

Examining Intervention Support in Mathematics: Can students' attitudes and  
achievement be positively affected?

A Master's Research Project Presented to

The Faculty of the Gladys W. and David H. Patton College of Education and Human Services

Ohio University

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

by

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June, 2011

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### **Abstract**

Mathematics continues to be a root of frustration, confusion, and perplexity for students of all ages, but primarily in middle school as the concepts intensify and increase in complexity. Teachers are faced with the pressures of adequately preparing students for high-stakes tests and addressing required standards which have become part of the curriculum, on top of keeping students engaged and motivated. This becomes an area of even greater focus when students with mild disabilities, other service delivery models, and intervention specialists are considered. This study explored the current literature on mathematics at the middle school level, student motivation, mathematics and the arts, the pull-out service delivery model, and Gardner's theory of multiple intelligences. This research was designed to answer the question: How does the intervention specialist, along with specific intervention, impact students' attitudes and achievement in mathematics and standardized tests? Data was collected through the completion of a Mathematics Attitudinal Survey pre- and post-intervention and was collected over the course of one academic year. Results showed that middle school students with disabilities felt encouraged and more confident in their mathematical abilities following the intervention. Results pertaining to the impact of the intervention on participants' academic outcomes indicated a slight improvement over the course of the study.

Math is used in everyday life in a multitude of ways. From the start of elementary school and continuing through high school and beyond, math continues to play an integral role in the curriculum. Aside from its importance in the classroom, Leinwand (2009) believes, "...the language of mathematics is international. The subject transcends cultural boundaries and its importance is universally recognized" (p. 11).

Furthermore, mathematics is a cumulative subject that consistently builds upon prior knowledge. A strong foundation, as well as continual fostering and reinforcement of skills is critical for success inside and outside the classroom. With each grade level comes new and important knowledge and skills to be mastered. Seventh grade presents students, in many cases, with their first in-depth look at algebra, which is the introduction to higher level math concepts. It is important for students to grasp the concept of algebra in order for them to understand any sort of statistical classes, more advanced algebra in years to come, and in order to utilize basic problem solving skills. Consequently, according to a study completed by Cleary and Chen (2009), elementary and middle school students' motivation and achievement in mathematics is reliant on their genuine (or lack thereof) interest in the subject. Their study noted a substantial decrease in interest from sixth to seventh grade, which may result in lower motivation and achievement (Cleary & Chen, 2009). Additionally, with state tests, unpredictable weather, and various levels of abilities among students, teachers are faced with the constant stress of preparing their students as thoroughly as possible for the standardized state tests and for the following school year. Additionally, students' level of interest is frequently at the root of their academic success (Schifter, 1996).

Because of the importance placed upon students not only learning, but understanding mathematics, schools may go to extensive means to be sure to reach each student when teaching

mathematics. For students who have specific learning disabilities or developmental disorders that impede their ability to keep up with their typical peers, teachers often collaborate with intervention support specialists to best serve their students (<http://www.cec.sped.org>). Essentially, intervention specialists work with children with mild to moderate disabilities using or modifying the general education curriculum to meet children's individual needs (<http://www.cec.sped.org>). Intervention specialists hold a teaching license with, at the very minimum, an additional 4-year teaching degree.

The role of the intervention specialist is to adapt the general education curriculum to students' abilities and needs, which can be done in a variety of ways. For instance, an intervention specialist might co-teach alongside the general educator or conduct a smaller class, outside of the general education classroom for students with educational needs, typically known as "pull-out" instruction. This form of instruction is meant to benefit the students because of the increased one-on-one attention from the intervention specialist, fewer distractions than the general education classroom, and material can be taught at a slower pace because there are fewer students. Additional supports offered by the intervention specialist include adapting assignments by shortening the number of problems, instructing for a longer period of time than would be possible for the general education teacher, providing guided notes for the students to follow along, or providing additional time for students to complete work. Ultimately, students with various learning disabilities and/or developmental disorders may be more responsive to this teaching style.

Reisman and Kaufman (1980) suggest there is a link between children solving math problems and solving their own problems, which are impacted if children have learning disabilities or developmental disorders, such as those in a pull-out class. Sobel and Maletsky

(1988) mention that skills and concepts are best learned when students are allowed to make discoveries and explanations on their own. Providing students with the opportunity to illustrate their own unique understandings allows them to have ownership of their work. This may be done by focusing on teaching and learning mathematics through various mediums, such as art. Embedding mathematics in real-world contexts or in something greater than simply the math class itself is echoed by Leinwand's (2009) belief that the context in which math can be applied, serves as an excellent motivator. The purpose of this study was to explore if the role of the intervention support specialist, coupled with the intervention of drawing, impacts students' achievement on their unit assessments, as well as their attitudes toward mathematics in general. This study answers the question: how does the intervention specialist, along with specific intervention, impact student achievement in mathematics and attitudes?

### **Literature Review**

To explore the content and characteristics of mathematics at the middle grades, this researcher read and analyzed literature pertaining to this topic through scholarly journals and studies. After gaining a sound understanding, the researcher reviewed specific literature pertaining to the definition and effectiveness of the pull-out service delivery model. From there, student motivation was researched, along with the joining of mathematics and the arts which are presented in the following sections.

#### **Middle School Mathematics**

Middle school marks an integral time in students' experiences in learning mathematics, as well as in teachers' roles of teaching mathematics. Teachers are faced with the responsibility of addressing and attending to the challenges their students face in the move from elementary to middle school mathematics (Schielack & Seeley, 2010). In order to foster their students' needs

regarding the challenges associated with the transition to middle school mathematics, Schielack and Seeley suggest teachers pay special attention and care to their instructional strategies, materials, and work expectations in math class. Most notably, teachers of middle school mathematics should be ultra-sensitive to students' anxieties toward mathematics, as well as be incredibly mindful of the parent-teacher partnership in mathematics, and across content areas (Schielack & Seeley, 2010).

Changes in work expectations in middle school mathematics compared to elementary mathematics is an incredible challenge for most students to get used to and essentially, a root of stress (Schielack & Seeley, 2010). Moreover, middle school mathematics, particularly 7<sup>th</sup> grade mathematics material, introduces an entirely new vernacular of language and terms for students to learn and be able to use and understand. In addition to new language and terms, 7<sup>th</sup> grade content varies from that of previous grades in intensity, concept load, and level of mastery (<http://www.ode.state.oh.us>). According to the Ohio Department of Education's Mathematics Model Curriculum, the five domains addressed in middle school grades remain the same, yet the clusters of standards get much more precise as the grades progress (<http://www.ode.state.oh.us>). For instance, grade seven state standards require students to specifically solve a given problem or demonstrate their reasoning of a given topic, whereas grade six state standards require a basic understanding of the topic rather than the need to apply it to a task/problem (<http://www.ode.state.oh.us>).

Undoubtedly, it is common for students to respond to the 7<sup>th</sup> grade math curriculum with frustration and disinterest. Teachers can address this through various methods of instruction and by realizing their students may prefer different styles of teaching and learning (Thomas & Brunsting, 2010). Unfortunately, given state standards and high stakes assessments, teachers are

faced with the daunting task of addressing state standards while catering to the individual needs of their students. As a result, instruction frequently ends up being driven by high stakes assessments such as the Ohio Achievement Assessment. Since the passage of the No Child Left Behind Act in 2001 (NCLB),

...new versions of state standards connected to annual assessments have become a reality for all involved in education. Teachers, in particular, have been greatly impacted by this development. For many, state standards and grade level expectations (GLEs) now compete with the adopted text for classroom time and attention. (Horvath, Dietker, Larnell, Wang & Smith, 2009, p. 276)

Aside from the lack of flexibility that may occur due to instruction being driven by high stakes assessments, Vogler (2002) argues that changes to teacher's instructional practices have "... included increases in the use of instructional practices deemed by educational researchers as 'best practices' " (p. 50). In order to prepare students of various abilities and learning styles for high stakes assessments, as well as mathematics in upcoming grades, teachers may use a variety of strategic approaches.

### **Definition and Effectiveness of Pull-out Service Delivery**

One instructional service delivery model for students with specific learning disabilities and mild disabilities that intervention specialists might utilize is pull-out instruction. Marston (1996) defines a pull-out model as "a method of instruction where the student receives special education services in the IEP area from an intervention specialist in the resource room only, away from the general education classroom" (p. 123). It is an approach designed to serve students with learning and other intellectual disabilities in a separate environment, usually in the resource room every day at a designated time for core subjects (Klingner, Vaughn, Schumm,

Cohen, & Forgan, 1998). This model typically allows very little collaboration between the general education teacher and intervention specialist since there is an intense focus on the students' goals derived from their IEPs (Marston, 1996).

The pull-out model can be implemented in various ways, such as putting it into practice exclusively or combining it with other service delivery models. Some research recommends that pull-out instruction be “well designed, small group, brief, and intensive and thus should not entail placements for long periods of time outside the general education classroom” (McLeskey, Hoppey, Williamson, & Rentz, 2004, p. 109). Taik (2009) used pull-out instruction as a means of serving students with behavior disorders and focused on increasing their mathematics skills while encouraging and maintaining positive classroom behavior. This study's outcomes included higher achievement scores and more positive behavior for participating students (Taik).

Alternatively, other research supports the notion that students served in an inclusive setting perform better than students in a pull-out setting. Rea, McLaughlin, and Walther-Thomas concluded that students with learning disabilities who were served in inclusive classrooms earned better grades in math, language arts, science and social studies, as well as higher scores on standardized tests when compared to other students with learning disabilities served using a pull-out model (2002).

These findings suggest that success of services delivered through inclusive or pull-out models is dependent on the students, foremost, as well as the teacher, intervention specialist, and general set-up and design of services. Consequently, Klingner, Vaughn, Schumm, Cohen, and Forgan's (1988) research yielded student responses that were in favor of being in the inclusion classroom, as well as student responses in favor of a pull-out service delivery model which further encourages the debate surrounding these models.

## **Motivation**

For the purpose of this study, motivation is defined as “the act or an instance of motivating; desire to do; interest or drive” (www.dictionary.com). In regards to school, student motivation is highly impacted by a variety of factors. When discussing motivation in the context of school and this study, both intrinsic motivation and extrinsic motivation are explored. Intrinsic motivation is defined as “the undertaking of an activity, as a hobby, without external incentive; also, personal satisfaction derived through self-initiated achievement” (www.dictionary.com). Extrinsic motivation is defined as “motivation that comes from outside an individual” (www.dictionary.com).

Teachers certainly play an integral role in student motivation, and whether or not they utilize intrinsic and/or extrinsic motivation affects their students. If teachers themselves model intrinsic motivation, students are bound to do the same. Furthermore, students in classrooms where teachers implement higher levels of intrinsic motivation perceive themselves receiving more support from their teachers as opposed to having teachers who primarily use extrinsic motivation (Lam, Cheng & Ma, 2009). Consequently, “to the extent that students are motivated for their school work because of its utility value for achieving other important goals in the near or more distant future, they are--by definition--not intrinsically but extrinsically motivated” (Husman & Lens, 1999, p. 118).

Aside from teachers, parents also have an influence on student motivation. Weihua and Williams (2010) examined the extent to which parental involvement predicted students’ intrinsic motivation towards math and English and concluded that parental advising and monitoring of what children watch on television positively affected their engagement and intrinsic motivation toward math. When studying 5<sup>th</sup> grade students’ academic achievement, motivation, and parental

involvement, Coleman and McNeese (2009) found that while academic success positively correlated with motivation, parent involvement did not. Essentially, they found that when parental involvement decreased, student achievement and motivation increased, which they attributed to the students' age and maturity levels since some students are entering puberty at this time. The findings can also be credited to the notion that at this time in their lives, students are yearning for more independence from their parents and teachers (Coleman & McNeese, 2009).

By contrast, student motivation is also argued to be self-regulated, whereby the student is responsible for controlling his/her own motivational processing. Keeping this in mind, Cleary and Chen (2009) concluded that students' interest in the task(s) served as the primary means of motivation, as well as contributed to the substantial difference between sixth and seventh grade students and their level of self-regulation. It is important to note that this may not be the case for every student, as students at different developmental and ability levels may or may not use motivational regulation strategies (Wolters, 2011).

In terms of students of varying abilities, higher achieving students that have higher levels of motivation in turn were found to have higher math anxiety, while lower achieving students were found to have lower levels of motivation and less anxiety toward school in general because they had become complacent (Kesici & Erdogan, 2010). These finding may be attributed to the realization that elementary and middle school students' motivation and achievement in mathematics is reliant on their genuine (or fake thereof) interest in the subject. In support of this, Cleary and Chen (2009) noted a substantial decrease in interest from sixth to seventh grade, which in turn may result in lower motivation and achievement.

### **Mathematics and the Arts**

The National Council of Teachers of Mathematics (NCTM) believes that “a major requisite in mathematics is that all students develop ‘representational fluency,’ that is they know about representations, and can use knowledge appropriately to solve problems” (NCTM, 2000, p. 471). Unfortunately, many students struggle with or never develop representational fluency (Scheuermann & Garderen, 2008). As a result, students are at an increased risk of failure in mathematics solely because representational fluency is necessary for gaining mathematical understanding (NCTM, 2000).

Teachers can address representational fluency by incorporating art in the teaching and learning of mathematics. By providing students with the incorporation of art into mathematics, Scheuermann and Garderen argue, “a picture or, specifically, a graphic representation, such as a diagram, table, or chart, can contain much information about what a student understands and can do in mathematics” (2008, p. 471). Keeping this in mind, incorporating art in the mathematics classroom addresses the need for representational fluency as expressed by NCTM. Rather than teaching them separately, “representations should be treated as essential elements in supporting students’ understanding of mathematical concepts and relationships; in communicating mathematical approaches, arguments, and understandings to one’s self and to others” (NCTM, 2000, p. 67).

Teachers may choose to provide students with representations in addition to explanations and reasoning when teaching concepts or they may provide students with the opportunity to create their own representations to accompany learned concepts. Students given this opportunity have been observed to develop meaningful, personal representations to help in making sense of a given problem (Tarlow, 2008). Using various modes of explaining mathematical concepts, such as through representations, is comparable to

...examining the concept through a variety of lenses, with each lens providing a different perspective that makes the picture (concept) richer and deeper. Thus, employing multiple representations of a concept to teach and learn mathematics seems appropriate to the nature of the discipline. (Tripathi, 2008, p. 439)

Middle school mathematics is particularly difficult for students to grasp because of the frequent disconnect between real-life and the learned concepts. Because of this, the National Research Council (NRC) recommends, “teachers play a more active and direct role in providing relevant experiences to enhance students’ informal understanding and in helping them elaborate their informal understanding into a more formal network of concepts” (NRC, 2001, p. 231). By having students create visual representations, they can bridge the gap between the classroom and real-life context(s). Further, by asking questions about students’ drawings and writings regarding a specific math concept, teachers can create a classroom environment in which multiple means of expressing knowledge is encouraged (Tarlow, 2008).

### **Multiple Intelligences**

Combining mathematics and the arts takes into account Howard Gardner’s theory of Multiple Intelligences. This theory “offers an explanation of individuals who excel in some areas and not in others and applies to a broad spectrum of tests of intellectual ability” (Willingham, 2004, p. 20). In his Theory of Multiple Intelligences, Howard Gardner expounded upon the concept of intelligence by defining the following eight intelligences:

- Logical-mathematical intelligence—the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking.

- Linguistic Intelligence-- having a mastery of language. This intelligence includes the ability to effectively manipulate language to express oneself rhetorically or poetically. It also allows one to use language as a means to remember information.
- Spatial Intelligence-- the ability to manipulate and create mental images in order to solve problems. This intelligence is not limited to visual domains—Gardner notes that spatial intelligence is also formed in blind children.
- Musical Intelligence-- encompassing the capability to recognize and compose musical pitches, tones, and rhythms. (Auditory functions are required for a person to develop this intelligence in relation to pitch and tone, but is not needed for the knowledge of rhythm).
- Bodily-Kinesthetic Intelligence-- the ability to use one's mental abilities to coordinate one's own bodily movements. This intelligence challenges the popular belief that mental and physical activities are unrelated.
- Personal Intelligence-- includes interpersonal feelings and intentions of others and intrapersonal intelligence—the ability to understand one's own feelings and motivations.
- Naturalist intelligence-- enables human beings to recognize, categorize and draw upon certain features of the environment. It 'combines a description of the core ability with a characterization of the role that many cultures value. (Smith, 2002)

Utilizing an awareness of these eight intelligences, teachers can adapt their teaching to students' individual learning styles. Moreover, Watkins (2010) suggests using both Vygotsky's approach to teaching, as well as Howard Gardner's Theory of Multiple Intelligences to reach students of all abilities. Vygotsky's approach to teaching and learning strongly involves scaffolding, which essentially means providing supports to students and removing them as students progress (Watkins, 2010). Particularly when teaching students with learning or other

mild disabilities, teachers can give “individual intelligences scaffolding that are specific to the student’s type of multiple intelligence,” thus merging these two educational theories, creating an extremely supportive learning environment” (Watkins, 2010, p. 4). Thus, when teaching mathematics to students with mild disabilities, using multiple means of expression and explanation, (i.e., mathematical reasoning, artistic expression), fosters the need to recognize and accommodate diverse learners.

### **Method**

After an extensive review of existing literature regarding mathematics education and instruction for various learners, it is evident mathematics instruction is an area of great concern for teachers and students alike. To investigate the intervention specialist’s role in student success and attitude toward mathematics, this investigator conducted an attitudinal survey and specific intervention within her pull-out 7<sup>th</sup> grade math classroom.

### **Design**

A pre-post test design without a formal control group was utilized for this study. This design addressed the research question because it did not radically interfere with how the students were already being taught. It took into account the importance of maintaining a routine and rather than offering ways of getting around tricky math concepts, it offered alternate ways of understanding major concepts. As this was an action research project, it focused on particular problems that local practitioners might deal with in their schools or communities (Burke & Christensen, 2011). A key characteristic of action research is that instead of it being conducted by an academic researcher, it is conducted by teachers, principals, or other educational professionals that are conducting research as a means to solve their own problems (Burke & Christensen).

## **Setting**

This study was conducted within a middle school located in a rural district in the Midwest region of the United States. This district includes students from three area communities and the entire school district is housed in one single complex containing separate wings for the elementary, middle, and high school. There are 1,652 students within the district, with approximately 354 students enrolled in the middle school (grades 6-8). Students are primarily Caucasian and nearly half of the total student population meets the criteria for free breakfast and reduced lunch.

## **Participants**

For the purpose of this study, participants were drawn from the investigator's own pull-out 7<sup>th</sup> grade math classroom. The sample included all male and female students currently enrolled in the seventh grade pull-out mathematics class. They were all between the ages of 12 and 13, and were diagnosed with specific learning disabilities and developmental disorders using criterion outlined in the Individuals with Disabilities Education Act (IDEA). For purposes of this research, participants were not identified by name; rather they were assigned a code number to maintain anonymity. A description of each participant is provided below using pseudonyms.

**Owen.** Owen turned 13 years old at the beginning of this school year. According to his Individualized Education Plan (IEP), he is identified as having a learning disability which impedes his mathematical understanding and reading comprehension. Owen reads on a 4<sup>th</sup> grade level and relies on a calculator to complete math problems that involve addition, subtraction, multiplication and division. He receives pull-out instruction in mathematics and language arts and has been since 5<sup>th</sup> grade. Owen's home life occasionally interferes with his ability to pay

attention at school because he is often tired from lack of sleep and familial circumstances that are beyond his control.

**Parker.** Parker will soon be turning 13 years old (at the end of the school year). According to his IEP, he is identified as having Attention Deficit Disorder (ADD) and a learning disability which impedes his writing abilities in math and language arts. As a result, he is permitted to utilize a scribe for assignments that involve writing. Parker reads at a 5<sup>th</sup> grade level and relies on a calculator to complete math problems that involve addition, subtraction, multiplication and division. He receives pull-out instruction in mathematics and language arts and has been since 6<sup>th</sup> grade. Parker is very diligent with his homework and class assignments, and receives ample support from his parents.

**James.** James turned 13 years old during the course of the current school year. According to his IEP, he is identified as having a learning disability which impedes his mathematical understanding and his reading and writing comprehension in language arts. This is his first year in the school district, and he received pull-out instruction in mathematics and language arts based on his previous teacher's recommendation. James reads at a 4<sup>th</sup> grade level and although he relies on a calculator to complete math problems that involve addition, subtraction, multiplication and division, he is able to recall simple addition/subtraction/multiplication facts. James lacks organizational skills and frequently loses his homework, though he has a very close relationship with his grandfather and receives support and encouragement from him.

**Mia.** Mia will turn 13 during the upcoming summer. According to her IEP, she is identified as having Attention Deficit Disorder (ADD), a specific learning disability which impedes her writing abilities, and with developmental delays. As a result, she is able to utilize a scribe for assignments that involve writing. She reads at 2<sup>nd</sup> to 3<sup>rd</sup> grade level and is easily

frustrated with printed text. She relies on a calculator to complete math problems that involve addition, subtraction, multiplication and division and often times needs reinforcement and modeling on how to use the calculator properly. Mia's mother often helps her with homework that she does not understand, though she has poor organizational skills while at school and has expressed her dislike for school.

**Anne.** Anne will turn 13 years old after the end of the current school year. According to her IEP, she is identified as having a learning disability that impedes her mathematical understanding and reading comprehension. Anne reads at a 5<sup>th</sup> grade level and she relies on a calculator to complete math problems that involve addition, subtraction, multiplication and division. She attended school in this district until 4<sup>th</sup> grade, attended a new school in another district for two years, and then returned to the district this year. She receives pull-out instruction in mathematics and language arts based on her IEP and recommendations from her previous teachers. Anne excels in recalling previously learned concepts and is confident in her math and reading abilities. Anne receives sufficient support at home rarely misses school or is unprepared for class.

**Julia.** Julia turned 13 years old at the beginning of the school year. According to her IEP, she is identified as having a learning disability that impedes her mathematical understanding and reading fluency and comprehension. Julia reads at a 5<sup>th</sup> grade level and relies on a calculator to complete math problems that involve addition, subtraction, multiplication, and division. She has received pull-out instruction in mathematics and language arts, and has since the 6<sup>th</sup> grade. Julia is able to recall simple addition/subtraction/multiplication facts which help her complete work more independently. Unfortunately, Julia has a very unstable home-life that interferes with her academics. As a result, she has missed several weeks of school and does not receive sufficient

support at home. Consequently, she is often unprepared and frequently loses assignments, as well as arrives at school tired, hungry, and/or upset.

### **Instruments**

In order to assess students' attitudes towards math before and after the intervention, a mathematics attitudinal survey (see Appendix A) was created by the researcher. The survey was comprised of 16 'yes' or 'no' questions and two open-ended questions that required short responses. This format allowed the participants to provide the investigator with both qualitative and quantitative responses.

The first seven questions focused on how mathematics made the participants feel and whether or not they viewed math as fun, interesting, or difficult. The next three questions focused on participants' own perceptions of their abilities in mathematics. The remaining six questions requiring a 'yes' or 'no' response, combined the participants' feelings toward math and their perceptions of themselves regarding math, by evaluating their responses and reactions to how they feel or act when learning mathematics or when in math class. Question 16 read, "Do you draw pictures to help you understand math?" and was followed by the final two questions, both of which were open-ended. Question 17 was directly related to question 16, as it asked, "If you draw pictures to help you understand math, please explain how and why you think it helps you." Finally, the last question asked participants to identify their favorite part of math class. The investigator administered this survey at the beginning of the school year which served as the pre-assessment for the study, and then concluded the study by administering it once more at the end of the school year at the conclusion of the intervention.

### **Intervention**

In addition to the attitudinal survey, the investigator carried out an intervention that was implemented three times a week during the participants' math class. The intervention involved participants showing their understanding of the mathematical concept that was taught that day through drawing. Following the day's lesson, the investigator prompted students to express their understanding and comprehension of what was taught through drawing, or illustrating what they knew. They were given the remaining time in the class period to do this, which was typically about 15 minutes. Participants were encouraged to explain and share their illustrations with the investigator and their peers in the classroom. Drawings were collected and analyzed by the investigator.

At the end of each week, participants were given an assessment on the week's concepts in the form of a traditional quiz or test. This intervention began during the first quarter of the school year and continued the rest of the year, alternating every week, until the last month of the school year. This intervention was deliberately carried out every other week in order to compare weekly assessments taken during weeks that involved intervention and weeks that did not involve intervention. The alternating weeks without intervention served as a control for the intervention weeks.

## **Procedure**

This research was carried out over the course of one academic year. Following IRB approval granted by the university, parents were contacted and asked to provide consent. Once parental consent was granted, student assent was obtained. Upon getting parental consent and student assent, the investigator and participants discussed their respective roles in this research study. Attitudinal surveys were distributed and completed during the pull-out math class to acquire baseline data and the intervention was implemented. The intervention continued over the

course of the academic school year, with the previously described intervention being implemented every other week. Assessment scores were recorded via the school's online grade book. Recording grades using this tool made it very easy to compare scores and retrieve them from previous weeks as the study progressed. After nine weeks of intervention (19 weeks total, alternating weeks with and without intervention), this study concluded with re-administering the attitudinal surveys to all participants.

### **Analysis**

**Attitudinal survey.** Items from the pre-post evaluation were re-coded and given a score of 2 = yes; 1 = sometimes or yes/no; and 0 = no. Negatively worded items (items 3, 7, 12, 13, 14) were reverse coded. Scores could range from a low of zero to a high of 48, with higher numbers indicating a more positive attitude towards mathematics and lower numbers indicating a more negative attitude towards mathematics.

**Weekly test/quiz scores.** Weekly test and quiz scores were averaged by grading period for intervention and non-intervention weeks. The number of quizzes or test scores varied by grading period due to factors related to school cancellations due to weather conditions in the third grading period, and administration of Ohio Achievement Assessments during the fourth grading period.

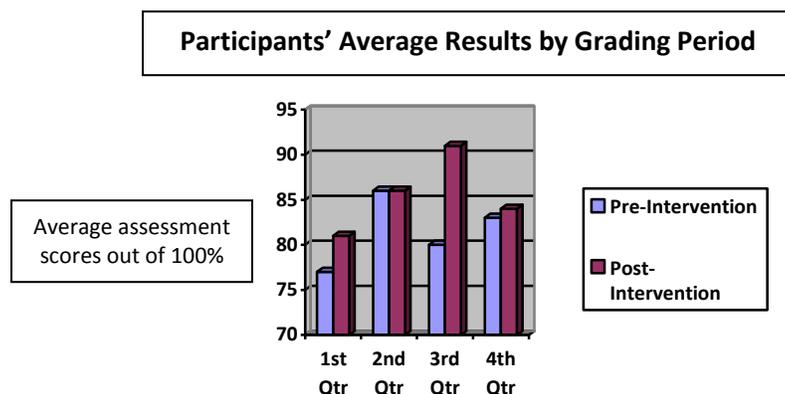
### **Results**

Results of this study were two-part as there was data gathered regarding participants' grades, as well as their feedback on the pre-post attitudinal surveys. Even though the sample size included only six participants, results demonstrated meaningful findings. To begin, general results regarding the intervention will be discussed, followed by general results of pre-/post data from the attitudinal survey. Then, specific results of the intervention pertaining to each

individual participant will be reported, in addition to specific results of each participant's pre-/post- attitudinal survey results.

### General Intervention Results

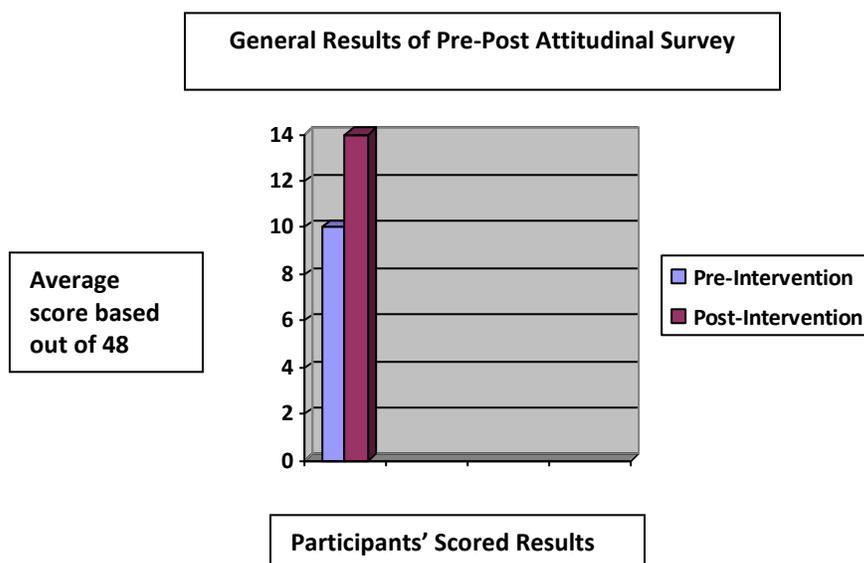
Overall, assessment results based on the implementation of the intervention varied a great deal. Patterns of both successes and struggles were noted for particular assessments which can be attributed to the complexity of the content being covered. Generally speaking, the intervention was well-received by all of the participants and it was something they unanimously looked forward to. They were noticeably excited and encouraged by the intervention which was unfortunately not completely carried over to the mathematical assignments themselves. Essentially, the intervention served as a positive motivator for the participants as a whole, and was requested by each participant on several occasions. Results below display the class average earned pre-intervention and post-intervention. It is evident that while there was a relative improvement in assessment scores, it was not very substantial.



### General Attitudinal Survey Results

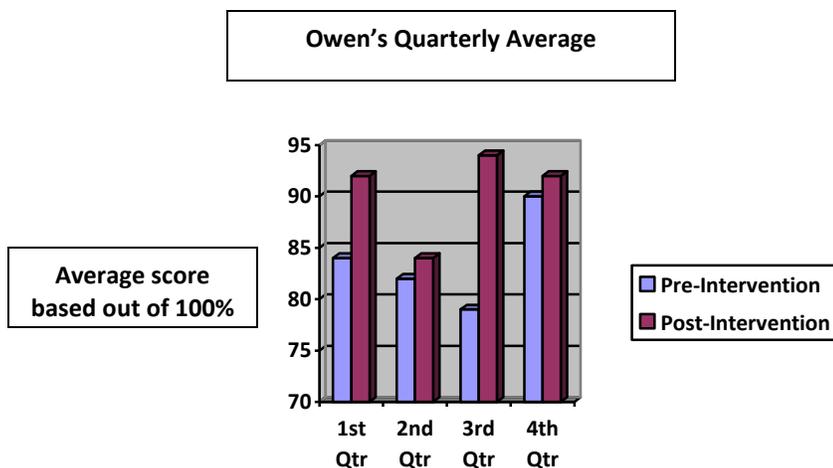
By and large, attitudinal survey results yielded mixed results. Based on attitudinal surveys completed pre- and post-intervention, all participants' responses demonstrated change.

While several had responded with the same answers on at least 9/18 questions, two participants' responses varied greatly between pre-intervention and post-intervention surveys.

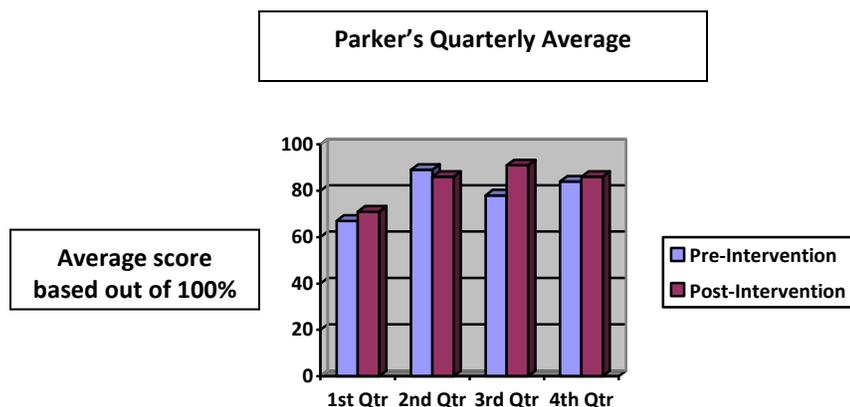


### Specific Intervention Results

**Owen.** Owen was very eager to begin this particular intervention after the researcher explained it to him. At the start of the study, Owen did not fully grasp the concept, and thus, viewed it as extra time to draw at the end of math class. After re-direction and further explanation, he understood and was able to demonstrate his understandings to the best of his ability through his artistic representations. Owen's assessment results show a steady increase from the beginning of the year toward the end of the year. Despite a few irregular scores, there is a positive association between weeks of intervention and assessment results.

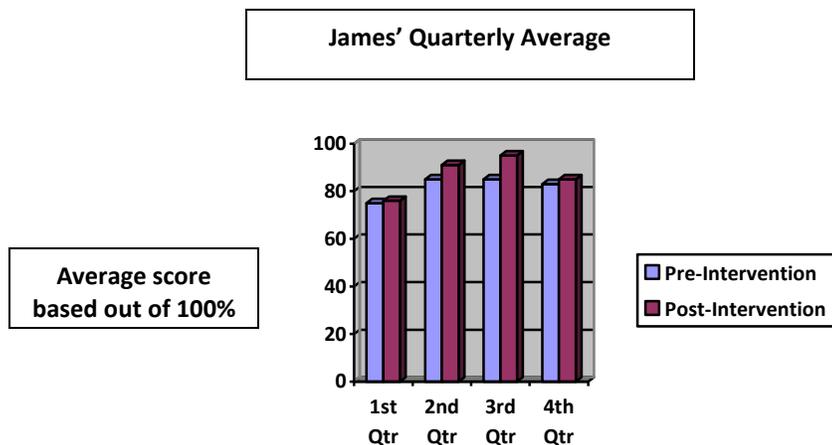


**Parker.** Parker was very responsive to the intervention and easily understood its premise from the start. Though typically Parker requires a scribe for assignments that involve substantial writing, since the intervention was primarily drawing, he did not have any difficulty. Parker asked several questions throughout the intervention to assure that he was not making any mistakes and overall, his assessment results show a positive association between weeks of intervention and assessment results.

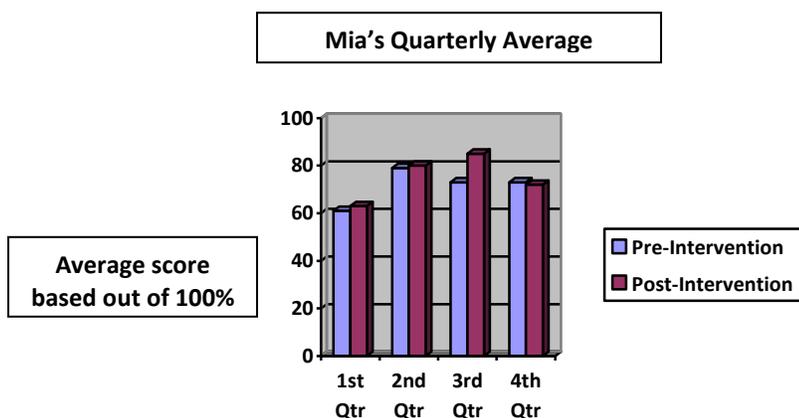


**James.** James was confused by the introduction of the intervention. At the start of this study, he made it clear that he was not interested in math or anything pertaining to math. He managed to overcome his distaste for the subject through consistent effort and class participation. An area that James struggled with both during intervention and during weeks with no

intervention was rushing through activities. When he did this, his assessment results were significantly lower. His assessment results demonstrate a relatively steady, positive association between weeks of intervention and assessment results.

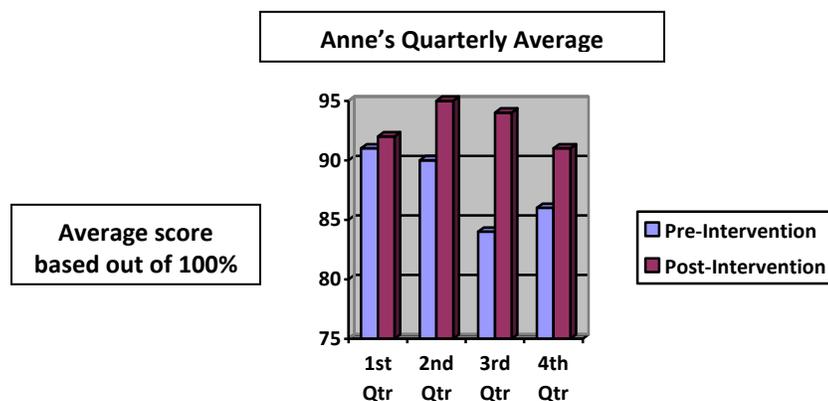


**Mia.** Of all the participants, Mia struggled with the intervention and the assignments the most. Though she enjoyed having time to demonstrate her understanding through illustrations, it was apparent that she did not grasp the mathematical concept enough in the first place to be able to create a graphical representation of it. Her assessment results display an array of low scores that show little to no consistency.

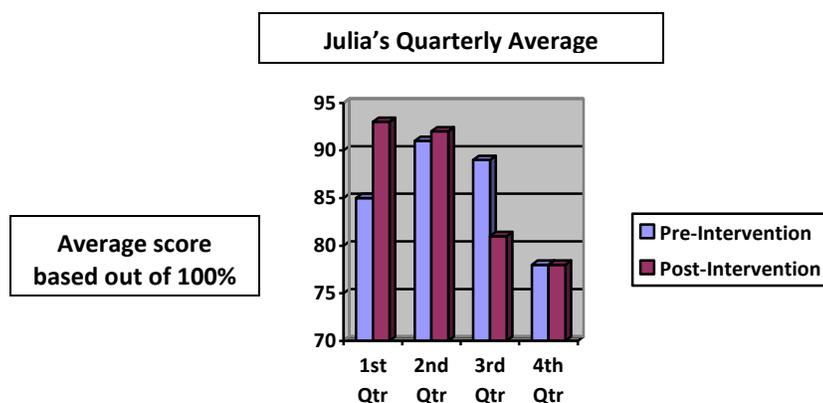


**Anne.** Based on her assessment results, Anne proved to be most successful of all the participants. Not only did she grasp mathematical concepts quickly and with ease, she was able

to incorporate this understanding throughout the intervention (see Appendix B). Since Anne's scores reflect consistent growth both with and without intervention, it is evident that she was comfortable in her abilities from the beginning. Furthermore, the intervention served as added scaffolding for her understanding.



**Julia.** At first, Julia demonstrated that she understood the mathematical concepts that were taught, as well as the premise of the intervention by completing assignments with minimal assistance and by helping other students. However; because of circumstances beyond her control, she was not able to participate as actively as the year progressed. Throughout the course of the study, Julia missed a total of 18 days of school that inhibited her ability to maintain progress. Her unstable home-life greatly impacted her level of concentration and motivation, as displayed by inattentiveness and hostile nature. As a result, her assessment results yielded somewhat erratic data.



### Specific Attitudinal Survey Results

**Owen.** Owen's initial attitudinal survey results yielded mixed data since he did not fully agree with 'yes' or 'no' for several of the questions, and chose to circle both. These items were scored as a 1, for a total score of 4. Relative to a possible total of 48, his results were extremely low. Generally speaking, his results display a negative attitude and opinion toward mathematics. His results also portray a low sense of confidence in himself and his mathematical abilities.

Owen's post-intervention results portrayed a much more positive outlook on mathematics and his own abilities. He responded 'yes' to many of the questions in which he originally answered 'yes/no' and responded with more 'yes' answers than 'no' answers in general for a total score of 16. These results demonstrate a significant positive change in attitude toward math.

**Parker.** Parker's initial attitudinal survey results' score of 13 demonstrated that he viewed his mathematical abilities more negatively than he viewed the subject of mathematics itself. This can be concluded based on his responses to particular questions. For instance, he agreed that learning math was fun and interesting; however, he answered that math is hard for him; he feels he cannot complete problems without a calculator; and he does not feel confident in math class.

Parker's post-intervention results also added up to a score of 13, however; it is important to note his answers varied. His post-intervention attitudinal survey showed that he reported feeling confident in math class, not feeling lost in math class, and that he did indeed draw pictures to help understand math.

**James.** James' initial attitudinal survey results yielded a low score of 4 which can be translated to be very negative. He only responded 'yes' to two questions that each had a two point value: he thought math was easy for him and he believes he can solve math without a calculator.

James' post-intervention attitudinal survey results yielded an identical score of 4, and in fact, his answers were identical when comparing pre-intervention to post-intervention data.

**Mia.** Mia's initial attitudinal survey results demonstrated a more negative than positive attitude towards math with a total score of 12. Like Owen, she answered several questions with 'sometimes', and questions regarding her mathematical abilities were answered negatively.

Mia's post-intervention attitudinal survey results showed slight improvement, with a total score of 13. The only question she answered differently was whether or not she could complete math homework independently. Initially, she responded 'no', but post-intervention, her response changed to 'yes'.

**Anne.** Anne's initial attitudinal survey results revealed a generally more positive attitude towards mathematics, especially in comparison to all the participants. Her total score was 17, and she had very few 'no' responses, with more 'yes' and 'sometimes' responses.

Anne's post-intervention attitudinal survey results remained relatively the same, though her total score decreased to 14. The only differences between her initial attitudinal survey and

her post-intervention survey was that she changed a 'yes' response to 'sometimes' and responded 'yes' to getting angry when she doesn't understand math.

**Julia.** Julia's initial attitudinal survey results demonstrate a considerably negative response toward mathematics with a total score of 10. Many of her negative responses involved questions that directly related to math class and concepts, as opposed to other participants whose negative responses were related to personal abilities/confidence.

Julia's post-intervention attitudinal survey showed a substantial increase in positive responses with a total score of 18. However, her responses toward questions regarding content were, for the most part, still negative.

### **Discussions and Recommendations**

Results of this study demonstrated findings that were somewhat reflective of the previously reviewed literature. Generally speaking, the participants' average results on the Attitudinal Survey increased by four points from pre-intervention to post-intervention. Though there was an observable increase, it is important to note that each participant's results were significantly low on both surveys, given that there was a possibility of 48 points and the highest recorded total score was 18. These low scores reflect an overwhelmingly negative attitude toward math and could imply that participants have built up such animosity toward this subject that any intervention is unlikely to impact their opinions.

The minimal increase in attitudinal survey results can also be due to the time of year that the post-intervention survey was administered. The investigator administered it within the last month of the school year and after participants had taken a high-stakes assessment. With that being said, participants were disinterested in their academics and ultimately exhausted after a full year of school.

Participants' assessment scores varied; however overall, there was a steady increase in average scores each grading period. As stated earlier, this was not significant by any means but was observable. The investigator attributes this increase to two things: successful implementation of intervention or maturation (i.e., the idea that students naturally get more intelligent as they develop from the beginning to the end of the academic year), regardless of intervention(s). On the other hand, participants in this study had a general distaste towards school to begin with and struggled in many academic areas, resulting in erratic, inconsistent scores, also known as regression to the mean. Since the students in this study are low-scoring students, all of whom have some sort of learning disability, they may have scored higher on the post-test not because of the intervention, but because of the regression to the mean. Often times this can be misconstrued as the intervention being successful because any positive change from pre-testing to post-testing is taken as evidence of the treatment being effective, when in reality, it is may not be.

To strengthen this study, the investigator could incorporate a third component or measurement of assessing whether or not high-stakes assessment results improved. High-stakes assessment scores would provide scores with no grey area or inconclusive aspects since they are standardized.

The issue of no control group can be addressed in future studies by asking students, parents, and other teachers whether they think the intervention worked and if it could be improved. This issue can also be addressed by analyzing school records to see if the participating class did better, worse, or the same compared to similar classes. Although this would not fully address the lack of a control group, it would certainly help.

To ensure this study's credibility, member checking would be utilized with the participants involved in the study. This would occur by allowing them to review their pre/post

attitude surveys and high-stakes assessment results, as well as allowing them to re-read and discuss their responses if interviews were conducted regarding the usefulness of the intervention.

### **Implications**

The findings of this study are useful for educators and students alike. Mathematics educators can implement a similar intervention in their classrooms as a means of improving assessment results or positively affecting their students' attitudes toward mathematics. Furthermore, educators may attempt similar interventions and conduct a similar attitudinal survey in their classrooms, regardless of the number of students or their abilities. Students may benefit from these results because the findings indicate that alternate methods of demonstrating understanding and knowledge can positively impact achievement.

Specifically, intervention specialists who teach in a pull-out service delivery model could replicate this study in their classroom. Alternatively, intervention specialists who teach using other service delivery models might benefit from this intervention while working with specific students. Principals and administrators could implement these strategies to help improve their school's services and to bridge the gap between students' lack of interest and motivation toward mathematics.

### **Conclusion**

This study set out to answer the question: how does the intervention specialist, along with a specific intervention, impact student achievement in and attitudes towards mathematics? Based on the results, it is clear that the intervention specialist plays a crucial role in the academic success of students. By utilizing various modes of instruction and intervention, such as the artistic intervention discussed and implemented in this study, intervention specialists can positively impact their students' achievement and attitudes toward mathematics.

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### Appendix A

Unique Identifier	Last 2 Letters of Mom's Name		Your Birth Month		Your Birth Day	
EXAMPLE	D	A	0	4	1	9
Your Unique Identifier						

### Math Attitudinal Survey

Please circle YES or NO for each question.

- |   |     |    |
|---|-----|----|
| 1. Is math fun?   | YES | NO |
| 2. Do you find learning math is interesting?  | YES | NO |
| 3. Is math hard for you?  | YES | NO |
| 4. Does math make you feel happy?   | YES | NO |
| 5. Does math class pass quickly?  | YES | NO |
| 6. Is math easy for you?  | YES | NO |
| 7. Does math make you angry?  | YES | NO |
| 8. Do you think you can solve math problems without a calculator?                             | YES | NO |
| 9. Can you do your math homework by yourself?   | YES | NO |
| 10. Do you like working in groups when learning math?   | YES | NO |
| 11. Is math your favorite subject?  | YES | NO |
| 12. Do you get nervous before math tests?   | YES | NO |
| 13. Do you feel lost in math class?   | YES | NO |
| 14. Do you get angry when you don't understand math?  | YES | NO |
| 15. Do you feel confident in math class?  | YES | NO |
| 16. Do you draw pictures to help you understand math?   | YES | NO |
| 17. If you draw pictures to help you understand math, please explain how and why you think it |     |    |

helps you. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

18. What is your favorite part of math class?

\_\_\_\_\_

\_\_\_\_\_

**Appendix B**

Anne's Work Sample

Concept: Number Line

Academic Content Standard addressed: Represent and compare numbers less than 0 through familiar applications and extending the number line.



## Anne's Work Sample

Concept: Prime Factorization (Factor Tree)

Academic Content Standard addressed: Apply and explain the use of prime factorizations, common factors, and common multiples in problem situations.

