)	-.358**	-.680**		-.186*	-.312**	
Question 4	3.63 (1.10)		.198*	-.186*		.234**	
Question 5	2.86 (1.07)	.290**	.421**	-.312**	.234**		-.245**
Question 6	2.21 (1.02)		-.225**			-.245**	
Question 7	3.35 (1.15)						
Question 8	2.80 (1.07)					3	
Question 9	3.88 (.88)	.196*					
Question 10	3.49 (.93)					.184*	
Question 11	3.84 (.83)	.184*				.171*	
Question 12	3.50 (.98)			.211*			

Table 3. *(Continued)*

	Q7 Sig.	Q8 Sig.	Q9 Sig.	Q10 Sig.	Q11 Sig.	Q12 Sig.
Question 1			.196*		.184*	
Question 2						
Question 3						.211*
Question 4						
Question 5				.184*	.171*	
Question 6						
Question 7						
Question 8				-.230**	-.330**	
Question 9					.284**	.206*
Question 10		-.230**	.284**		.491*	.171*
Question 11		-.330**		.491**		.266**
Question 12				.171*	.266**	

**Correlation is significant at the 0.01 level (2-tailed)
**Correlation is significant at the 0.05 level (2-tailed)

Table 4. *Descriptive Statistics Among Year in College on Survey Two*

	Year	*Mean*	*Standard Deviation*
Q1	Year 1	3.78	.428
	Year 2	4.14	.727
	Total	3.97	.628
Q2	Year 1	2.78	.943
	Year 2	3.38	1.024
	Total	3.10	1.021
Q3	Year 1	3.44	.922
	Year 2	2.67	.966
	Total	3.03	1.013
Q4	Year 1	3.39	1.145
	Year 2	3.57	1.028
	Total	3.49	1.073
Q5	Year 1	2.33	.907
	Year 2	2.86	1.014
	Total	2.62	.990
Q6	Year 1	2.22	.548
	Year 2	2.00	.949
	Total	2.10	.788
Q7	Year 1	3.56	1.097
	Year 2	3.33	.913
	Total	3.44	.995
Q8	Year 1	2.61	1.037
	Year 2	2.76	.995
	Total	2.69	1.004

Table 4. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q9	Year 1	3.56	.992
	Year 2	4.00	.548
	Total	3.79	.767
Q10	Year 1	3.50	.857
	Year 2	3.52	.680
	Total	3.51	.756
Q11	Year 1	4.00	.485
	Year 2	3.90\3.95	.768
	Total		.647
Q12	Year 1	3.78	.808
	Year 2	3.52	.814
	Total	3.64	.811
Q13	Year 1	2.67	1.085
	Year 2	3.48	1.030
	Total	3.10	1.119
Q14	Year 1	3.06	1.056
	Year 2	3.24	1.338
	Total	3.15	1.204
Q15	Year 1	4.33	.485
	Year 2	4.24	.625
	Total	4.28	.560
Q16	Year 1	3.89	.676
	Year 2	3.95	.805
	Total	3.92	.739

Table 4. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q17	Year 1	3.33	1.138
	Year 2	2.90	.889
	Total	3.10	1.021
Q18	Year 1	3.28	1.227
	Year 2	3.05	1.203
	Total	3.15	1.204
Q19	Year 1	3.39	.344
	Year 2	2.90	.257
	Total	3.12	.212
Q20	Year 1	3.94	.098
	Year 2	3.48	.178
	Total	3.69	.111
Q21	Year 1	3.22	.286
	Year 2	3.52	.190
	Total	3.38	.167
Q22	Year 1	3.78	.732
	Year 2	3.48	.814
	Total	3.62	.782
Q23	Year 1	3.11	.900
	Year 2	3.14	.655
	Total	3.13	.767
Q24	Year 1	2.50	.857
	Year 2	2.81	.981
	Total	2.67	.927

Table 4. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q25	Year 1	2.78	1.003
	Year 2	2.62	.865
	Total	2.69	.922
Q26	Year 1	3.33	.840
	Year 2	3.29	1.056
	Total	3.31	.950
Q27	Year 1	3.61	.037
	Year 2	3.76	.831
	Total	3.69	.922
Q28	Year 1	3.28	1.179
	Year 2	3.43	.978
	Total	3.36	1.063
Q29	Year 1	3.22	1.166
	Year 2	2.62	1.203
	Total	2.90	1.209
Q30	Year 1	2.67	.07
	Year 2	2.81	1.167
	Total	2.74	1.044
Q31	Year 1	1.89	.676
	Year 2	2.10	.831
	Total	2.00	.762
Q32	Year 1	2.56	2.249
	Year 2	2.29	1.102
	Total	2.41	1.117

Table 4. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q33	Year 1	3.28	.895
	Year 2	3.48	1.030
	Total	3.38	.963
Q34	Year 1	3.39	.778
	Year 2	3.62	.921
	Total	3.51	.854
Q35	Year 1	3.39	1.145
	Year 2	2.86	.062
	Total	3.10	1.119

Table 5. *Descriptive Statistics Among Gender on Survey Two*

	Year	*Mean*	*Standard Deviation*
Q1	Female	3.88	.793
	Male	4.13	.806
	Total	3.96	.798
Q2	Female	2.97	1.150
	Male	3.56	1.263
	Total	3.17	1.209
Q3	Female	3.13	.942
	Male	2.63	1.204
	Total	2.96	1.051
Q4	Female	3.56	1,076
	Male	2.44	.964
	Total	2.52	1.031
Q5	Female	2.50	1.107
	Male	2.88	1.088
	Total	2.63	1.104
Q6	Female	2.19	.896
	Male	1.88	.719
	Total	2.08	.846
Q7	Female	3.50	.984
	Male	3.56	.964
	Total	3.52	.967
Q8	Female	2.63	1.040
	Male	2.75	1.125
	Total	2.67	1.059

Table 5. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q9	Female	3.75	.672
	Male	4.00	.894
	Total	3.83	.753
Q10	Female	3.56	.716
	Male	3.38	1.088
	Total	3.50	.851
Q11	Female	3.91	.641
	Male	4.06	.772
	Total	3.96	.683
Q12	Female	3.56	.840
	Male	3.63	.806
	Total	3.58	.821
Q13	Female	2.84	1.221
	Male	3.75	.931
	Total	3.15	1.203
Q14	Female	2.94	1.216
	Male	3.56	1.263
	Total	3.15	1.255
Q15	Female	4.19	.644
	Male	4.31	.602
	Total	4.23	.627
Q16	Female	3.97	.695
	Male	3.94	.929
	Total	3.96	.771

Table 5. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q17	Female	3.03	1.031
	Male	3.13	1.204
	Total	3.06	1.080
Q18	Female	3.09	1.174
	Male	3.13	1.204
	Total	3.10	1.171
Q19	Female	3.34	1.285
	Male	2.44	1.365
	Total	2.04	1.368
Q20	Female	3.66	.787
	Male	3.44	.964
	Total	3.58	.846
Q21	Female	3.41	1.073
	Male	3.44	.892
	Total	3.42	1.007
Q22	Female	3.69	.738
	Male	3.50	.996
	Total	3.63	.815
Q23	Female	3.16	.808
	Male	3.19	.981
	Total	3.17	.859
Q24	Female	2.50	.842
	Male	2.88	1.147
	Total	2.63	.959

Table 5. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q25	Female	2.63	.907
	Male	2.69	1.078
	Total	2.65	.956
Q26	Female	3.47	.718
	Male	3.31	1.302
	Total	3.42	.942
Q27	Female	3.69	.965
	Male	3.94	.929
	Total	3.77	.951
Q28	Female	3.38	1l212
	Male	3.00	1.095
	Total	3.25	1.176
Q29	Female	2.91	1.376
	Male	2.31	1.195
	Total	2.71	1.336
Q30	Female	2.41	.979
	Male	3.31	1.138
	Total	2.71	1.110
Q31	Female	1.81	.780
	Male	2.00	.894
	Total	1.88	.815
Q32	Female	2.47	1.295
	Male	2.06	.998
	Total	2.33	1.209

Table 5. *(Continued)*

	Year	*Mean*	*Standard Deviation*
Q33	Female	3.19	1.148
	Male	3.88	.806
	Total	3.42	1.088
Q34	Female	3.44	1.076
	Male	3.63	.885
	Total	3.50	1.011
Q35	Female	3.13	1.338
	Male	2.50	1.033
	Total	2.92	1.269

Table 6. *Correlations and Descriptive Statistics Among Questions on Survey Two*

	M (*SD*)	Q1 Sig.	Q2 Sig.	Q3 Sig.	Q4 Sig.	Q5 Sig.	Q6 Sig.
Question 1	3.96 (.80)		.735**	-.433**	.337*	.417**	-.310*
Question 2	3.17 (1.21)	.735**	-.664**	-.644**		.558**	-.430**
Question 3	2.96 (1.05)	-.433**			-.431**	-.509**	.363*
Question 4	3.52 (1.03)	.337*		-.431**		.325*	-.295*
Question 5	2.63 (1.10)	.417**	.558**	-.509**	.325*		
Question 6	2.08 (.86)	-.310*	-.430**	.363*	-.295*		
Question 7	3.52 (.97)						
Question 8	2.67 (1.06)						
Question 9	3.83 (.75)						
Question 10	3.50 (.85)					.317*	
Question 11	3.96 (.68)						
Question 12	3.58 (.82)			.300*			
Question 13	3.15 (1.20)	.694**	.788**	-.736**		.539**	
Question 14	3.15 (1.26)	.686**	.685**	-.479**		.409**	
Question 15	4.23 (.63)	.487**	.370**				
Question 16	3.96 (.77)	.343*					
Question 17	3.06 (1.08)	.392**	-.432**	.565**			
Question 18	3.10 (1.17)						
Question 19	3.04 (1.37)	-.330*	-.468**	.430**			

Table 6. *(Continued)*

	M (*SD*)	Q1 Sig.	Q2 Sig.	Q3 Sig.	Q4 Sig.	Q5 Sig.	Q6 Sig.
Question 20	3.58 (.85)			.339*			
Question 21	3.42 (1.01)						
Question 22	3.63 (.82)			.304*		-.325*	
Question 23	3.17 (.86)						
Question 24	2.63 (.96)						
Question 25	2.65 (.96)			.303*			
Question 26	3.42 (.94)						
Question 27	3.77 (.95)	.436**	.367*				
Question 28	3.25 (1.18)			.301*	-.373**		
Question 29	2.71 (1.34)	.371**	-.562**	.582*	-.351*	-.307*	.417**
Question 30	2.71 (1.11)				-.292*		
Question 31	1.88 (.82)				-.351*		.355*
Question 32	2.33 (1.21)	-.449**	-.505**	.380*			.388**
Question 33	3.42 (1.09)	.658**	.561**	-.394**			-.293*
Question 34	3.50 (1.01)	.607**	.644**	-.501**	.439**	.420**	

Question 35	2.92 (1.27)	-.382**	-.560**	.604**		-.342*	.383**

Table 6. *(Continued)*

	Q7 Sig.	Q8 Sig.	Q9 Sig.	Q10 Sig.	Q11 Sig.	Q12 Sig.	Q13 Sig.
Question 1							.694**
Question 2							.788**
Question 3						.300*	-.736**
Question 4							
Question 5				.317*			.539**
Question 6							
Question 7							
Question 8					-.461**		
Question 9							
Question 10							
Question 11		-.461**					
Question 12							
Question 13							
Question 14			.296*				.719**
Question 15				.299*	.470**		.378**
Question 16				.325*	.360*		

Question 17			.294*	-.531**
Question 18	.355*	-.340*		
Question 19				-.521**

Table 6. *(Continued)*

	Q7 Sig.	Q8 Sig.	Q9 Sig.	Q10 Sig.	Q11 Sig.	Q12 Sig.	Q13 Sig.
Question 20							
Question 21		-.326*		.298*			
Question 22	.361*					.747**	
Question 23		.296*		-.291*			
Question 24		.524**					
Question 25		.533**					
Question 26		-.434**		.319*	.292*		
Question 27		-.458**		.355*	.411**	.366*	.328*
Question 28							-.312*
Question 29		.321*					-.608**
Question 30							
Question 31							
Question 32							-.459**
Question 33				.322*	.310*	.341*	.700**
Question 34		-.398**					.621**
Question 35							-.605**

Table 6. *(Continued)*

	Q14 Sig.	Q15 Sig.	Q16 Sig.	Q17 Sig.	Q18 Sig.	Q19 Sig.	Q20 Sig.
Question 1	.686**	.487**	.343**	-.392**		-.330*	.339*
Question 2	.685**	.370**		-.432**		-.468	
Question 3	-.479**			.565**		.430**	
Question 4							
Question 5	.409**						
Question 6							
Question 7							
Question 8					.355*		
Question 9	.296*						
Question 10		.299*	.325*				
Question 11		.473**	.360*		-.340*		
Question 12				.294*			
Question 13	.719**	.378**		-.531**		-.521**	
Question 14		.389**		-.368*		-.425**	
Question 15	.389**		.504**			-.408**	
Question 16		.504**					
Question 17	-.368*				.	.474**	
Question 18				.432**	.432**		
Question 19	-.425**	-.408**		.474**	.474**		

Table 6 *(Continued)*

	Q14 Sig.	Q15 Sig.	Q16 Sig.	Q17 Sig.	Q18 Sig.	Q19 Sig.	Q20 Sig.
Question 20							
Question 21							
Question 22							
Question 23							
Question 24		-.314*					
Question 25					.509**		
Question 26		.447**	.288*			-.328*	
Question 27		.340*			.475**		
Question 28	-.328*			.507**	.429**	.429**	
Question 29	-.507**			.514**	.414**	.391**	.379**
Question 30				.388**			
Question 31							.293*
Question 32	-.534**			.391**	.306*	.455**	.305*
Question 33	.625**	.512**		-.312*		-.541**	
Question 34	.613**	.588**	.410**	-.322*		-.292*	
Question 35	-.447**			.594**	.378**	.529**	.442**

Table 6. *(Continued)*

	Q21 Sig.	Q22 Sig.	Q23 Sig.	Q24 Sig.	Q25 Sig.	Q26 Sig.	Q27 Sig.
Question 1							.436**
Question 2							.367*
Question 3		.304*			.303*		
Question 4							
Question 5		-.325*					
Question 6				.328*			
Question 7		.361*					
Question 8	-.326*		.296*	.524**	.553**	-.434**	-.458**
Question 9							
Question 10	.298*		-.291*			.319*	.355*
Question 11						.292*	.411**
Question 12		.747**					.366*
Question 13							.328*
Question 14							
Question 15				-.314*		.447**	.340*
Question 16						.288*	
Question 17							
Question 18					.509**		-.475**
Question 19						-.328*	

Question 20

Table 6. *(Continued)*

	Q21 Sig.	Q22 Sig.	Q23 Sig.	Q24 Sig.	Q25 Sig.	Q26 Sig.	Q27 Sig.
Question 21		.376*				.352*	
Question 22	.376**						
Question 23							
Question 24					.478**	-.412**	
Question 25				.478**		-.423**	-.349*
Question 26	.352*			-.412**	-.423**		.418**
Question 27					-.349*	.418**	
Question 28							
Question 29					-.384**		
Question 30							
Question 31							
Question 32							
Question 33							.444**
Question 34							.432**
Question 35					.291*		

Table 6. *(Continued)*

	Q28 Sig.	Q29 Sig.	Q30 Sig.	Q31 Sig.
Question 1		.371**		
Question 2		-.562**		
Question 3	.301*	.582**		
Question 4	-373**	-.351*	-.292*	-.351*
Question 5		-.307*		
Question 6		.417**		.355*
Question 7				
Question 8		.321*		
Question 9				
Question 10				
Question 11				
Question 12				.397**
Question 13	-.312*	.608**		
Question 14	-.328*	-.507**		
Question 15				
Question 16				
Question 17	.507**	.514**	.388**	
Question 18	.429**	.414**		
Question 19		.391**		

Question 20		.379**		.293*

Table 6 *(Continued)*

	Q28 Sig.	Q29 Sig.	Q30 Sig.	Q31 Sig.
Question 21				
Question 22				
Question 23				
Question 24				
Question 25		.384**		
Question 26				
Question 27				
Question 28		.548**	.302*	
Question 29	.548**		.286*	.337*
Question 30	.302*	.286*		.288*
Question 31		.337*	.288*	
Question 32	.419**	.667**	.375**	.475**
Question 33		-.354*		
Question 34		-.299*		
Question 35	.642**	.738**	.375**	.319*

Table 6. *(Continued)*

	Q32 Sig.	Q33 Sig.	Q34 Sig.	Q35 Sig.
Question 1	-.449**	.658**	.607**	-.382**
Question 2	-.505**	.561**	.644**	-.560**
Question 3	.380**	-.394**	-.501**	.604**
Question 4			.439**	
Question 5			.420**	-.342*
Question 6	.388**	-.293*		.383**
Question 7				
Question 8			-.398**	
Question 9				
Question 10		.322*		
Question 11		.310*		
Question 12		.341*		
Question 13	-.459**	.700**	.621**	-.605**
Question 14	-.524**	.625**	.613**	-.447**
Question 15		.512**	.588**	
Question 16			.410**	
Question 17	.391**	-.312*	-.322*	.594**
Question 18	.306*			.378**
Question 19	.455**	-	-.292*	.529**

.541**

Table 6. *(Continued)*

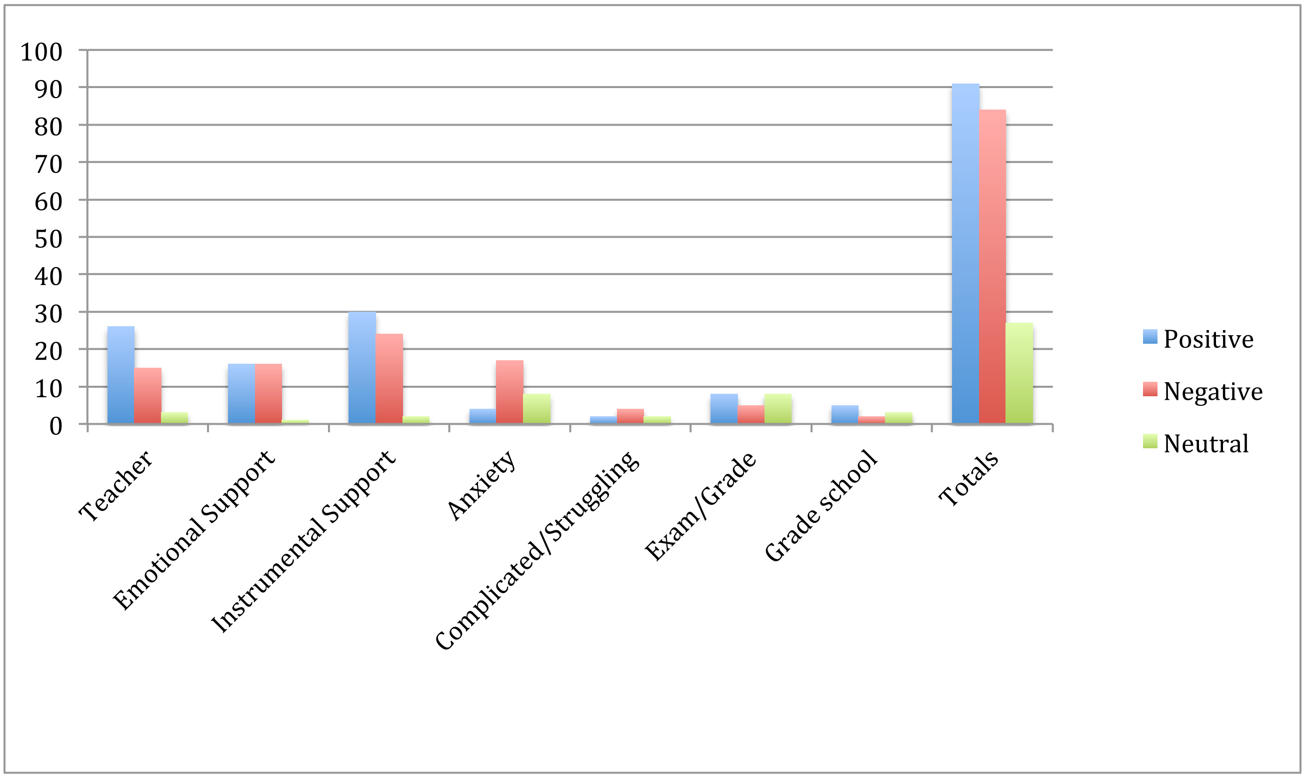
	Q32 Sig.	Q33 Sig.	Q34 Sig.	Q35 Sig.
Question 20	.305*			.442**
Question 21				
Question 22				
Question 23				
Question 24				
Question 25				.291*
Question 26				
Question 27		.444**	.432**	
Question 28	.419**			.642**
Question 29	.667**	-.354*	-.299*	.738**
Question 30	.375**			.375**
Question 31	.475**			.319*
Question 32		-.286*		.671**
Question 33	-.286*		.677**	-.329*
Question 34		.677**		
Question 35	.671**	-.329*		

**Correlation is significant at the 0.01 level (2-tailed)
**Correlation is significant at the 0.05 level (2-tailed)

Table 7. *Frequency of Codes on Survey One*

Codes	*Positive*	*Average*	*Negative*
Teacher	26	3	15
Emotional Support	16	1	16
Instrumental Support	30	2	24
Anxiety	4	8	17
Complicated/Struggling	2	2	4
Exams/ Grades	8	8	5
Grade School	5	3	2
Totals	91	27	84

Figure 1. *Frequency of Codes on Survey One*



Author's Biography

Victoria M. Calabrese was born in Madison, New Jersey on September 27, 1993. She was raised in New Jersey until she was 13 and then moved to Patagonia, Arizona where she graduated from high school as valedictorian of her class in 2012. Majoring in elementary education, Victoria has a minor in mathematics. She is a member of Kappa Delta Pi and Gamma Sigma Sigma Delta Nu. She is also a student ambassador for the University of Maine and works in the Math Den on campus.