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Evaluating The Effectiveness Of A Pre-Algebra 1 Mini-Camp Summer Intervention Program For Rising Seventh-Grade Algebra 1 Honors Students

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EVALUATING THE EFFECTIVENESS OF A PRE-ALGEBRA 1 MINI-CAMP SUMMER INTERVENTION PROGRAM FOR RISING SEVENTH GRADE ALGEBRA 1 HONORS STUDENTS

by

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ABSTRACT

This study evaluated the effectiveness of a summer intervention program for middle school Algebra 1 Honors students. The intervention program, Pre-Algebra 1 Mini-Camp, was offered for rising seventh grade students at a middle school prior to them entering Algebra 1 in the Fall semester. The literature review and analysis of data from school districts in Central Florida showed that the increase in middle grade students enrollment in Algebra 1 has coincided with a decrease in the passing rate among those students on the Florida Algebra 1 End of Course exam and the course. The intervention program and this study were premised on the assumption that the decreased pass rate was the result of these students missing critical mathematics skills and concepts from the seventh grade curriculum. This study describes a design framework and other details of the intervention program.

The evaluation study used a quasi-experimental design, comparing the 18 students who took part in the intervention with a comparison group composed of 21 other seventh grade students taking Algebra 1 Honors from the same school district. The matching sample was created using case-control matching based on student demographic data and sixth grade standardized test scores. Dependent variables were school district-administered, standardized test scores and grades collected during the first and second quarters of the school year. The main effect was tested using a within-between repeated measures MANOVA. Data analysis revealed that participants in the intervention group had slightly better performance on both standardized tests and grades versus the comparison sample (partial $\eta^2 = .06$). The intervention groups also showed marginally better performance over time (partial $\eta^2 = .02$). However, neither the

between-group difference ($F(2,32) = 1.04$, $p = .06$) nor the greater improvement of the intervention group over time ($F(2, 32) = 80.28$, $p = .83$) were statistically significant. These findings of statistically non-significant differences must be interpreted cautiously due to the low power of the research design (Power = .22, between groups; Power = .10, between groups x time). A larger sample would be needed to achieve sufficient power in the research design.

This study added to a small pool of research on seventh grade students enrolled in algebra courses. It briefly described some of the gaps in mathematical concepts and skills that likely led to students struggling for success in algebra. Implications of this study include revisiting policies supporting the enrollment of middle grade students in Algebra 1 Honors. This study also presents the design of a summer intervention program that may support student success in an algebra course and suggestions for creating a longer program which would provide more opportunity to support to the students' pre-algebra concepts, skills and practices.

This book is dedicated to the two women who helped to create the person who I am today. I am dedicating this to my grandmother, Bernice Margaret Haught (1906-2002), for her support, unconditional love, and belief that we should only look for the good in people. It is also dedicated to my mother, Karen Haught Harris, for always reminding me to reach for the stars.

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CHAPTER ONE: INTRODUCTION

There has been a national push for younger students to be offered enrollment in Algebra 1 courses over the past 25 years (Gojak, 2013). The state of Florida has followed this trend and has changed curriculum standards and requirements to facilitate the enrollment of middle grade students into Algebra 1 Honors courses. According to the Florida Department of Education (FDOE) each middle school must offer at least one high school level mathematics course for which students may earn high school credit (FDOE, 2014). While a select few of one Central Florida district's seventh graders were placed in Algebra 1 Honors courses as early as the 2004-2005 school year, the percentage has increased significantly since. One middle school in this school district, referred to as the Harley School District from this point forward, had greater than 30% of all seventh grade students in 2016-2017 enrolled in Algebra 1 Honors. While the school was one of 14 middle schools in the district, this middle school's seventh grade Algebra 1 Honors student population accounted for a total of 36% of all the seventh grade Algebra 1 Honors students in the district (FDOE, 2017). As a teacher at that middle school, I was able to witness how many of those seventh grade students enrolled in Algebra 1 Honors struggled throughout the course and completed the course with a failing grade. Due to the design of the eighth grade mathematics courses the seventh grade Algebra 1 Honors students were placed in Geometry Honors the following year. This was the practice for all students, whether they had passed the Algebra 1 Honors course or had failed it.

Algebra 1 Honors is an advanced mathematics course that a student may qualify to take part in while in middle school. This course is a course that is designed for and was originally offered to ninth grade students. It is a high school level course and being an "Honors" course, it

carries an additional one-half grade point weight when averaged into a student's grade point average. A seventh grade student enrolled in Algebra 1 Honors is taking a high school level course. I point this out as the student is not just two years younger than a ninth grade student taking Algebra 1, but the seventh grader also has two less academic years of exposure and practice with fundamental mathematic concepts and skills. The seventh grade Algebra 1 Honors student is earning a high school credit and their academic performance in the course will be a permanent factor on their high school transcript. While the middle grade algebra course is titled Algebra 1 Honors, a course with the same curriculum and standards becomes Algebra 1 when taken by a student at the high school level. Tests administered in both courses are referred to as Algebra 1 assessments. The district offers Algebra 1 Honors at each of its 14 middle schools. Algebra 1 Honors is also an available course through a district created virtual school format.

One of the driving forces behind the district's push to enroll a greater number of middle grade students in Algebra 1 Honors is financially driven. A school accountability grading system is used by the Florida Department of Education. In this grading system each school receives a letter grade. The top grade is an A with the lowest grade of an F assigned to a school deemed a failing school. In this grading system a middle school can earn a total of 1,000 points through the performance of their students on the state standardized tests. Of those 1,000 points three components of the mathematics test; results, achievement, learning gains, and learning gains of the lowest 25% of the student population, can account for 300 points. Each component is worth a total of 100 points. In addition to these possible 300 points, another 100 can be earned for middle school acceleration success as measured by the taking and passing of a Florida End of Course (EOC) Exams. The Florida EOC exams are given to Algebra 1 Honors and Geometry

Honors students. These exams are administered statewide. In this school grading system those students who are placed in Algebra 1 Honors can potentially earn two points versus the standard one point per mathematics student for the middle school. If a seventh grade student takes Algebra 1 Honors, then they will be enrolled in Geometry Honors as an eighth grader and will be in position once again to earn double mathematics points for the school for a second year (FDOE, 2019). Each school that earns an A rating is awarded $100 per full-time student.

The Florida Department of Education mandates that students must pass an Algebra 1 course and the Florida Algebra 1 End of Course Exam as one of the necessary requirements prior to receiving a standard high school diploma (FDOE, 2013). In addition to the previously mentioned requirements, in compliance with Florida Senate Bill 1076 the Algebra 1 End of Course Exam accounts for 30% of the final course grade (FDOE, 2013). This district follows the policies set forth by the Florida Department of Education, as is clear in the district's Student Progression Plan 2017-2018 available on their website. The problem with this practice is that middle grade students are not always prepared for the rigor, abstract thinking, and outside of the classroom practice and study commitment that is necessary in order to be successful in algebra and those mathematics courses that follow the completion of algebra.

My role in this study was that of the internal evaluator. There were a few reasons that I chose to focus on the seventh grade Algebra 1 Honors student in this study. The first reason was the trend to enroll seventh graders in Algebra 1 Honors has increased significantly in the past decade. Previous research studies were more focused on eighth grade algebra students than on the seventh grade student enrolled in the same course. At the time that I began the initial phase of my study, the practice used by the Harley School District and the middle school that was the

focus of this study was one that pushed an even greater number of seventh grade students into Algebra 1 Honors than other middle schools withing the same district. Students demonstrating performance and achievement at the slightly below average and average level, as established by their earned score at Achievement Level 2 or Achievement Level 3 on the 6th Grade Mathematics Florida Standards Assessment, were enrolled into Algebra 1 Honors. Many of these students did not meet with success and nevertheless were moved into Geometry Honors the following school year. This practice was altered in the past two years, and now the students being targeted for Algebra 1 Honors enrollment must score on the same instrument at the Achievement Level 4 or Achievement Level 5. An additional factor that drove my focus to specifically be on seventh grade Algebra 1 Honors students was my experience as a Grade 7 Mathematics and Grade 7 Mathematics Advanced course teacher. I was able to see what mathematics concepts, skills, and practice the seventh grade Algebra 1 Honors students forfeited by foregoing one of those courses, and this is a gap in their mathematics curriculum that was concerning to me.

Harvard graduate and Director of Center for Mathematics Education at the University of Maryland Chazan (2008) stated there has been an increase in many districts' policies throughout the United States that require students who plan to attend college to enroll in an Algebra 1 course in the middle grade years. He attributed this trend to a desire to remain competitive with international mathematics achievement and adds that algebra is a course offered prior to high school in several countries. While opportunity for earlier enrollment and advanced acceleration in Algebra 1 is available, overall success in the course is necessary to graduate high school. Not only do students need the Algebra 1 credit as a portion of the requirements to earning a high

school diploma, students need to master the concepts and the skills required by Algebra 1 to continue achieving success in the mathematics courses that follow Algebra 1.

Algebra is often considered a gateway course due the belief that it can open the gate to a greater number of advanced mathematics courses. If an algebra course is taken early in an educational path it can move students toward a path of accelerated mathematical learning and increase their secondary education opportunities (Smith, 1996). Early introduction to algebra may help students by increasing the mathematics credits that students earn which in addition can also support improved performance on standardized tests (Smith, 1996). According to Smith (1996) early enrollment in Algebra offers greater choice in high school courses and continues to be beneficial to the students in college enrollment. This theory was supported by a longitudinal study conducted by Hallinan (2000). The findings of her study suggest that students attain higher achievement if they are placed in a higher-level performing group. She was supportive of a greater number of students being enrolled in algebra courses. However, if students do not gain sufficient mastery of the Algebra 1 course content, they will struggle in subsequent mathematics courses.

With previous research showing the possible benefits of early enrollment in Algebra 1 courses, an increase in this practice has taken place. Former President of the National Council of Teachers of Mathematics Linda Gojak (2013) discussed the changes across the United States that have taken place within the previous 20 years resulting in middle grade students enrolling in Algebra 1 courses. She attributed this push to offer algebra earlier as a way to align the performance of students in the United States to other countries on international assessments (Gojak, 2013). As a greater number of seventh and eighth grade students enroll in Algebra 1

courses, there is also a greater need to support the success of more students placed in those courses. If a student takes Algebra 1 Honors while in the seventh or eighth grade, the student is foregoing the mathematics course offered to seventh and/or eighth grade students. Those rising seventh grade students who enter Algebra 1 Honors will forego the exposure and experience of the mathematical concepts and skills taught through the seventh grade mathematics curriculum as well as the eighth grade Pre-Algebra course. The concepts and skills covered in seventh grade mathematics courses can offer a bridge between concrete math, concepts, skills, and thinking to the more abstract mathematics of algebra and other advanced mathematics courses. In a study that investigated middle school students' understanding of algebraic concepts, it was found that many seventh grade students had not developed the mathematical concepts and/or practices often considered the pre-requisites for success in algebra courses (Tekin-Sitrava, 2017). Based on the findings of the study, one would tend to assume that the algebra abilities of students transitioning from sixth grade to seventh would be weaker than rising eighth grade students who enroll in Algebra 1 Honors courses. An algebra course requires students to enter the course with prerequisite concepts, skills, and mathematical understanding. Students can be moved out of algebra courses, but removing a struggling student may have social implications for the student and can have a detrimental effect on their self-confidence or self-efficacy, which in turn can play a vital role in their success in future mathematics courses (Gojak, 2013) .

Statement of the Problem

The problem of practice that this Dissertation addressed was the success of rising seventh grade students in Algebra 1 Honors, who enter the course foregoing the seventh grade

mathematics curriculum standards. By foregoing enrollment in a seventh grade mathematics course, be it Grade 7 Mathematics or Grade 7 Mathematics Advanced, these rising seventh grade Algebra 1 Honors students are missing content that has been designed to support student success in algebra. Harley School District's policy suggests that rising seventh grade students, who earn a score at Achievement Level 3, Level 4, or Level 5 on the 6th Grade Mathematics Florida Standards Assessment, be targeted for enrollment in Algebra 1 Honors. Those students that score at the Achievement Level 3 must have a high scale score. Their scale score is typically only a few points lower than the cut off determining an Achievement Level 4. The middle school at which this study took place follows the district policy. The administrative team at this middle school does make some exceptions to the district policy for students who are considered Gifted, or for students that may not have performed on the 6th Grade Mathematics Florida Standards Assessment at an Achievement Level 4 or 5 although that had been the student's predicted achievement level due to his previous mathematical performance. There were no members in my experimental or control group that scored below an Achievement Level 4 on the assessment, therefore no exceptions applied to any students involved in this study.

The Pre-Algebra 1 Mini-Camp took place over a four consecutive day period, three hours per day. The location of the Pre-Algebra 1 Mini-Camp was at a middle school found in the Harley School District. Based on available data, four topics were identified as the focus of lessons and activities that occurred in the Pre-Algebra 1 Mini-Camp, as described in more detail in Chapter Three. This Dissertation in Practice evaluated the effectiveness of an intervention designed to support Algebra 1 Honors students who forfeit a seventh grade mathematics course along with the concepts and skills associated with that course due to earlier Algebra 1 Honors

enrollment, compared to a matched sample of students from the same school district who did not participate in the Pre-Algebra 1 Mini-Camp.

Purpose of the Study

The purpose of this study was to evaluate the effectiveness of an intervention designed to support Algebra 1 Honors students who forfeit a seventh grade mathematics course due to earlier Algebra 1 Honors enrollment, compared to a matched sample of students from the same school district who did not participate in the Pre-Algebra 1 Mini-Camp. This study's findings contribute to the overall field of middle grades mathematics, specifically seventh grade students enrolled in Algebra 1 Honors.

Research Questions

To evaluate the effectiveness of an intervention designed to support Algebra 1 Honors students who will forego a seventh grade mathematics course due to earlier Algebra 1 Honors enrollment, the following research questions were posed:

1. Are the four topics, integers; perfect squares, cubes, and their roots; expressions; and equations, addressed during the Pre-Algebra 1 Mini-Camp the topic areas of greatest need for the seventh grade Algebra 1 Honors students?
2. Does participation in the Pre-Algebra 1 Mini-Camp improve seventh grade students' success in Algebra 1 Honors?

To answer Research Question 1, I analyzed the mathematics curriculum standards of sixth grade, seventh grade, and Algebra 1 Honors. This curriculum investigation was supportive in determining which mathematics topics would offer the greatest benefit to rising seventh grade Algebra 1 Honors students. Once the 2019 6th Grade Mathematics Florida Standards Assessment results were released, additional analysis of the results was conducted in order to evaluate if the four topics should still be considered the ones that were most aligned to the needs of the students being identified as possible participants in the study. This research question was examined and addressed prior to the start of the Pre-Algebra 1 Mini-Camp.

To answer Research Question 2, the research design was a quasi-experimental study. Participants in the Pre-Algebra 1 Mini-Camp were matched to a sample of rising seventh grade students who did not take part in the mini-camp. The matched sample was chosen using case-control score matching. Research question two was addressed through the collection and analysis of the Pre- and Post- Assessment given during the camp, the first semester Algebra 1 Honors grades, and the Harley School District's Algebra 1 benchmark tests known as the Algebra 1 State Mandated Test (Algebra 1 SMT) given in August and again in December.

Significance of the Study

If middle grade students enroll in Algebra 1 Honors, they should also be provided with opportunities to support their success. Seventh grade Algebra 1 Honors students forego two academic years of mathematic concepts, skills, and practice compared to the past traditional ninth grade Algebra 1 student. There are several algebra pre-requisite concepts and skills covered throughout the seventh grade mathematics course that the seventh grade Algebra 1

Honors student do not receive due to moving from sixth grade mathematics directly into Algebra 1 Honors. The significance of this study was to evaluate if a summer enrichment program could be beneficial by offering participants access to a portion of the seventh grade curriculum, they forfeit entering the Algebra 1 Honors classroom early. Chapter 2 will discuss previous research that assisted in my design of the Pre-Algebra 1 Mini-Camp as well as the decisions I made regarding what instruments to use in my data collection.

CHAPTER TWO: REVIEW OF LITERATURE

Raising Expectations

In response to the A Nation at Risk (1983) report that described how the American education system was failing, those in the field of education began questioning what could be done to create a more rigorous education system. One response was to examine education standards. In 1992, the National Council of Teachers of Mathematics (NCTM, 1989) called for a standards reform movement. In response to this reform movement, school district leaders began to examine their longstanding curricular practices that restricted middle school students from enrollment in algebra.

In a report by the National Center of Education Statistics (NCES, 1994), middle schools that were considered "effective" were those that offered algebra to eighth grade students. The National Mathematics Advisory Panel (NMAP) considered algebra as a gateway to long-term success and achievement in mathematics (NMAP, 2008). High school graduates who had completed at least a trigonometry course prior to graduation increased from 24% to 57% in the academic years spanning from 1982 through 2004 (Domina and Saldana, 2012). Researchers have aligned success in Algebra II or higher mathematics courses, greater access to college admission, greater likelihood of college graduation (Spielhagen, 2006), and potential for higher future earnings (Clark, Arens, & Stewart, 2015) as measures of long-term success. Domina, Hanselman, Hwang, and McEachin (2016) look at the nationwide trend of the education policymakers at both the state and district level working to create changes in mathematics curricula in response to the theory that success in algebra can lead to greater access to advanced

mathematics courses. Research has suggested that high school mathematics coursework can result in an increase in college enrollment and college completion as well as have an outcome on the choice of college majors. The acceleration of mathematics coursework, created by offering high school level courses in the middle grades, can support the increase of students enrolled in college preparatory mathematics courses as well as support students' college aspirations (Dougherty, Goodman, Hill, Litke, & Page, 2017).

Enrollment Trends

In response to the research and the call for a change in increasing expectations for achievement in mathematics, an increase in middle grade student enrollment in algebra courses has taken place. Between 2003 and 2013 the percentage of eighth graders enrolled in an algebra mathematics course nearly doubled from 35% up to 65% nationwide (Domina et al., 2016). They also attribute the push to increase eighth grade students in algebra to intensify the rigor of mathematics curricula and narrow the inequalities in the opportunities to learn. Enrollment of a greater number of eighth grade, and more recently seventh grade, students in algebra courses has taken place in large part due to correlational research that has documented significant differences in the long-term outcomes of those students who enroll in algebra prior to high school and those who do not (Clotfelter, Ladd, & Vigdor, 2015). Rickles (2013) reported that his study findings supported earlier research that, on average, eighth grade algebra students benefitted from earlier enrollment in an algebra course. In a study conducted by Stein, Kaufman, Sherman, and Hillen (2011) it was found that enrollment of eighth grade algebra enrollment increased from 15% to 20% in the late 1980s and early 1990s and had increased to approximately 30% in 2009.

Reflecting the trends and needs of the education and business communities, American Institutes for Research and Microsoft have urged eighth grade students to succeed in algebra (Evan, Gray, & Olchefske, 2006).

Data shows the percentage of middle school students enrolled in Algebra 1 or Algebra 1 Honors in the Central Florida area has also increased. The Florida Department of Education offers information regarding an increase in the percentage of all middle grade students passing the Florida 1 Algebra 1 End of Course exam, but one should keep in mind that there has been a statewide increase in the number of students being enrolled in the course. A higher number of students placed in the course should result in a greater number of the overall population passing the course. In the Spring of 2018 over 50% of Collier County (Florida) School District's middle school student population passed the Florida Algebra 1 End of Course exam, with Orange County School District having slightly less than 50% of their middle school students passing the exam (Cottle, 2018). Cottle went on to point out that while Collier County had a much higher percentage of eighth grade Algebra 1 students, Orange County had one-quarter of their Algebra students comprised of seventh graders. Harley School District had between 36% and 38% of their total middle school student population pass the Algebra 1 End of Course Exam. Of the entire population of middle school students enrolled in the Harley School District, just under 15% were seventh grade Algebra 1 Honor students.

Performance

While a greater number of middle school students are being offered the opportunity to enroll in Algebra 1 or Algebra 1 Honors, not all seventh grade Algebra 1 Honors students appear

prepared with knowledge of mathematical concepts and the skills required for success in the Algebra 1 Honors course. While some would be quick to point the finger at the elementary school teacher for not covering the elementary mathematics curriculum, that is not the case. Policies that push the practice of algebra for all have not resulted in high success rates (Viadero, 2010), which certainly is due to poor mathematical preparation prior to algebra. Recent studies raise questions and concerns regarding the effectiveness of offering algebra during the middle school years, with some researchers attributing the issue to the challenges associated with teaching algebra to students who may lack foundational mathematic concepts and skills (Clotfelter, Ladd, and Vigor 2015; Domina, Penner, and Conley 2015). Students often consider algebra to be one of the most difficult subjects in mathematics and this may lead to misconceptions and difficulties in understanding algebra (Kieran, 1992). Algebra requires a fair degree of automaticity with the procedural skills learned in elementary and middle school, but it also relies on an understanding of the key concepts learned in elementary, especially those dealing with the four main arithmetic properties. The properties being referred to are associative property, commutative property, distributive property, and identity property. In addition to these properties, the inverse element, additive and multiplicative inverse, is also a key concept. Students can recite "keep, change, flip", but they cannot explain what it is they are doing mathematically or the how or why this process works. A deep and formal understanding of the arithmetic properties and the inverse element is a strong foundation to the abstract reasoning principles of algebra. Algebraic concepts require students to incorporate a set of abstract reasoning concepts and skills to build upon those procedural skills learned in elementary and middle school (Carraher & Shliemann, 2007; Howe, 2005; Vogel, 2008).

Middle grades have traditionally been viewed as the transitional period in which students are moving from the learning of arithmetic and the associated skills towards the learning of mathematical concepts such as integers, algebraic representation with variables, expressions, and equations. A student's success with these concepts and the skills related to them can strongly predict algebra achievement (Clark, Arens, & Stewart, 2015). An evaluation study of Chicago Public Schools' effort to increase student enrollment in algebra prior to ninth grade demonstrated that while a greater number of students were enrolled in algebra coursework during the middle grade years, the outcomes were not all positive. Failure rates increased, grades slightly dropped, test scores did not improve, and students did not show any greater likelihood of attending college at the end of their high school career (Viadero, 2010). Domina, McEachin, Penner, and Penner (2015) found that broad-based efforts to enroll a greater number of eighth grade students into algebra courses have no benefits to students in small or medium school districts and have negative effects on student achievement in large school districts. According to Sparks (2013) there has been an increase in the middle grade student enrollment in Algebra 1, but an increase in the National Assessment of Educational Practice (NAEP) mathematics scores has not aligned with the boost in earlier Algebra 1 enrollment. In a study conducted by Liang, Heckman, and Abedi (2012) the data analysis suggested that eighth grade courses other than Algebra 1 might provide students with a stronger foundation for greater success in mathematics due to the focus of the course's curriculum on algebra pre-requisite concepts and skills.

According to the 2019 Spring Florida Algebra 1 End of Course Exam results, Harley School District had a total of 856 seventh graders assessed, with a mean score of 520, and an overall 90% passing rate among seventh grade algebra students. The seventh grade Algebra 1

Honors students accounted for 17% of the Harley School District students taking the Algebra 1 End of Course exam in the spring of 2019. There were 1,264 eighth grade Algebra 1 Honors students assessed from Harley School District, with a mean score result of 520 and 80% of the eighth graders passed the End of Course Exam. The eighth grade students accounted for 25% of Harley School District students assessed with the Algebra 1 End of Course Exam in the spring of 2019. A combination of both seventh and eighth grade Algebra 1 Honors students accounted for the 179 students tested on the Algebra 1 End of Course Exam at the middle school that is the location of the study. The mean score of this group of students was 511 with 78% of the students passing the spring 2019 Algebra 1 End of Course Exam (FDOE, 2019).

While Harley School District had an overall seventh grade mean score of 529 with 94% passing the 2018 Florida Algebra 1 EOC. The focus middle school of this study had a mean score of 514 with only 86% of the students passing. There were 161 seventh grade students enrolled in Algebra 1 at the time in which the testing took place.

Harley School District's overall seventh grade student results on the 2017 Florida Algebra 1 EOC was a mean score of 530 with again 94% of the students passing, while the focus middle school had a mean score of 511 with 82% of the students passing the exam. The focus middle school had 229 seventh grade students enrolled in Algebra 1 Honors at the time of the testing in 2017, which means that 42 seventh graders exited an algebra course unable to demonstrate mastery of algebraic concepts and skills.

The focus school's policy is one that will result in placement of all seventh grade Algebra 1 Honors students into Geometry Honors their eighth grade year. While geometry may be considered a different branch of mathematics, some of the basic concepts and skills expected to

be mastered in the previous algebra course are important pre-requisites to the successful completion of the Geometry Honors course. Yet some of the students did not been master the algebraic concepts and skills in their Algebra 1 Honors course. Having students placed in a second advanced course while not meeting with success in the previous advanced course cannot be the best course of action. Creating a support program to ensure success in Algebra 1 Honors for a greater number of students would aid in addressing this situation. This was one of the factors that led me to my research study. Observing this continued practice gave me some insight as to the students' needs and the design of the Pre-Algebra 1 Mini-Camp as a possible intervention.

Student Support

With the increase of enrollment of middle grade students into Algebra 1 or Algebra 1 Honors, an intervention program could be useful for the Algebra 1 Honors student. A systematic review of the research showed an increase in algebra enrollment also showed there was an increase in the number of students not meeting with success in algebra (Stein, Kaufman, Sherman, & Hillen, 2011). In their study of previous research Stein et al (2011) found strong evidence that achievement gains occurred more often where support for struggling students was also a part of the program. In the summer of 2014, a program known as Elevate Math, a mathematics support program designed by the Silicon Valley Education Foundation began in California. The results of the Elevate Mathematics summer program showed a significantly improved mathematics achievement and algebra readiness among participating grade seven students (Snipes, Huang, Jaquet, & Finkelstein, 2016). While there have been many studies

conducted regarding eighth grade students enrolled in algebra courses, there are fewer that specifically focus on seventh grade students being offered algebra courses. My study is one that addresses only the seventh grade students in the Algebra 1 Honors course.

Closer to the location of this study, Orange County Public Schools, found in Central Florida, has created a summer intervention program known as the "Calculus Project" (Cottle, 2018) that has proven to be successful. The program started with 23 students in the summer of 2014, and there were 2,500 students enrolled in the program during the summer of 2017 (Postal, 2017). The Calculus Project targets seventh grade Algebra 1 students as participants in a four-week summer camp program. In addition to the summer program the participants also receive after-school tutoring throughout the academic school year. The length of the summer portion of the Calculus Project is significantly longer than the Pre-Algebra 1 Mini-Camp. It also offers support throughout the school year with after school tutoring, whereas the Pre-Algebra 1 Mini-Camp ends after the initial four days. The Calculus Project program has been so successful for Orange County Public Schools that it became House Bill (HB) 4105 to the Florida PreK-12 Appropriations Committee in February of 2019 (Florida Senate, 2019). An intervention program offered during the summer months could prove to be a useful tool in supporting seventh grade students' success in Algebra 1 Honors. With the intervention being offered prior to the Algebra 1 Honors course the student may be better prepared for the Algebra 1 Honors curriculum.

In a study conducted by Falco (2019), an assistant professor in the Disability and Psychoeducational Studies Department at the University of Arizona, a correlation between a middle grade student's self-efficacy and success in mathematics was so prominent that an intervention to creates stronger self-efficacy was developed. Falco's report on her research

refers to previous studies that align self-efficacy and success in mathematics. She points out how the middle school years can be the period in which students are developing their beliefs in their abilities and how a strong self-efficacy can lead to educational choices that lead to career choices. The Pre-Algebra 1 Mini-Camp would offer a summer intervention that could help seventh grade Algebra 1 Honor students develop a stronger self-efficacy as they enter the course.

Factors Leading to Curriculum of Intervention

The Florida Department of Education has created the Florida State Standards, formerly known as the Mathematics Common Core (MACC). These standards are aligned with the Common Core State Standards (2019) which were created to provide clear and consistent learning targets and to support an increase of achievement in mathematics. The Florida State Standards are used to drive the instruction throughout each academic course. Florida also has Standards for Mathematical Practice. These practices include

- make sense of problems and persevere in solving them
- reason abstractly and quantitatively
- construct viable arguments and critique the reasoning of others
- model with mathematics
- use appropriate tools strategically
- attend to precision
- look for and make use of structure
- look for and express regularity in repeated reasoning

and are aligned with the Common Core State Standards for Mathematical Practice.

Harley School District (HSD) took the Florida State Standards and created a curriculum map for each course offered in the HSD district (see Appendices A through H for HSD curriculum map). The above practices were included in the HSD curriculum map. Mathematic concepts are grouped together by topics, these groups of topics are referred to as a domain or cluster. Grade 7 Mathematics Florida Standards include the mathematic domains of

- the number system.
- expressions, equations, and inequalities.
- ratios and proportional relationships.
- geometry
- statistics and probability.

These domains are also covered throughout the Grade 6 Mathematics courses, but a review of the domains and then an increase in the complexity of those domains and associated skills takes place in the regular Grade 7 Mathematics course. Grade 7 Mathematics Advanced Florida State Standards include the mathematic domains of

- expressions
- equations, and inequalities
- real numbers
- angles
- Pythagorean Theorem
- geometry
- statistics and probability

- functions
- scientific notation
- transformations.

The difference in the two seventh grade mathematics course curriculums is that the latter is a purposeful design created to better prepare students for Algebra 1 Honors. The Grade 6 Mathematics Honors course incorporates some of the Grade 7 Mathematics Advanced standards. Some rising seventh grade Algebra 1 students may have been enrolled in the Grade 6 Mathematics course prior to attaining an Achievement Level 4 a Level 5 on their Grade 6 Mathematics Florida Standards Assessment. Moving from a general sixth grade mathematics course to an Algebra 1 Honors course, foregoing a seventh grade course, results in limited exposure and practice of those pre-algebra concepts and skills that are covered throughout the seventh grade mathematics courses.

The general mathematics course offered in eighth grade is Grade 8 Pre-Algebra. In addition to this course, some students will have the opportunity to enroll in Algebra 1 Honors, and those students who completed Algebra 1 Honors as a seventh grader proceed to Geometry Honors as eighth graders. Ninth grade students who enroll in Algebra 1 have two added years of foundational mathematics and pre-algebra mathematic concepts and skills. Enrolling in Algebra 1 Honors as a rising seventh grade student results in the loss of an added one to two years of pre-requisite algebra concepts and skills.

With all the concepts and skills that the rising seventh grader Algebra 1 Honors students forfeit by advancing past the seventh and eighth grade mathematics courses, the opportunity to learn any of it what will be missed would be a beneficial support toward their success in Algebra

1 Honors. I have witnessed students who began their year in Algebra 1 Honors with aspirations of a possible future that included enrollment in higher level mathematics courses become discouraged and lose self-confidence in their mathematics abilities. This discouragement can lead to a choice made by the student to move away from those courses and career options that require a strong mathematics background.

Algebra 1 Honors curriculum addresses a significantly greater number of Florida State Standards than the other middle grade mathematics courses. With the number of standards that must be covered in the Algebra 1 Honors class, there is little or no time for reteaching topics that the curriculum presumes the students already know. My teaching experience and knowledge of the middle grades' mathematics curriculum aided in determining the four specific topics that were the focus of the Pre-Algebra 1 Mini-Camp. Integers and the rules that apply when solving problems using the four basic operations of mathematics can be difficult for middle grade students. While exponents have been introduced to rising seventh grade students, the students have had limited practice with problem solving involving exponents. The topics of perfect squares, cubes, and their roots are taught in Grade 7 Mathematics Advanced and Grade 8 Pre-Algebra courses. Rising seventh graders enrolled in Algebra 1 Honor may have no previous knowledge of rational squares and cubes. The understanding and solving of expressions, equations, and inequalities is an area that many seventh grade students struggle with due to the introduction of variables. The Algebra 1 course and its curriculum was originally designed for ninth grade students A student enrolled in Algebra 1 as a ninth grader would have been provided with instruction and practice in using the skills associated with these topics, while enrolled in seventh grade and eighth grade mathematics courses

Elements of the Pre-Algebra 1 Mini-Camp

Through a desire to help students grasp a deeper understanding of the mathematic concepts and skills necessary to meet with success in algebra, I wanted to incorporate the use of mathematics manipulatives in my intervention program. Mathematics manipulatives are physical items that can be implemented as a part of a mathematics lesson. The manipulatives can help to build a bridge between the concrete into a representation of an abstract idea (Moyer, 2001). Baroody (1989) shared how a pupil's use of mathematic manipulatives can create a meaningful experience because they are actively engaged and thinking about the problems or activities.

The mathematics manipulatives that were chosen to be used in the Pre-Algebra 1 Mini-Camp are ones that I have found to offer learners the greatest connection and success when working in the four topic areas covered throughout the mini-camp. The National Council for Teachers of Mathematics (NCTM, 2010) addressed the need for the usage of representational models as a significant area of effective practice in mathematics instruction. Furner and Worrell (2017) explored the earlier research and use of mathematics manipulates in the classroom. They went on to match a variety of manipulatives to the Common Core Mathematics Standards taught in classrooms throughout the United States. Among the manipulatives that Furner and Worrell (2017) aligned with the Common Core Mathematics Standards were Base-10 Blocks, number tiles, two-sided counters, and a scale/balance used to work with expressions and equations. The scale/balance is like the Hands-On Equation materials that was used in the Pre-Algebra 1 Mini-Camp. This is a learning tool designed by Borenson with the purpose of simplifying the learning of abstract algebraic concepts (Steiny, 2013). Using mathematics manipulatives during an

activity or lesson can be beneficial in aiding a student with their learning process. Offering mathematics manipulatives to learners and giving them the choice of choosing to use them or not has been a teaching practice I have maintained throughout my career.

Previous research has supported that students being given the opportunity to engage in mathematical conversation supports their learning. *Principles of Action: Ensuring Mathematical Success for All* (NCTM, 2014) shared that students should be able to share their ideas with one another. Sharing their ideas can help them develop language for expressing their mathematical ideas and understanding. This in turn supports the student's ability to create convincing arguments related to why and how they solve mathematical problems. Cooke a seventh grade teacher in Washington, and Adams (1998) a professor at Washington State University, found that students' learning is supported by their mathematical conversations. They found that it offered students the opportunity to develop or deepen their understanding of problem-solving and that it supported students in developing a greater self confidence in their problem-solving abilities. Small groups and/or cooperative learning groups create the opportunity for students to use mathematics talk. Groups were used throughout the Pre-Algebra 1 Mini-Camp to support this best practice.

Support for many of the design elements incorporated in the Pre-Algebra 1 Mini-Camp were found in an evaluation study investigating the impact of the Jaime Escalante Mathematics Program (JEMP) researchers assessed the aspects of the program that appear to attribute to student achievement. Researchers found that the use of hand on manipulatives, collaborative and cooperative learning, discourse and discussion incorporating the use of mathematics vocabulary, and purposeful questioning were all best practices that supported student achievement (Bowens

& Warren, 2016). Each of these practices align with the Common Core State Standards and Florida State Standards for Mathematical Practice and were incorporated throughout the Pre-Algebra 1 Mini-Camp.

Instruments

A variety of algebra readiness assessments were considered when searching for an instrument to assess the camp participant's pre-algebra skills. Harley School District (HSD) does not use any specific algebra readiness assessment. The instrument most mentioned in earlier research was the Iowa Algebra Aptitude Test (Schoen & Ansley, 2006). The Iowa Algebra Aptitude Test (IAAT) was developed by the University of Iowa to assess students' readiness for success in Algebra 1. Individual results might also be used to assess areas of intervention or support that the individual could require to meet with success in an Algebra 1 course. The assessment aligns to the National Council of Teacher of Mathematics (NCTM) standards. A Pre- and Post-Assessment was designed with problems from the purchased Iowa Algebra Aptitude Test (IAAT) which offers a parallel assessment, and the assessment was designed to be administered in one class period (Appendix I, Appendix J, and Appendix K). Sub-sections of the IAAT include number concepts and skills, interpreting mathematical information, representing relationships, and using symbols, so the assessment aligned with pre-algebra concepts and skills as well as topics covered throughout the mini-camp. The IAAT has proven to be a valid and reliable assessment over a period (Perkman, Foegen, & Olson, 2006). A student and instructor friendly format were also an appealing characteristic of this assessment (Schoen & Ansley).

Harley School District require teachers in core area subjects to administer the Algebra 1 State Mandated Test (Algebra 1 SMT) twice per academic school year. The test is first administered districtwide the first two weeks of the school year. Scores earned by the students on the first exam are used as a benchmark score. The scores are recorded as a diagnostic score in the gradebook. This practice allows a teacher, student, and parent to quickly reference the score, but the score does not have any weight in the first quarter grade of the students. The Algebra 1 SMT is administered again in December to determine if learning gains are occurring at a proper pace. The December Algebra 1 SMT is used as a second quarter summative grade for the students. Harley School District weights summative scores as 60% of a student's overall average, with formative assessments being weighted at 40% of the overall average of the course grade (HSD, 2019). Analysis of the data offered from the outcome of the assessment assists teachers in driving instruction regarding what standards students are demonstrating strengths and weaknesses in understanding. Each State Mandated Test aligns with the Florida Standards Assessments or the Florida End of Course exams. An example of this is students in 7th Mathematics and 7th Mathematics Advanced take the 7th Grade Mathematics State Mandated Test. Students enrolled in Algebra 1 Honors will take the Algebra 1 State Mandated Test.

District level personnel and teachers collaborated in the creation of the Algebra 1 State Mandated Tests. Subject area teachers and the district's department leaders aligned test questions to the required Florida Sunshine State Standards required per course or per grade level. The questions chosen were drawn from previously created assessments published by Engage New York, Dade County (Florida) School District, as well as the North Carolina Department of Public Instruction Tools and Resources for Mathematics Educators. Some questions were used

verbatim while others were slightly altered. Harley School District treats the State Mandated Tests (SMT) they have created as secure documents. The assessment is administered in a similar format as the Florida Department of Education (FDOE) mandated tests and exams. Teachers are not able to aid or coach a student during the test, all paper version of the tests must be accounted for and returned to a secure area at the completion of the test. Due to the importance and expectations attached to the results of the Algebra 1 SMT I believed this would be a reliable assessment to use as an instrument for data collection. To obtain information regarding the validity and reliability of the Algebra 1 SMT, I requested information or statistics on how the Algebra 1 SMT results aligned with the end results on the Florida Standards Assessment or Florida End of Course Exams. These requests were made through email sent to the Specialist of Mathematics 6-12 of Harley School District. No response was received from these requests.

The purpose of the Florida Standards Assessments (FSA) and End of Course Exams (EOC) are to measure education gains and progress (FDOE, 2019). In addition to offering students and families a means to assess education gains and progress, the FSA and EOC results are used to provide accountability indicators to those involved in the education system in Florida as well as citizens that are interested in the education being offered in Florida schools. Open communication between the FDOE and Florida educators guides the development of these assessment items. According to the FDOE there are six stages used in the development of an assessment item which include item writing, committee reviews, field testing, statistical review, test construction, and operational testing. These documents are considered secure with penalties for educators that do not adhere to the security and administration guidelines set forth by the Florida Department of Education (2019). The Grade 6 Mathematics Florida Standards

Assessment is made up of a minimum of 62 and a maximum of 66 items. The exam is administered during three 60 minutes sessions. Mathematics clusters and the percentage of each cluster that is covered by the exam include

- ratio and proportional relationships, 15%
- expressions and equations, 30%
- geometry, 15%
- statistics and probability, 19%
- the number system, 21%.

A closer look at the expressions and equations centered questions show that the questions can include up to one-variable equations and inequalities (FDOE, 2019). This is a paper-based assessment, moving away from the earlier computer-based method in 2019.

The Algebra End of Course Exam (EOC) follows the same development process and requires the same security and administration parameters. This exam is made up of a range from 64 and 68 items and is administered in two 90 minutes sessions. It is a computer-based criterion-referenced assessment. The Algebra EOC is made up of items covering three main topics which include algebra and modeling, functions and modeling, and statistics and the number system. Percentage break down of the three topics are 41% of the test items address algebra and modeling, 40% functions and modeling, and 19% statistics and the number system. Unlike the grade level Florida Standards Assessment exams, the Algebra EOC carries two added weights. The Algebra EOC accounts for 30% of the overall course grade and passing the Algebra EOC is a Florida high school graduation requirement (FDOE, 2013). Both additional accountability pieces add to the importance of passing the Algebra EOC.

Summary

In the implementation and design of my Pre-Algebra 1 Mini-Camp intervention program I relied upon earlier research to aid in driving the decisions regarding the elements of the program. While there has been a continuing trend to offer seventh grade students the opportunity to enroll in Algebra 1 or Algebra 1 Honors in response to increasing mathematics achievement both at the national and state level, there has been a decline in the overall percentage of Algebra 1 students that are achieving success in passing the Algebra 1 End of Course Exam. Studies have shown that summer interventions can be a venue to support a student's academic success and achievement. In addition to the benefits of intervention programs specific elements of those programs have also been found to be effective. The use of mathematics manipulatives can aid students in gaining a deeper understanding of mathematics concepts and have a productive place in many activities. I used mathematics manipulatives throughout the Pre-Algebra 1 Mini-Camp. Previous research has also shown the use of cooperative and collaborative groups as well as student driven conversation as being best practices to support learning. These are practices that were also incorporated into the camp. The next chapter describes the design of the Pre-Algebra 1 Mini-Camp intervention.

CHAPTER THREE: INTERVENTION DESIGN

This chapter will address the details of the Pre-Algebra 1 Mini-Camp. The curriculum of the Pre-Algebra 1 Mini-Camp was a teacher-created curriculum that was purposely designed in a way that addressed learning outcomes, but in a slightly different manner than what typically takes place in a Grade 7 Mathematics, Grade 7 Mathematics Advanced, or Algebra 1 Honors classroom. Analysis of the sixth grade mathematics curriculum, the 2019 6th Grade Mathematics Florida Standards Assessment results, and knowledge of the concepts and skills covered in the seventh grade mathematics curriculum were a driving factor in the choice of topics to address throughout the Pre-Algebra 1 Mini-Camp. With the purpose of this study being to evaluate the effectiveness of an intervention designed to support Algebra 1 Honors students who forfeited a seventh grade mathematics course due to earlier Algebra 1 Honors enrollment, there was a need to address standards that the participants would be missing.

Standards

The curriculum of the Pre-Algebra 1 Mini-Camp was designed primarily to address the following content standards.

- Solve real-world and mathematical problems involving the four operations (+, -, ×, ÷) with rational numbers.
- Use variables to represent quantities in a real world or mathematical problems and construct simple equations and inequalities to solve problems.
- Solve linear equations with one variable.

- Evaluate square roots and cube roots.

Each of these content standards are covered in the Grade 7 Mathematics Advanced Curriculum. After consulting with my mathematics teaching peers, and two Associate Professors of Mathematics Education the four standards were identified as pre-requisite concepts and skills that support success in algebra.

The sixth grade mathematics curriculum offered insight into what topics the students may have previously learned, while the examination of the seventh grade mathematics curriculum illustrated what the participants would not learn as they moved from sixth grade directly to Algebra 1 Honors. The Algebra 1 Honors curriculum illustrated what topics the participants would be expected to know prior to starting the course.

In addition to the mathematics concepts and skills that were to be addressed in the intervention there were Florida State Standards for Mathematical Practice (FSSMP) that needed to be included in the curriculum design. The Florida State Standards for Mathematical Practice have been aligned with the Common Core Standards for Mathematical Practices (CCS, 2019) There are eight FSSMP and the Pre-Algebra 1 Mini Camp was designed to address six of those eight.

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

Two affective objectives the were addressed in the curriculum were also addressed.

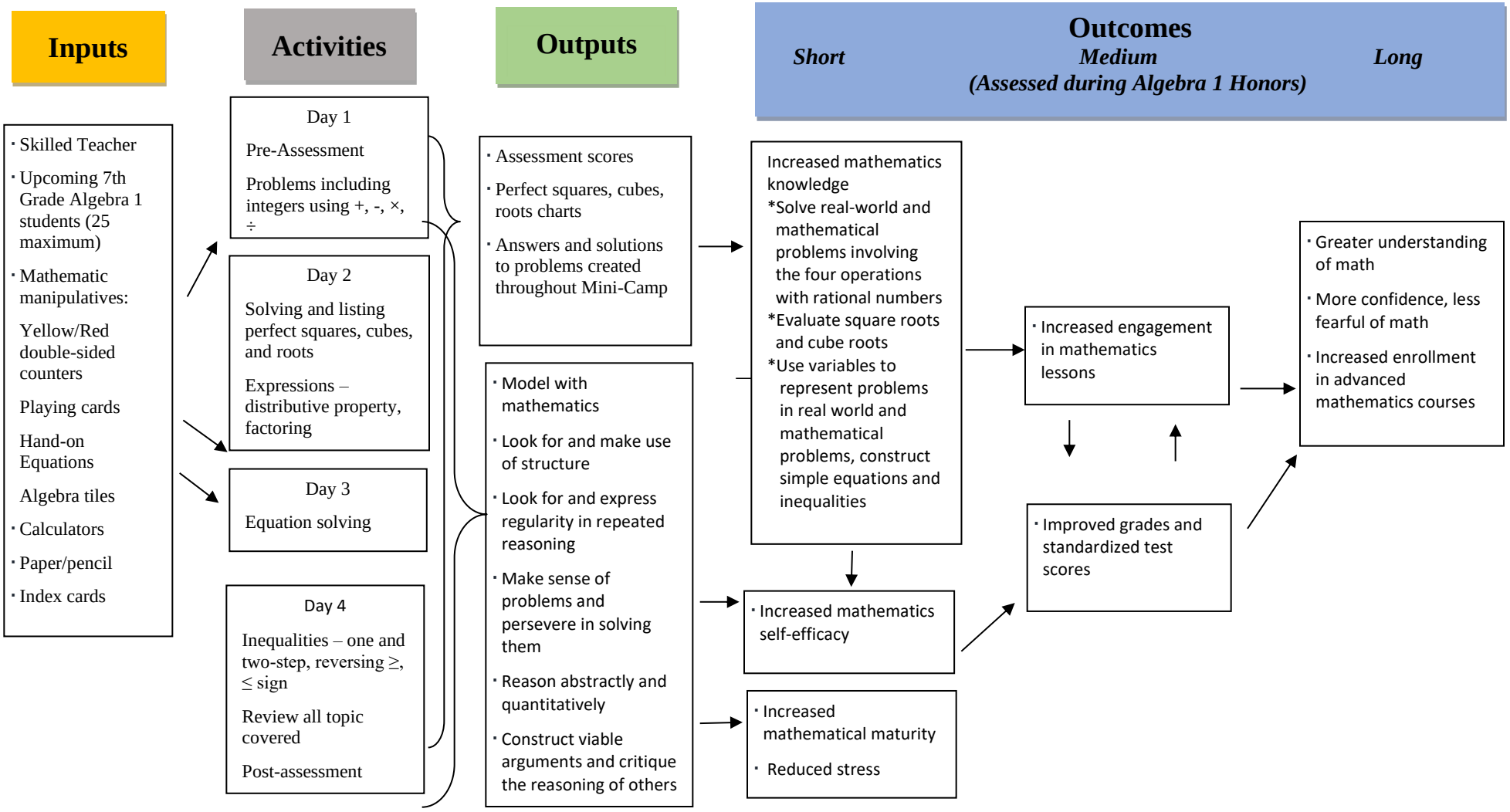
- Promote motivation
- Reduce anxiety

The curriculum of the Pre-Algebra 1 Mini-Camp was designed to provide participants opportunities to learn these four content objectives, using six practice objectives and two affective objectives. The combination of these objectives could assist participants in obtaining mathematical maturity. Mathematical maturity is a phrase that is used to describe a student that demonstrates skills, persistence, uses investigation techniques, and possesses conceptual understanding related to mathematics (Braun, 2019).

Logic Model

A logic model was created to assist with the design of curriculum covered in the Pre-Algebra 1 Mini-Camp. It allowed for the alignment of standards with the activities and the short, medium and long term outcomes of the intervention.

Pre-Algebra 1 Mini-Camp Logic Model



The mathematic topics covered during the program included integers, perfect squares and cubes and their roots, expressions, and equations. After examination of the sixth and seventh grade course curriculums as well as the Algebra 1 Honors course curriculum it was determined these were the appropriate focus topics. The first topic was integers and the use of integers in all four operations: addition, subtraction, multiplication, and division. Perfect squares, cubes, and their roots was the second topic covered. Mathematical expressions were the third topic with equations being the final topic covered. These four topics were all covered in the 7th Grade Mathematics and 7th Grade Mathematics Advanced courses offered throughout Harley School District (Harley School District Curriculum Map, 2017). Harley School District mathematics standards aligned with the Florida State Standards that were disbursed by the Florida Department of Education (2014).

Logistics

The Pre-Algebra 1 Mini-Camp took place three hours per day for a total of four consecutive days. It was scheduled to coincide with a week of the Harley School District Summer School schedule to avoid additional site costs. Aligning the days and time of the Pre-Algebra 1 Mini-Camp to the Summer School schedule was also helpful for families that had siblings enrolled in other programs. Parent/guardian permission was obtained prior to the start of the program. Parents/guardians were responsible for providing the transportation of the participants to and from the Pre-Algebra 1 Mini-Camp. The student to teacher ratio was set at no greater than 25:1. While I was the researcher in this study I also served as the instructor of the Pre-Algebra 1 Mini-Camp.

The preliminary plan was to emphasize one of the four previously listed topics each day. During the design of the study, it was established that should participants demonstrate a need for additional time or less time to be spent on each topic the lessons and activities would be adjusted accordingly. As an instructor who has taught the courses of Grade 7 Mathematics, and Grade 7 Mathematics Advanced for the past several years there was a familiarity with the curriculum. In addition to teaching the two courses, I have also served on the HSD Curriculum Map Committee and had been actively involved with establishing the most meaningful sequence of the curriculum standards. This experience supported my ability to remain flexible and allowed me to adapt the instruction and activities of the camp as needed.

The small group setting afforded participants the opportunity to discuss their ideas, thoughts, and findings with one another. Mathematics talk between students helps support students understanding of mathematic concepts and skills (NCTM, 2014). Students talking about mathematics helps them to develop and or deepen their understanding (Cool & Adams, 1998).

Participants worked in small groups with hands-on engaging activities throughout the camp. Mathematics manipulatives were incorporated in most activities. Mathematics manipulatives are concrete objects that can be physically handled by students to help them model and visualize abstract concepts. The National Council of Teachers of Mathematics consider manipulatives a mathematical tool as referenced in *Principles and Standards for School Mathematics* (NCTM, 2000). Prime Factorization Tiles, Centimeter Cubes, Two-Color Counters, and both the students and I used Hands On Equation sets. Research has shown that students who used manipulatives in their mathematics classes have greater understanding of algebraic concepts and have higher algebraic abilities than those students who do not use

mathematic manipulatives (Chappell & Stutchens, 2001). During the pilot study participants expressed how they had not often used mathematic manipulatives as sixth graders. They demonstrated excitement regarding the use of the manipulatives. The pilot study participants' reactions and comments regarding the use of mathematic manipulatives reinforced my desire to incorporate them in this study. The mathematic manipulatives used in this study and the topics they aligned to can be viewed in Table 1.

Table 1: Mathematic Manipulatives and Uses

Manipulative	Integers	Perfect Squares, Cubes, Roots	Expressions	Equations
Prime Factorization Tiles			Factor out expressions	Factor out equations
Centimeter Cubes		Illustrate values squared		
Two-Color Counters	Demonstrate zero pairs			
Hands-On Equations				Illustrate using pawns and number cubes
Playing Cards	Addition and multiplication of integers			

Participants willingly gave up a portion of their summer break to attend the Pre-Algebra 1 Mini-Camp. Being aware of this, I felt compelled to create a curriculum that would be fun as well as educational. It is my belief that classroom lessons would be more effective in engaging and motivating the students to participate and learn if they could all be filled with fun activities, but I know as a teacher it is easy to lose sight of this as we find ourselves trying to meet pacing

goals. Many games and activities can be applied to mathematics concepts and skills. I incorporated a few into the daily activities. The first 15 minutes of the camp was used for introductions, my sharing of expectations, and the intended learning goals and outcomes of the camps. The participants then took the Pre-Assessment. There were 45 minutes given for the administering of the Pre-Assessment, but most participants had finished well before the time had expired. The daily activities and lessons presented and used in the Pre-Algebra 1 Mini-Camp are illustrated in Table 2.

Table 2: Pre-Algebra 1 Mini-Camp Activities

Day	Topic	Activity	Florida State Standard Addressed
1	Integers	Pre-Assessment Yellow/red double-sided counters	MAFS.7.EE.2.3 Solve real-life mathematical problems posed with positive and negative numbers.
2	Perfect squares, cubes, and their roots	Created a chart of all the perfect and rational squares, cubes, and their roots	MAFS.8EE.1.2 Use square root and cube root symbols to represent solutions to equations.
3	Expressions	Factoring with distributive property	MAFS.7.EE.2.3 Apply properties of operations to calculate with numbers in any form.
3	Equations	Hands-on Equations Algebra tiles	MAFS.7.EE.2.4 Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities.

Day One

Once participants had completed the Pre-Assessment we began working on integers. The Florida Standard that was addressed through integers was solving real world and mathematical problems posed with positive and negative numbers. The lesson began with a discussion of what was known about integers. Participants were encouraged to talk with a friend and to share all that they could think of regarding integers. After five minutes of participant talk the participants came back together as a whole group to share what was discussed. Integers do not include fractions and can be positive and negative was the focus of the conversation. Participants were asked to give some real-life examples of integers. This resulted in responses of owing money, diving below sea level, playing and keeping score in golf, and temperatures during the winter in some areas of the world. From the definitions and examples of integers the lesson flowed to using integers with the four mathematic operations of addition, subtraction, multiplication, and division. I created some sample problems that the participants worked on in their groups. Each group created one or two problems they shared with the other groups to solve.

Double sided counters were incorporated into the integer problem-solving activities. One side of the counter is red which is used to represent negative integers, the other side is yellow which is used to represent positive integers. Participants formed small groups ranging between two and four participants per group. A set of problems was posed to the participants and time was given for them to work together through the problems. Participant discussion was encouraged through this activity as well as continually throughout the mini-camp. Discussion included how to add the negative and positive integers with some confusion regarding the adding of two negatives make a positive. This is a common mistake made by seventh grade students. They often become confused with the addition rules and practices once they have been exposed

to the multiplication rules. Once the confusion regarding addition versus multiplication rules as applied to negative integers was addressed with the use of the counters, the participants were able to see that a group of negative (red) counters added to an additional group of negative counters actually created a greater number of negative counters. Participants were addressing the FSSMP of making sense of problems and persevering in solving them. They were also addressing the FSSMP of reasoning abstractly and quantitatively.

During the subtraction using integers activities some participants could be heard discussing zero pairs. This refers to the pairing of a negative (red) counter and a positive (yellow) counter which becomes a zero value. Multiplication and division of integers was covered next. Some participants appeared unsure of how to incorporate the double-sided counters into the multiplication and division operations. Participants were given time for productive struggle with the concepts. The participants used the double-sided counter without a great deal of struggle when multiplying. They grouped the sets as positive numbers and if there was a negative involved in the problem, they would turn the counters to the negative side. Division created a bit more struggle. One student connected the idea of if one value was negative and one was positive when multiplying resulted in a negative product, then that same rule should also apply to division as they are just opposite operations of one another. Additional sample problems were worked by the groups.

A short stretch break was taken and whole group discussion occurred on what had been discovered. The integer rules of operations were discussed, each rule was summarized, and placed on the central white board. Participants copied the rules on index cards.

Two games that I incorporated into the integer session was what I refer to as Integer War and the second game Dice Golf. Participants play Integer War in pairs. Regular playing cards are used for this game. The red cards represent a negative value, and the black represent a positive value. Face cards are equivalent to ten, and the pair must decide prior to the game if an Ace is worth one point or 11 points. A deck of cards is divided evenly between the two players. Each player's cards are placed face down in front of them. The pair pulls a card from their pile and flip it face up simultaneously. In the addition version the player adds the value of the two cards, making sure to identify it as a negative value if that is the case. The first player that calls out the correct answer gains both cards. The player that gains the greatest number of cards is deemed the winner. The multiplication version follows the same steps with the two card values being multiplied rather than added. Seventh graders often confuse the addition and multiplication rules as they apply to integers once they are introduced to multiplying integers. This game is one way to reinforce the difference in the addition vs multiplication rules with integers. We completed the integers activities with a game of dice golf. Using score cards previously donated by a golf resort, the participants use a dice to roll their "score" per hole. At the end of the 18 rolls the participant calculates their score. This gives them the opportunity to visualize scoring a round of golf as it relates to negative and positive values.

Day Two

The focus of the second day of the Pre-Algebra 1 Mini-Camp included perfect squares, square roots, perfect cubes, and cube roots. Using the square root and cube root symbols to represent solutions to equations was the Florida State Standard addressed during day two. Centimeter cubes, 10 blocks, 100 blocks, 1000 block cubes and algebra tiles were used to

illustrate the idea of a number squared. Participants were asked to talk about what they knew regarding numbers squared and square roots with those that were in their groups. A few participants were overheard supporting their group members through the clarification that squaring a number was multiplying that number by itself versus multiplying the number by two. The participants were pulled back into a whole group format and their prior knowledge and discoveries were shared with all. Using index cards or notebook paper the participants copied the perfect squares, square roots, perfect cubes, and cube roots chart that the instructor created on the main white board. Input was given by the participants throughout the process. Many were able to run down the answers of numbers squared but were a little more hesitant in their responses to the square roots. The same process was followed for the perfect cubes and cube roots. Participants were less familiar with the perfect cubes and cube roots than they were with the perfect squares and square roots.

After a short break the newly created charts were used to estimate irrational square and cube roots. Number lines were used as a means of giving the students a visual aid as to where irrational square and cube roots would fall in relationship with the perfect version. Related problems were posed to the participants by asking them to estimate what the roots would be of irrational squares and cubes. These problems were solved in the small group setting. Participants were engaged in the FSSMP of constructing viable arguments and critiquing the arguments of other during this activity. An atmosphere of friendly competition began as participants worked in a guess and check manner to solve for the answers to the problems. Calculators were available to the participants and they were encouraged to check their responses

once everyone in their group came to agreement on the correct answer. Discussion of the small groups' findings took place in a whole group setting.

Day Three

Expressions and equations were the focus topics on the third day of the Pre-Algebra 1 Mini-Camp. Applying properties of operation to calculate with numbers in any form was one of the Florida State Standard (FSS) that was addressed through the activities on this day. A second FSS was using variables to represent quantities in a real-world or mathematical problem and constructing simple equation and inequalities. The participants worked with me to create an expression. We discussed the different terms, the vocabulary, and definitions of those terms. Coefficient, constant, and variable were the vocabulary terms we concentrated on. Distributive property and factoring were reviewed and then applied to the simplifying of expressions. The participants that had been enrolled in 6^{th} Grade Honors and 6^{th} Grade Advanced courses the previous school year were familiar with expressions and this was a review for them. Those participants that had not been previously exposed to this topic caught on within a short period of time and we were able to advance to the topic of equations.

My experience as a seventh grade mathematics teacher has offered me the insight that solving equations can often be an intimidating experience and task for seventh graders. The variable makes the equation seem complex. I have demonstrated to my students how they have been working problems asking them to solve for the unknown since their first grade year. Finding the unknown value of an empty box appears to be far easier or less intimidating to the students than replacing the box with a variable and solving for the unknown value of the

variable. Including a mathematic manipulative that offers support for the conceptual and procedural outcome of this topic seemed necessary.

Using appropriate tools strategically is one of the FSSMPs, and it was important to incorporate this practice for the lessons on equations. Participants needed to make sense of the problems and be willing to persevere in solving them which is a FSSMP. Reasoning abstractly and quantitatively was also a FSSMP goal for the curriculum covered. A mathematic manipulative that I have found to be successful in assisting students with greater understanding is Hands-On Equations. This is a learning tool that incorporates a balance style tool, pawns, and cubes with number values included on them. The design of the Hands-On Equations manipulative set is to move the pawns and numbers around in a way that illustrates keeping the equation balanced. Hands on Equations was designed by Borenson with the purpose of simplifying the learning of abstract algebraic concepts (Steiny, 2013). I demonstrated, in a whole group setting, how to solve equations using the balance like tool or portion of the manipulatives set. Participants followed the demonstration by creating the same scenario on their Hands-On Algebra learning mats. This routine was repeated for three additional samples and then the participants worked on a set of pre-determined equations in their small groups. As the participants worked on solving the equations, I circulated around the room listening to the conversation taking place among the groups. Approximately 75 minutes was spent on this activity. After a short break, participants solved a few one and two-step equations containing only one variable.

Day Four

The final day of the mini-camp was spent focusing on inequalities followed by a review of the previous three days' topics. The lesson began with a review of the inequality symbols. Focus on the similarity of solving an inequality and an equation was stressed throughout the demonstration. At the start of the demonstration one-step inequalities were solved leading up to the solving of two-step inequalities. Participants demonstrated mastery of the solving of inequalities using positive integers. I introduced solving inequalities with negative integers. I then went on to work examples through the demonstration. The rules regarding the process of multiplying or dividing both sides of the inequality with a negative integer were given. Participants copied the rules in their notes and began to solve this type of inequality problem in their small groups. I circulated throughout the room listening and observing the work that was taking place in the groups. If errors were made, I would pose questions and scenarios to the group to lead them to discovering where a mistake may have been made. After the groups had solved a sample of inequality problems the groups shared their inequality discoveries with one another as well as summarized what they had learned about inequalities. A short review of all the topics that had been covered took place. The Post-Assessment was given during the final 45 minutes of the Pre-Algebra 1 Mini-Camp.

Final Reflections and Future Considerations

As the participants did in the pilot study, this group of participants showed enthusiasm of being able to use manipulatives while working through mathematic concepts and skills. Again, there were participants that commented on how in elementary school they always got to "play"

with fun things when they worked on mathematics in their classrooms. While the participants may not have been able to connect the use of mathematic manipulatives with a deeper understanding of mathematic concepts and skills, they voiced excitement at being given the opportunity to use them throughout the Pre-Algebra 1 Mini-Camp. When asked if they used mathematic manipulatives in their sixth grade classes most responded that they did not with one or two participants sharing they had a few times. The use of mathematic manipulatives can offer many students an extra tool in which to understand the concept and skill. As a teacher meeting the demands of the typical school day, I realize it is easy to leave mathematic manipulatives out of a lesson. Witnessing the participants' enthusiasm and use of the mathematic manipulatives reinforced the value of them to me.

The participants were very positive with one another and were excited about the opportunity to work in small groups or pairs of their choosing. At first the participants were hesitant to openly talk to one another. As they worked, I circulated among the groups and encouraged the conversation with one another. One of the students made the comment that they thought I was not serious about the talking. This was a group smaller in number than the typical mathematics classes the participants are in during the academic year, but I was surprised at how quiet they appeared to believe they should be. A few times throughout the first and second day I would find myself reminding the participants to talk with their group members, to discuss what they were thinking with one another. This could have been the result of the participants not feeling at ease with the setting, their fellow participants of the Pre-Algebra 1 Mini-Camp, or not being familiar with me. It was a reminder to build those safe learning communities in one's classes as a strong foundation that will foster the mathematics talk among the students.

A strong self-efficacy can assist the seventh grade student in dealing with the challenges they may encounter in Algebra 1 Honors. These students are embarking on an academic endeavor that quite possibly could be the first and/or most demanding course of their educational career. The need to persevere and work through difficult concepts and skills are necessary characteristics to meet with success in Algebra 1 Honors a high school level course that they are tackling as a seventh grader. Participating in the Pre-Algebra 1 Mini-Camp appeared to boost the participants belief in their ability to do well and become successful Algebra 1 Honors students. This was shared with me by a variety of participants as we moved toward the close of the last day of the program. It was suggested by me that participants could add comments regarding their view or feeling of the Pre-Algebra 1 Mini-Camp on the back of their Post-Assessment. One student wrote how they felt the camp helped them and would be a jump-start for the algebra class (Appendix L and Appendix M). While this chapter described the curriculum design of the Pre-Algebra 1 Mini-Camp, the next chapter describes the methods used to evaluate the intervention.

CHAPTER FOUR: RESEARCH DESIGN AND METHODS

Purpose and Research Questions

The purpose of this study was to evaluate the effectiveness of an intervention designed to support Algebra 1 Honors students forfeited a seventh grade mathematics course due to earlier Algebra 1 Honors enrollment, compared to a matched sample of students from the same school district who did not participate in the Pre-Algebra 1 Mini-Camp. To determine if a summer intervention was beneficial in supporting students' success in Algebra 1 Honors, the following research questions were posed:

1. Are the four topics addressed, integers; perfect squares, cubes, and their roots; expressions; and equations, during the Pre-Algebra 1 Mini-Camp the topic areas of greatest need for the seventh grade Algebra 1 Honors students?
2. Does participation in the Pre-Algebra 1 Mini-Camp improve seventh grade students' success in Algebra 1 Honors?

Pilot Study

I conducted a pilot study of this intervention, with the approval and support of my principal, during the Summer of 2018. The pilot study took place at the same school and had the same time commitment of four consecutive days, three hours per day. There were 22 rising seventh grade Algebra 1 Honors students who participated in the pilot study. The participants were identified by the school's administration team as those sixth graders who had scored at an Achievement Level 3, Level 4 or Level 5 on the 2018 6th Grade Mathematics Florida Standards

Assessment. Data collected with the pilot study prompted me to make some changes to the instruments and curriculum of the intervention. The assessment tool in the pilot study was the Glencoe Algebra 1 (McGraw Hill, 2014) Pretest and Posttest. This was one of the textbooks used in Harley School District algebra courses. This assessment included mathematics problems that were from a wide range of topics, but there were no questions addressing root, squares, cubes, solving inequalities or equations. The pilot study's assessment was too broad without a concentration or strong sampling of questions related to the concepts the participants covered in the camp.

To address the limitations of the assessment tool used in the pilot study, the Iowa Algebra Aptitude Test (IAAT) 5th Edition Form A, was more directly focused on the concepts, skills, and standards that were being specifically addressed in the mini-camp, unlike the assessment tool used during the prior camp. This led to the incorporation of a portion of the IAAT questions in the creation of the Pre-Algebra 1 Mini-Camp Pre- and Post-Assessment.

Another change made was that a greater amount of time and emphasis would be placed on integers. Middle and high school mathematics teacher peers discuss this topic as being an area of weakness for our students. The use of two-sided counter chips as a mathematics manipulative was added to the camp activities. One side of the chip is red and the other yellow. The chips are used to show the idea of zero pairs. One color represents a negative one, the other a positive one and together one of each will cancel the other out or create a pair with a zero value. This is a representation of the additive identity property.

Program Design

The design of the Pre-Algebra 1 Mini-Camp intervention program that was evaluated in this study offered participants exposure, experience, and practice with a small portion of the mathematic concepts and skills typically offered in the Grade 7 Mathematics Advanced course. The Pre-Algebra 1 Mini-Camp was held at my work organization, a middle school, in Harley School District, a district located in Central Florida. This middle school contains grades six, seven, and eight.

The Florida Standards Assessments incorporate an achievement level scoring system to provide stakeholders information that can be easily interpreted in a meaningful way. The Achievement Levels range from Level 1 to Level 5. Students who score at an Achievement Level 4 or a Level 5 are performing above average. These students are offered placement in the Algebra 1 Honors mathematics course as seventh graders. All rising seventh grade Algebra 1 Honors students enrolled at the targeted middle school were invited to take part in the camp to eliminate any inequality in the educational opportunities being given. Participation was on a voluntary basis. The administrative team identified the students who met the requirements of Algebra 1 Honors enrollment. There was a total of 92 possible eligible participants for the Pre-Algebra 1 Mini-Camp identified. Once identified the school's principal made a Connect-Ed phone call to the parents or guardians of all those students identified by the administrative team. The phone message offered a brief explanation of the Pre-Algebra 1 Mini-Camp and invited the student to participate in the camp.

The participants were all rising seventh graders and had a variety of backgrounds regarding their teacher and mathematics course placement while in sixth grade. Some students

had been enrolled in the 6th Grade Mathematics course, others in the Grade 6 Mathematics Advanced course, and the remainder of the participants had been enrolled in the Grade 6 Mathematics Honors course.

Results of the Florida state assessments typically are released mid to late June, but the results of the 2019 assessments were not released until early July 2019. The target dates of the Pre-Algebra 1 Mini-Camp were set up as July 15-18, 2019. These dates were chosen as they were toward the end of the Harley School District Summer School schedule and it was believed would afford the time needed to analyze the data for more meaningful development of the camp curriculum. The 2019 Florida Standards Assessment (FSA) results play an instrumental role in the decision of which students are offered enrollment in Algebra 1 Honors. Teacher recommendation is a factor, but the FSA scores have a greater preponderance in the decision. After receiving the 2019 6th Grade Mathematics Florida Standards Assessment results, the school's mathematics coach and I were able to view the topic areas of weakness that were evident by those results. The areas of need were in alignment with the earlier four topics chosen.

The intervention was implemented as designed, with a few minor exceptions noted in Chapter Five. Conducting the pilot study the previous summer offered some insight to the practices that worked well and those that did not, but no comparison of the experimental group to a control group occurred during the pilot study Greater detail of the changes made due to the need for a more effective comparison model will be addressed in the upcoming chapter.

Sample Selection

To evaluate the effectiveness of the Pre-Algebra 1 Mini-Camp and answer the research questions this study used a quasi-experimental research design Participants in the experimental group included all the students who participated in the Mini-Camp and whose parents provided consent to participate in the study and who continued to enroll as a student in Harley School District during the first two quarters of the 2019 school year. All students who participated in the camp were also invited to participate in the study

A total of 20 students signed up to be participants in the mini-camp and of those 20 a total of 18 participants were present for the Pre-Algebra 1 Mini-Camp. One participant was unable to attend the first day of the Pre-Algebra 1 Mini-Camp due to a medical issue and a second participant was not able to attend the final day due to a prior commitment. These two participants were excluded from the pre-test and post-test comparison, resulting in a sample of 16 complete matching datasets for that part of the study.

There were an equal number of female and male participants. Three of the participants were Hispanic with the remaining participants being White. One participant receives Exceptional Student Education services while in the general education classroom throughout the academic school year. This participant was not afforded any additional accommodations during the mini-camp due to the inability to access his Individual Education Plan.

In selecting the control group, the case-control matching method was chosen as it offers a means of comparison between those who participated in the intervention and those that did not. The comparison sample was chosen through case-control matching as it offers the closest matched control group prior to the Pre-Algebra 1 Mini-Camp. Three covariates were used to

identify the comparison group: gender, race and Grade 6 Mathematics Florida Standards Assessment scores. At least one exact match was identified for every participant in the experimental group. When multiple exact matches were identified, all matches were included in the comparison group. This method had the additional benefit of not being intrusive on the participants after the completion of the intervention. Morgan and Harding (2006) reported one of the benefits of case-control score matching versus the use of a regression-based method is it offers a more explicit focus on heterogeneity of causal effects. They did go on to point out that case-control score methods did not eliminate the possibility of selection bias created from unobserved factors.

A population of 619 seventh grade Algebra 1 Honor students, who did not participate in the Pre-Algebra 1 Mini-Camp, was created as a comparison pool for this study. The study design was created with the original plan to use propensity score matching between participants and members of the control group. When the data was formatted and entered the IBM SPSS Statistics program it was not effective in matching up the students under the three covariates used to identify the sample group. An example of this was a White male participant who scored a Level 5 on the 2019 6^{th} Grade Mathematics Florida Standards Assessment was matched with a Hispanic female control group member that had scored a Level 3 on the assessment. A second method, known as case-control matching, was tried and it appeared to be a better choice due to the small number of covariates used when matching a large pool of students to the 18 Pre-Algebra 1 Mini-Camp participants.

Instruments

To answer the research questions, data from three dependent variable were collected: Iowa Algebra Aptitude Test (IAAT), Harley School District Algebra 1 State Mandated Test (Algebra 1 SMT), and the quarterly grades from Quarter 1 and Quarter 2 of the 2019-2020 school year. The IAAT scores were collected from students in the intervention group, while Algebra 1 SMT and quarterly grades were collected for both intervention and control groups.

The IAAT contains four sections: pre-algebraic number concepts and skills, interpreting mathematical information, representing relationships, and using symbols. The 16 focus questions used as the Pre- and Post-Assessment were questions related to mathematical operations with integers, cubed number values, expressions, and equations. The chosen questions were the ones that most closely aligned to the topics covered during the four days of the Pre-Algebra 1 Mini-Camp. Both the Pre- and Post-Assessment used the same 16 questions. The original purpose of this test is to assess student readiness for Algebra 1, but due to time constraints the instrument was shortened. The items included specifically assess if participants had gained understanding of the topics and related skills covered during the camp. In this study the Pre- and Post- Assessment scores were treated as ratio level data.

In addition to the Pre- and Post-Assessment given during the camp, analyzed data and subsequent findings from the Harley School District Algebra 1 benchmark test known as the Algebra 1 State Mandated Test were also collected at the end of the second quarter. The same test was administered twice to all students enrolled in Algebra 1 courses throughout the school district, once within the first two weeks of the school year and again at the end of the first semester of the school year. Each individual student's results are compared from the test given

in August to the test given again in December. The purpose of this assessment and practice is to assess student growth in the subject area. These scores are used as formative assessment data during the second semester by instructors to remediate areas in which students are not yet proficient. These assessments were used as a source of data to compare Pre-Algebra 1 Mini-Camp participants to a matched sample of non-participants. In this study, Algebra 1 SMT scores were treated as ratio-level data.

Individual teachers determine what assessments are used in the design of their course's quarterly grades. Harley School District requires that each teacher offers three summative grades per quarter and encourages the assignment of a minimum of an additional nine formative grades per quarter. The gradebook system used throughout Harley School District has a predetermined weight of 60% of the overall grade average be from summative assessments, while formative assessments account for the remaining 40% of the averaged grade. The first Algebra 1 SMT is not counted as a grade in the first quarter final grade. However, the Algebra 1 SMT given before the end of the second quarter is averaged into the grade as a summative assessment in the students' second quarter final grade. It accounts for one of three summative scores during the second quarter. Therefore, the results of the second Algebra1 SMT can impact the second quarter final grade that was collected and analyzed in this study. The discretion that teachers have regarding course-grading policy will result in data with uncertain reliability. Quarterly grades were reported on an A, B, C, D, or F scale and were treated as ordinal-level data in this study.

Study Procedures

I ensured that the parents/guardians provided consent for their child to be included in the study, and the participants also provided assent. To answer these research questions the research design was a quasi-experimental study. Participants in the Pre-Algebra 1 Mini-Camp were compared to a matched sample of Harley School District' seventh grade students who did not take part in the mini-camp After I introduced myself and shared the camp objectives, camp participants were given the pre-assessment. A 45-minute period had been allocated for the pre-assessment. The post-assessment was given during the last 30 minutes of the Pre-Algebra 1 Mini-Camp on the final day.

After the completion of the summer intervention, data were collected from the Pre-Algebra 1 Mini-Camp participants' and the matching group of non-participants' Harley School District's benchmark test known as the Algebra 1 State Mandated Test results. This data was used to compare the performance of the camp participants to the non-participants to address my second research question. Individual scores were compared as well as overall group scores. As a third source of data analysis, the final Algebra 1 Honors course grades from the first and second quarter of the 2019-2020 school year of the camp participants to the matched sample group were compared

Methods of Data Analysis

To answer Research Question 1, the targeted middle school's student data from the 2019 6th Grade Mathematics Florida Standards Assessment as well as the 2019 Florida Algebra 1 End

of Course Exam provided information regarding topic areas in which our seventh grade Algebra 1 Honors students demonstrated the greatest weakness. The questions and the corresponding standards that received the lowest percentage of correct responses on both state assessments was determined. Through the collection and analysis of this data it was decided that integers, perfect squares and cubes and their roots, expressions, and equations are the areas of greatest need based on students' assessment scores. If the analysis had indicated that students had performed lower on topic areas other than those that were initially targeted to be addressed during the camp, topic focus would have been changed as had been needed.

The Pre- and Post-Assessment given during the camp were analyzed to establish if any changes occurred in participants' mathematics understanding. A within-subjects t-test was used to determine if there was a statistically significant difference and improvement in the scores on the scores of the pre-assessment versus the post-assessment.

For the analysis of the Algebra 1 State Mandated Test results and the first semester grades analysis a within-between repeated measures MANOVA with two dependent variables, Algebra 1 SMT scores and the course grades at the end of the first and second quarters of the school year. Analysis of variance (ANOVA) statistical method was used. This method was chosen as it is used to test the difference between the means of two groups using two variables. Analysis was done through the comparison of the differences between two groups at two different time points. This analysis illustrated the overall performance of the camp participants compared to matched sample students for the first half of the school year.

Threats to External and Internal Validity

As a researcher I understand and acknowledge the importance of a study being free from personal biases, though all threats to internal validity to the studies could not be eliminated. While I acknowledge that I am the designer, evaluator, and the teacher involved with this study, steps were taken to prevent personal bias from playing a part in this study. During the planning stage of the Pre-Algebra 1 Mini-Camp , I incorporated the assistance of our school's mathematics coach to help establish that the curriculum and 6th Grade Mathematics Florida Standards Assessment data supported my choice regarding the greatest area of needs of the seventh grade Algebra 1 Honors students. The school administrative team and mathematics coach were responsible for identifying the rising seventh grade students who qualified for enrollment in Algebra 1 Honors. Each family of a student that was identified as a rising seventh grade Algebra 1 Honors student was contacted by our school's principal in a ConnectEd phone message and invited to allow their child to participate in the camp. By inviting all students, I addressed the issue of educational equality for all, and attempted to reduce or eliminate selection bias. The Iowa Algebra Aptitude Test has been assessed for validity and reliability. By using questions from the Iowa Algebra Aptitude Test, I incorporated an assessment from a third party to avoid any personal bias that may have occurred had I used an instructor created assessment. When comparing the camp participants to a control group the decision was made to use case-control matching, a technique that attempts to estimate the effect of a treatment or intervention by accounting for the covariates that predict the intervention outcome. Case-control matching is a method that can approximate a control group with experimental subjects.

A possible threat to the external validity of this study was selection bias. While 92 rising seventh grade students were eligible to participate in the Pre-Algebra 1 Mini-Camp, only 20 of those 92 signed up for the intervention. There was no way to determine if the 20 willing participants were true representatives of the remaining 72 eligible non-participants. This allows for the possibility that the experimental sample was not a true representation of all seventh grade Algebra 1 Honors students at the school or across the school district.

There were some threats to the internal validity of this study. Among these threats repeated testing using the same instrument took place. The study participants took the same Pre- and Post-Assessment at the beginning and conclusion of the camp. Both groups took the same Algebra 1 SMT benchmark test within a five-month period. The advantage of using the same instrument is that I avoided instrumentation threats to internal validity and could be sure that scores were equivalent. However, some score improvement could possibly be attributed to students having prior experience with the test. Instrument change occurred with the Pre- and Post-Assessment given during the Pre-Algebra 1 Mini-Camp. Due to the time constraints the test length was shortened. This required omitting some of the original assessment, changing the original instrument.

An additional internal threat to this study may have been regression toward the mean. The danger that participants might earn high scores due to guessing correctly on the questions they do not know the answer could occur. This could have occurred with both the Pre- and Post-Assessment given during the intervention of the camp. It also could be an issue with the Algebra 1 SMT data. Neither instrument was created for the purpose of assessing an intervention. This may have had some bearing on the use of the data collected from them for this study.

Unmeasured confounding variables are outside influences that can change the effect of the dependent and independent variables. An unmeasured confounding variable such as motivation, might have influenced the outcomes. While they were good choices, the Pre- and Post-Assessment did not offer data as robust as I would have hoped it to have been. The camp participants performed at such a high level on the Pre-Assessment that there was marginal room for growth on the Post-Assessment.

Summary

The methods used in this study were ones that previous research supported. Experience that I have gained through teaching was also helpful in creating the design of the Pre-Algebra 1 Mini-Camp. Lessons that incorporate the use of manipulatives, group activities, and encouraging the participants to share their ideas and findings with one another are all best practices supported by research and my experience as a veteran teacher. Research and thought went into the choice of instruments that were used in this study. These were circumstances beyond my control but could have perhaps created a difference in the outcome of the study data.

CHAPTER FIVE: FINDINGS

The purpose of this study was to evaluate the effectiveness of an intervention designed to support Algebra 1 Honors students who forfeited a seventh grade mathematics course due to earlier Algebra 1 enrollment, compared to a matched sample of students from the same school district who did not participate in the Pre-Algebra 1 Mini-Camp. Additional data were collected to determine if participants' performance increased from the start of the camp to the conclusion of the camp which was.

The primary focus of this chapter is to answer the second research question of this study

> Does participation in the Pre-Algebra 1 Mini-Camp improve seventh grade students' success in Algebra 1 Honors?

My hypothesis of this study was that my experimental group would demonstrate greater achievement on the Harley School District Algebra 1 State Mandated Test (Algebra 1 SMT), and higher grades compared to the comparison group. My null hypothesis was that there was no difference between the experimental and the control group (H_0: $\mu_{Exp} = \mu_{Cont}$). My alternative hypothesis is that the mean scores of the experimental group will be greater than the mean scores of the control group (H_1: $\mu_{Exp} > \mu_{Cont}$).

Participant Demographics

Participants in the Pre-Algebra 1 Mini-Camp were a group of 18 rising seventh graders. There were an equal number of female and male participants. All students were White except for three Hispanic participants. While the lack of ethnic diversity was disappointing to me in

that there was not a greater diversity of participants, Table 3 shows that the gender and racial diversity of the participants were roughly equivalent to the demographic make-up of our advanced mathematics courses. The participants were friendly, cooperative, and worked well with one another. These students had parents/guardians who enrolled them in the program. The parents were also willing to transport them to and from the camp. I note this as it could be indicative of the unintended sampling bias that the participants may have a greater support system at home than those that did not participate. Not all seventh grade Algebra 1 students would have the same level of parental support.

Table 3: Comparison of Prior Achievement for Participants, Comparison-Group, School, and School-District

Characteristic	Participants	Comparison Group	Seventh Grade Algebra 1 Honors Students at Research Site	Seventh Grade Algebra 1 Honors Students in District
Number	16	16	98	599
6^{th} Grade FSA Scale Score	4 (0.58)	4 (0.58)	4.51 (0.59)	4.25 (0.61)
Female (%)	50	61	49.1	49.6
Hispanic (%)	17	19	4.3	16.4
Algebra 1 SMT #1 Scores (Mean: SD)	29.3 (13.1)	28.4 (12.6)	28.1(11.4)	30.6 (13.6)
Algebra 1 SMT #2 Scores (Mean: SD)	65.8 (11.2)	63.4 (15.4)	56.51(17)	63.8 (15.4)

In the comparing of the experimental group and control group to the achievement of seventh grade Algebra 1 Honor students in the district it appears that the students' demographic characteristics prior mathematical achievement was similar. The seventh grade Algebra 1 Honor students at the research site performed as a whole slightly lower on the Algebra 1 SMT #2 than the overall district, the control group and the mean percentage is 8.29% lower than the experimental group from the same school who are being taught by the same teachers. The mean percentage score was only 1.2% lower than the experimental group on the Algebra 1 SMT #1. This is of interest as the previous three years the Algebra 1 EOC results have demonstrated a lower percentage of the research sites school's seventh grade Algebra 1 Honors students passing the test when compared to other seventh grade Algebra 1 students within the same district.

Preliminary Analysis

Pre- and Post-Assessments from the Mini-Camp were scored and analyzed. A total of 16 participants took both the Pre- and Post-Assessment. I removed the scores of the participants who were not present for both assessments. Prior to the analysis of the collected data I wanted to verify that the three basic assumptions of a matching samples t-test required of the data have been verified. These three requirements include, data matching, the data are continuous, and the data are normally distributed. I matched the Pre- and Post-Assessments by eliminating any participant's scores that were unable to take both versions of the assessment. This allowed for a matched data set of scores. The data were scored using a percentage score. Percentages are continuous and this met the need of data being continuous. As a method to establish if the data were normally distributed, I created a Pre-Assessment Frequency Graph (see Figure 1) and a

Post-Assessment Frequency Graph (see Figure 2). These demonstrated an adequately normal distribution in assessment scores.

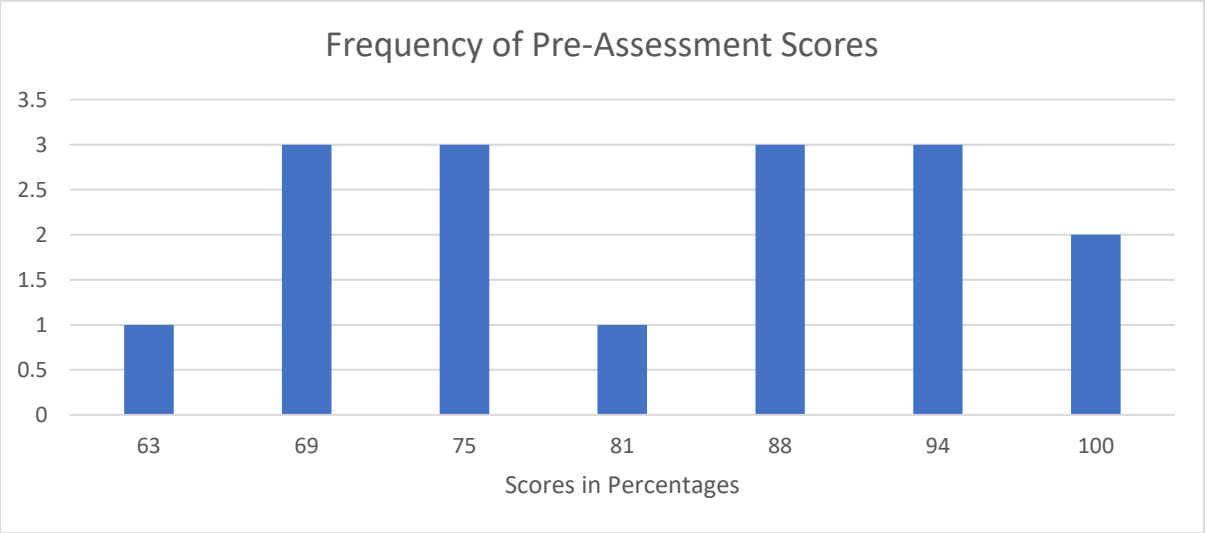


Figure 1: Frequency of Pre-Assessment Scores

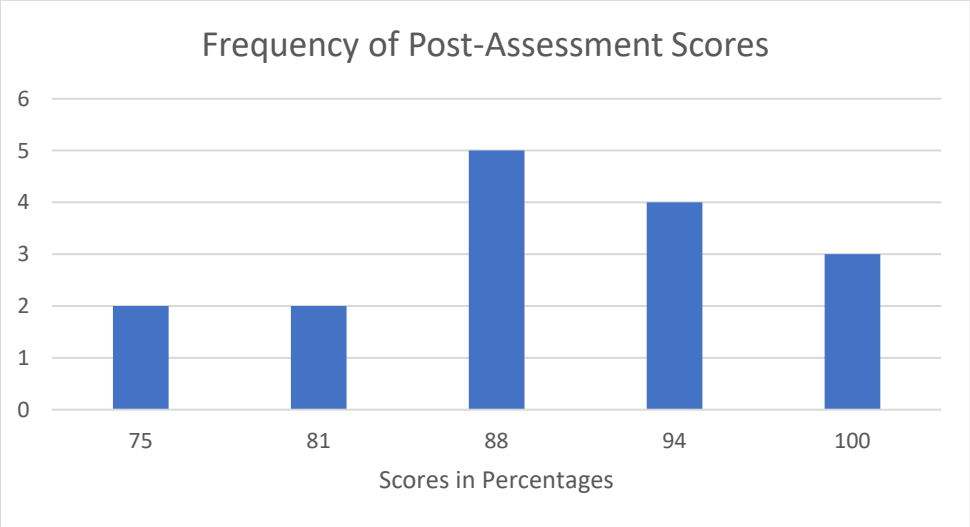


Figure 2: Frequency of Post-Assessment Scores

A similar process was used to assess the assumptions of the ANOVA regarding the Algebra 1 SMT #1 (see Figure 3) and the Algebra 1 SMT #2, (see Figure 4). Three assumptions of the ANOVA were checked: normality, continuous, and equality of variance. While the distribution of scores was platykurtic (i.e. negative kurtosis), ANOVA is quite robust to minor variations in normality.

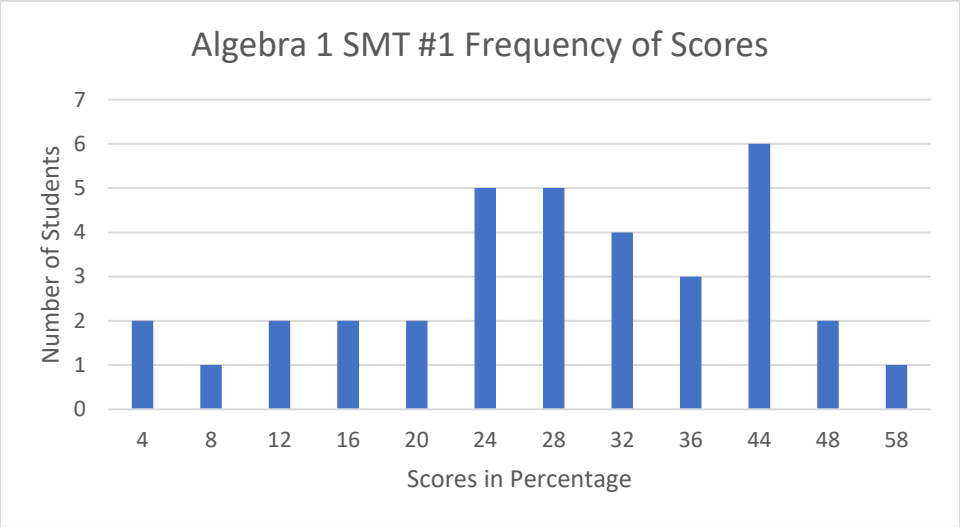


Figure 3: Algebra 1 SMT #1 Frequency of Scores

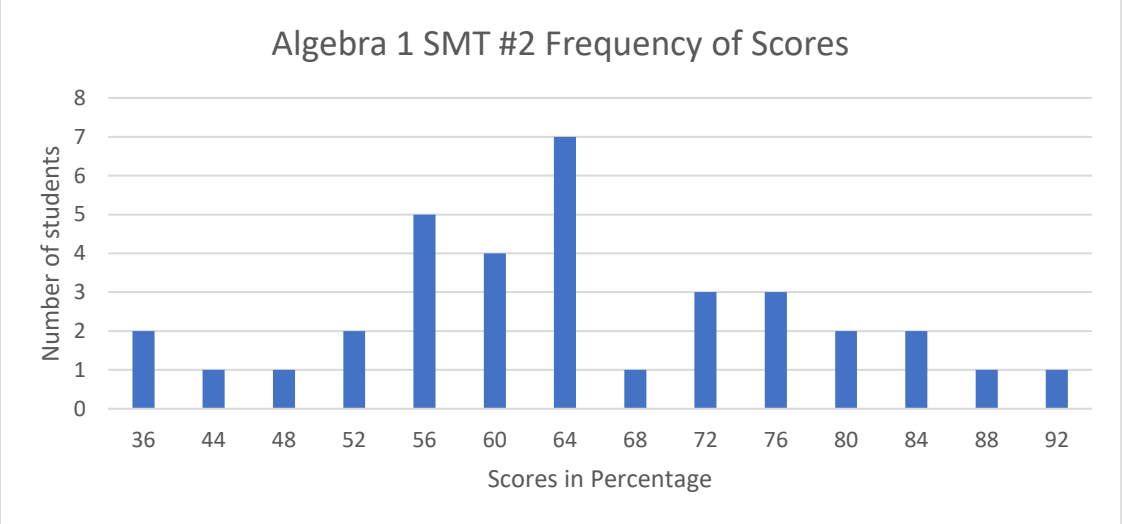


Figure 4: Algebra 1 SMT #2 Frequency of Scores

Quarter 1 and Quarter 2 grades all fell within a letter A-C range. Each letter was given a numerical value with A being given the value of four, B being given the value of three, and C being given the value of two (see Figure 5 and Figure 6). While grades are ordinal, I am choosing to treat them as if they are continual. While the data are skewed toward more students earning A-s than lower grades ANOVA is quite robust to variations in normality so long as there are no outliers. No outliers were evident in these data. Finally, the variance in both the Algebra 1 SMT and grade data were roughly equal between Quarter 1 and Quarter 2.

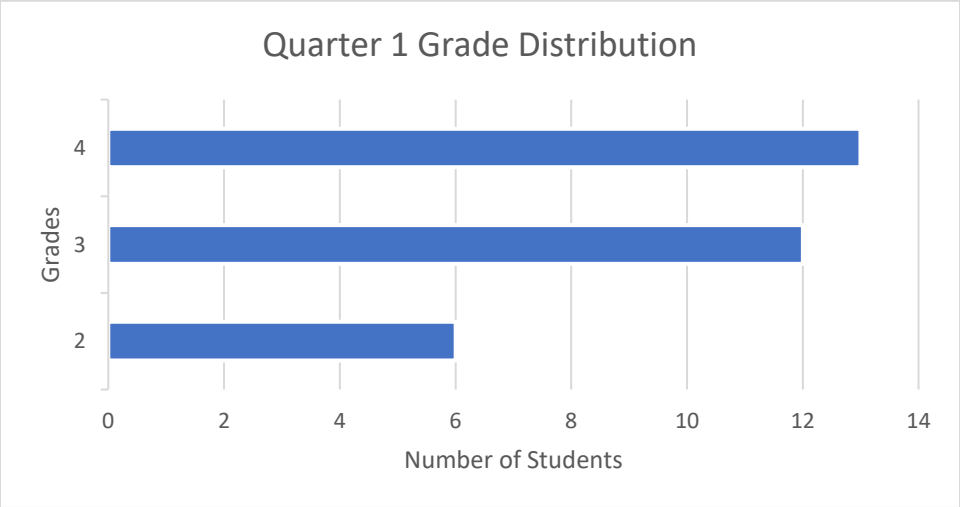


Figure 5: Quarter 1 Grade Distribution

Note: A = 4, B = 3, C = 2

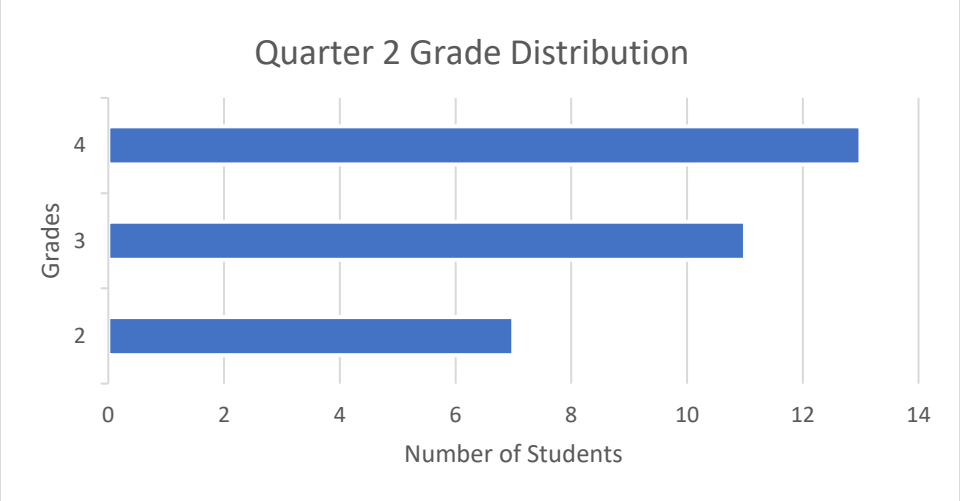


Figure 6: Quarter 2 Grade Distribution

Note: A = 4, B = 3, C = 2

Data Analysis

The results from the pre- assessment (M = 82.6, SD = 11.7) and post-assessment (M = 89.3, SD = 7.85), t(16) = .-4.95, $p < 0.0001$ demonstrated change from the beginning to the end of the Mini-Camp. The range in scores on the Pre-Assessment was a percentage score spread of 37, while the Post-Assessment demonstrated a spread of percentage scores of 25. Data from the assessments were close to the ceiling, there was not a great deal for some students to improve their scores. Those participants who scored 63% or 69% on the Pre-Assessment increased their percentage score by at least 12% on the Post-Assessment with one participant moving from a 69% on the pre-assessment up to a 94% on the Post-Assessment.

Analysis of the data revealed that participants in the intervention group had slightly better performance on both standardized test and grades at the end of both quarter one and two (partial $\eta^2 = .06$). However, neither the difference between groups (F(2, 32) = 1.04, p = .06) nor the

greater improvement of the intervention group between quarter one and quarter two ($F(2, 32) = 80.28$, $p = .83$) were statistically significant (see Table 4). These findings of statistically non-significant differences must be interpreted cautiously due to the low power of the research design (Power = .22 between subjects; Power = 10 between subjects x time). The results of this evaluation were inconclusive; more data is needed to achieve sufficient power in the research question. The estimated marginal means of Harley School District State Mandated Tests increased for both the participants and matched sample students as shown in Figure 1, but one group did not significantly outperform the other (see Figure 7).

Table 4: Results of the Quarter 2 Harley School District Algebra 1 Grades and State Mandated Test

Estimate

Measure	Participant/ Control	Mean	Standard Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Grade	Control	3.026	.176	2.669	3.384
	Participant	3.406	.191	3.017	3.796
Algebra 1 SMT	Control	45.895	2.393	41.025	50.764
	Participant	47.500	2.608	42.194	52.806

Note. Algebra 1 SMT = Algebra 1 State Mandated Test
Note Grade is on a scale of 0-4 with 4 = A, 3 = B; Algebra 1 SMT is a percentage grade 0-100%

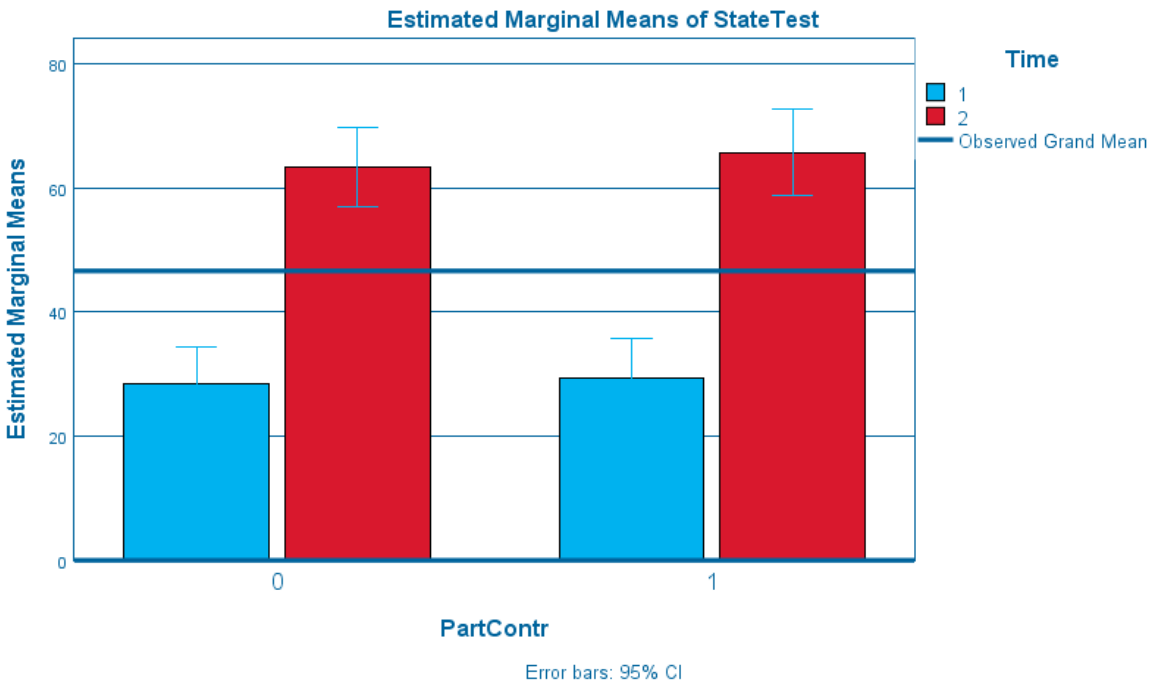


Figure 7: Estimated Marginal Means of State Mandated Test

Note: 0 represents the control group, 1 represents the experimental group

Post-hoc Analysis

While no official survey was given to the participants or their families as a means to gather their opinions on the Pre-Algebra 1 Mini-Camp, the participants were told they could add a note or comment regarding their view of the camp on the back of their post-assessment. Most participants comments were positive, with only three of the comments being negative. Two participants did not care for the Pre-Algebra 1 Mini-Camp starting at such an early hour. The camp was conducted in the same hours and dates as the Harley School District Summer Program to eliminate costs associated with the school being open and running. One of the highest performing participants wrote that he disliked the balance beam for expressions. He had a foundation for expressions and equations and he verbally shared with me that he was more

confused when trying to work the problems out using the Hands-On Equations manipulatives (see Appendix L and Appendix M for a complete list of participant comments).

Summary

The results of this study have offered some findings regarding seventh grade students enrolled in Algebra 1 Honors. While the findings were not as indicative as I had hoped for, there was apparent student growth in the understanding of algebra concepts and an improvement in related skills. The Algebra 1 SMT #2 scores showed an increase in the gap between our student base in comparison with students throughout our district. The same results also showed an increase in the gap between the performance of the participant group and other Algebra 1 Honor students who are located at the same school. The participant group performed above the district mean, but the overall group scored below the district mean. This could be the result of the Pre-Algebra 1 Mini-Camp participant group not being a true representation of all the seventh grade Algebra 1 Honors students at this school.

CHAPTER SIX: DISCUSSION

Introduction

In recent years there has been a nationwide push to increase the middle grade student enrollment in algebra and other advanced mathematics courses. The state of Florida has followed the trend. As a method to attempt to increase student achievement, the Florida Department of Education has created a point-based school grading formula that allocates additional points to middle schools with greater enrollment of students in advanced mathematics courses. A middle school can earn up to 1000 points on the grading scale. Of those 1000 points, 100 can be earned through the enrollment of students in advanced mathematics courses (Florida Department of Education, 2017). In response to the implementation of this school grading system, Harley School District increased seventh grade student enrollment in Algebra 1 Honors. Rising seventh grade students entering the Algebra 1 Honors course forego a year of a pre-algebra mathematics course traditionally taken in eighth grade, as well as a year of foundational mathematic concepts and skills in seventh grade.

Purpose

The purpose of this study was to evaluate the effectiveness of an intervention designed to support Algebra 1 Honors students who did forego a seventh grade mathematics course due to earlier Algebra 1 enrollment, compared to a matched sample of students from the same school district who did not participate in the Pre-Algebra 1 Mini-Camp. The two questions that this study was designed to address were:

1. Are the four topics addressed, integers; perfect squares, cubes, and their roots; expressions; and equations, during the Pre-Algebra 1 Mini-Camp the topic areas of greatest need for the seventh grade Algebra 1 Honors students?
2. Does participation in the Pre-Algebra 1 Mini-Camp improve seventh grade students' success in Algebra 1 Honors?

While there has been an increase in Harley School District of rising seventh grade students enrolled in Algebra 1 Honors, there has been a decrease in the percentage of seventh grade students passing the Florida Algebra 1 End of Course exam (Florida Department of Education, 2019). This exam is used as an instrument to measure student mastery of the mathematics standards and associated concept and skills taught in the course. A decrease in the passing rate could be interpreted as an increase in the number of students enrolled in algebra courses as well as an increase in Algebra 1 students that are not mastering the concepts and skills needed to demonstrate a basic understanding of algebra. The purpose of this intervention was to offer foundational skills and concept; the purpose of the study was to see if it worked.

Summary of the Study

This study took place during the summer and first semester of the academic school year of 2019. The location of the study was a Harley School District School located in east Central Florida. The targeted population was rising seventh grade Algebra 1 Honors students. The possible participants were initially identified as those students who scored at an Achievement Level 4 or an Achievement Level 5 on their 6^{th} Grade Mathematics Florida Standards Assessment (FSA) taken in April 2019. Students that scored an Achievement Level 3 and earned

a scale score that was a few points away from an Achievement Level 4 were also included in the pool of rising seventh grade Algebra 1 Honors students. Once students who were eligible for participation were identified, a phone call was placed by the school's principal inviting the students to participate in a Pre-Algebra 1 Mini-Camp four-day summer enrichment program. The program was held at the participants' middle school located on the east coast of Harley School District, Florida. The camp took place from 7:45 to 10:45 a.m. over four consecutive days beginning on July 15, 2019. There was a delay by the Florida Department of Education in the release of the 2019 FSA results which caused the turn-around period from the time the results of the FSA were released until the start date of the Pre-Algebra 1 Mini-Camp to be six days.

A total of 18 rising seventh grade Algebra 1 Honors students enrolled in and attended the camp becoming the original 18 participants of this study. The data that was analyzed for this study included the Pre- and Post-Assessment given during the Pre-Algebra 1 Mini-Camp, which was comprised of portions of the Iowa Algebra Aptitude Test (IAAT), the benchmark test known as the Harley School District School Algebra 1 State Mandated Test, and the first and second quarter Algebra 1 Honors grades, which are the two quarters following the Pre-Algebra 1 Mini-Camp. The participants' data were matched and compared with other seventh grade Algebra 1 Honors students throughout the Harley School District. The covariates used in matching participants to non-participants included 6^{th} Grade Mathematics Florida Standards Assessment (FSA) scores, gender, and race.

Summary of Results and Discussion

There were two questions that this study was designed to answer. The first question of this study:

> Are the four topics addressed, integers; perfect squares, cubes, and their roots; expressions; and equations, during the Pre-Algebra 1 Mini-Camp the topic areas of greatest need for the seventh grade Algebra 1 Honors students?

was answered prior to and throughout the Pre-Algebra 1 Mini-Camp. The answer to this question was yes with some caveats. The four topics were ones that participants had limited exposure and experience with, or they had no exposure to the topics, and needed to have understanding and practice with the concepts and skills prior to moving on to other algebraic topics. The Grade 6 Mathematic FSA results demonstrated an overall weakness of the concepts and skills related to integers, expressions and equations. Most participants were not at all familiar with perfect cubes and their roots, while some had a limited knowledge on perfects squares. Once shown or reminded of the process used in squaring a number, the participants were able to quickly master the skill of finding the root of a perfect square. The comments that some participants shared on the Post-Assessment also affirmed that the topics chosen were ones that they viewed as beneficial (see Appendix L and Appendix M for a complete list of comments).

Bowens and Sanders (2016) study assessed aspects of the Jaime Escalante Mathematics Program (JEMP) and found that hands-on manipulatives, collaborative and cooperative grouping, discourse and conversation rich in mathematics vocabulary, and purposeful questioning were all best practices that were beneficial to middle grade students. Each of these

practices were implemented throughout the Pre-Algebra 1 Mini-Camp. Although the amount of time spent on each of the four topics was limited during the intervention, the participants were able to gain understanding of the concepts and skills in those brief periods of time. The Harley School District Curriculum Guides for the seventh grade mathematics courses allocates a greater amount of time be spent on each of these topics. I believe the methods used to present and engage in the activities assisted the participants in gaining knowledge on the concepts and skills more quickly. This study supported those best practices findings in earlier research.

The second question of this study:

> Does participation in the Pre-Algebra 1 Mini-Camp improve seventh grade students' success in Algebra 1 Honors?

was not affirmatively answered through the data collected and analyzed. There was no statistically significant difference between the first and second quarter grades of the participants and the matched sample of seventh grade Algebra 1 Honors students. There was also no statistically significant difference between the two groups' performance on the Algebra 1 State Mandated Test (Algebra 1 SMT). Both groups had a mean grade that was equivalent to a letter "B" grade and performed very similarly on the Algebra 1 SMT. The participant group did perform better than the control group as was demonstrated in the measures of student learning at the end of the first and second quarter, but the better performance was small compared to the variance. This did not illustrate a statistically significant difference. The data collected does show above average grades, and scores above the district's average on the Algebra 1 SMT. Both the experimental and control group improved between quarter one and quarter two resulting in

the small differences between the two groups. The small difference seen between the two groups would be considered statistically insignificant.

While this study did not support the statistically significant increase in student performance that other studies on intervention programs such as the JEMP, Elevate Math, or the Calculus Project have shown, the study did add to research regarding rising seventh grade students enrolled in an algebra course. Discussion on pre-algebra skills that can be areas of weakness for rising-seventh grade Algebra 1 occurred in this study. The participant group did show a slightly higher performance than the control group on both the Algebra 1 State Mandated Test and Quarter 1 and Quarter 2 grades.

While the results of the evaluation did not show that the higher achievement experienced by participants in the Pre-Algebra 1 Mini-Camp was statistically significant, the mean differences, evident in the effect size calculations, were promising. There was a large effect size for the difference which had a large practical significance. The four topics addressed throughout the camp were ones that the participants felt were beneficial and were areas that Algebra 1 Honors teachers had shared as being topics that previous students had struggled with regarding demonstrating understanding. While participants are meeting with success in their Algebra 1 Honors course at the time this data was collected, their performance is not considered statistically significant than their non-participant peers.

I became interested in this topic of research during my first year of teaching seventh grade Algebra 1 Honors students during the academic year of 2017-2018. The 2017-2018 school year was the second year of Harley School District pushing for a significantly increased enrollment of seventh-graders in Algebra 1 Honors. The school that I am employed at had more

than 30% of their seventh grade population enrolled in Algebra 1 Honors. During this first two years of implementation, some of the students in the Algebra 1 Honors courses had scored at the Achievement Level 2 and Achievement Level 3. These Achievement Levels would be considered that of a student who was performing at an average (Achievement Level 3) and below average level. Students were struggling, frustrated, and I watched as many lost their interest in and enthusiasm for mathematics. As previously shared, from my school the percentage of the students passing the Spring 2018 Florida Algebra 1 End of Course exam was 86% of a total of 161 students that took the exam (FDOE, 2018). Approximately 23 students did not show proficiency in algebraic concepts and skills according to the data. Yet, those 23 students were then enrolled in Geometry Honors the following year, and many would move on to Algebra II two years after their Algebra 1 Honors course. It would be interesting to do a follow up study to track those 23 students through their mathematic education and continue the study to follow them through their career choices. If a student has failed to meet or has just barely met proficiency with mastering algebraic concepts and skills, one would believe that would have a negative impact on their long-term success in mathematics.

It is my opinion as an educator who has taught seventh grade mathematics and Algebra 1 Honors courses, that the vast majority of seventh grade students are not ready or developmentally prepared for the rigor and dedication to individual practice that is needed to excel in algebra concepts and skills. Although the criteria for targeting seventh grade students who are eligible for enrollment in Algebra 1 Honors in the past two years at our school has moved to those rising seventh grade students that score at what is considered an above average Achievement Level 4 or an Achievement Level 5 on the Grade 6 Mathematics Florida Standards

Assessment, the seventh grade Algebra 1 Honors students continue to struggle in the course. Algebra 1 Honors is considered a high school course that seventh graders are being placed in forfeiting two additional years of fundamental mathematics instruction and practice compared to the ninth-grade student that enrolls in the same course. While my focus was on the seventh grade Algebra 1 Honors students, there has been substantially more research done on eighth graders placed in algebra courses. A look at the previous studies of middle graders enrolling in algebra courses nationwide shows that not all research supports early enrollment. Broad-based efforts to enroll a greater number of eighth grade students into algebra courses have no benefits to students in small or medium school districts and have negative effects on student achievement in large school districts (Domina, McEachin, Penner, & Penner, 2015). Liang, Heckman, and Abedi (2012) conducted a study and their analysis of collected data suggested that eighth grade courses other than Algebra 1 might provide students with a stronger foundation for greater success in mathematics due to the focus of the course's curriculum on algebra pre-requisite concepts and skills. If eighth grade students are not best served with early enrollment in algebra courses, seventh grade students being enrolled in those same courses would be at an even greater disadvantage.

As there is a push to enroll middle grade students in advanced or high school level courses it is a move away from the middle school philosophy. There were reasons that educational leaders went from the junior high school model to the middle school model. While other factors contributed to the decision to create the middle school model, the one related to the needs of the students was the middle school model would address the special learning needs of the students at this developmental stage in their maturation (George, Stevenson, Thomason, &

Boone, 1992). A unique and effective learning environment that supported middle grade students at a crucial stage in their development was one of the goals that drove the path of moving from junior high schools to the middle school model (Urdan, Midgley, & Wood, 1995). A view that middle grade students were not developmentally ready for the academic drive of the high school years was in part why middle schools came to be. Research was conducted for several years before, during, and after the nation's move to the middle school model. This research supported the developmental difference between the two groups of students. Previous research would support the theory that seventh grade students are not developmentally ready for the rigor of a high school course.

Limitations

One of the limitations of this study was the sample size of participants in the Pre-Algebra 1 Mini-Camp. While securing the 18 participants was a solid outcome resulting from only a six day turn around period, the smaller population may have hindered the amount or variety in the data collected and analyzed. An additional limitation was that many of the participants were the students that had a higher performance on the 6th Grade Mathematics Florida Standards Assessment. I was unable to establish if the lower performing rising seventh grade Algebra 1 Honors students would have demonstrated more statistically significant results had they participated in the Pre-Algebra 1 Mini-Camp.

The participants did well on the Pre-Assessment given on the first day of the Pre-Algebra 1 Mini-Camp. While this assessment was a better instrument than the one used in the pilot program the previous year, it was not a precise measure of their preparedness. Pre-Assessment

scores were high making it prohibitive for those participants to demonstrate academic growth on the post-assessment. Three of the participants scored slightly lower, missing one additional question, on the Post-Assessment. Overall, the participants did show growth on the Post-Assessment.

A possible limitation may have been the amount of time that participants had in the camp. Adding additional days to the camp could have created a difference in the results. This is not a limitation of the study, but a limitation of the intervention. A full academic year of mathematics cannot be offered in a 12-hour intervention program. Previous studies and research have examined other mathematics intervention programs. The previous researched studies were ones that were implemented for a greater length of time than the Pre-Algebra 1 Mini-Camp.

In reflection of the topics, activities, and standards covered in the Pre-Algebra 1 Mini-Camp the focus leaned more toward the conceptual learning over procedural learning. This could be viewed as a limitation of this study. As a mathematics teacher I want my students to understand the why of problem solving, in order to apply that knowledge to procedural tasks and operations. The Algebra 1 State Mandated Test (Algebra 1 SMT) is an assessment that is designed to evaluate procedural skills and may not have captured the conceptual learning that occurred during the Pre-Algebra 1 Mini-Camp. Scores achieved on the Algebra 1 SMT as well as final grades earned in Algebra 1 Honors may not be indicative or a valid measure of a student's understanding of algebra. A truer measure of success would be the student's future success in mathematic courses. One way this discrepancy could be addressed would be to follow the group of participants through the full academic year of Algebra 1 Honors. Geometry Honors will be the course that follows Algebra 1 Honors. Tracking the participants through this course

and what course they enroll in as freshmen the following year would be a source of long-term data.

Recommendation for Future Research

My original hypothesis of this study was the experimental group would outperform the control group. Although the results of this study did not meet my hypothesis the Pre-Algebra 1 Mini-Camp did offer the participants an engaging learning intervention opportunity. This is an area of study in education that could benefit from additional research. I would recommend a future study having a larger sample so there would be a greater power in the statistical results. Inviting all rising seventh grade students that may have the opportunity to enroll in Algebra 1 Honors would create a pool of participants at the end of the school year resulting in a longer period of notification for the students and their families. This could eliminate some of the conflicts in identified participants' schedules and the dates and time of the Pre-Algebra 1 Mini-Camp. In turn, the extended period of notification may also help families plan for their child to participate in the camp.

Extending the study to include the Florida Algebra 1 End of Course exam results might offer a greater opportunity to establish if there are statistically significant differences among the two groups. Students take the exam in late May, with the results typically being released the first week in July. Data from the participants' performance in Algebra 1 Honors for the entire academic school year, may have offered different results. An extension of the study that followed the high school and post-secondary academic path of the Pre-Algebra 1 Mini-Camp participants would add to research on the theory that early enrollment in advanced mathematics,

specifically algebra, is a gateway to greater academic and career choice success (Clotfelter, Ladd, & Vigdor, 2014).

In a study conducted by Rutgers and George Mason University professors Cleary and Kistantas (2017), the role that motivation plays in a middle school student's success in mathematics was evaluated. In their robust literature review, they established that self-efficacy was the primary mediator of motivation. The curriculum of the Algebra 1 Honors course requires twice as many Florida State Standards be covered than any of the other middle grades mathematics courses. Students must be able to pick up on concepts and skills quickly and have the dedication and self-discipline to practice these skills outside of the classroom period to be successful in Algebra 1 Honors. In addition to these factors, one must not lose sight of the fact that the concepts in algebra are more abstract than those taught in a seventh or eighth grade mathematics course. While the seventh-grade Algebra 1 Honors are the top performing students in their class, and have previously excelled in mathematics courses, they often do not comprehend that this course will be more challenging than they are accustomed to and may require more of their time than previous courses. It is not an uncommon occurrence for the seventh grade Algebra 1 Honors student to tell me that they are too busy to work on homework assignments, or that their life and schedule is too full to work on school-work outside of school. It is difficult for the seventh grade Algebra 1 Honors student to struggle or not meet with success as they have been the student that has excelled in all their previous courses with far less effort that being successful in Algebra 1 Honors requires. Not meeting with success can have a negative impact on their self-efficacy and this can be a deterrent to their success in future mathematics courses (Falco, 2019). The struggling seventh grade Algebra 1 Honors student can

become very disillusioned with the course as they are uncomfortable not being successful and they are not familiar with such a significant amount of productive struggle as they may endure throughout this course. The issue of maturity and/or motivation may be a confounding variable that could be addressed in future research.

It is worth noting again, that the most compelling recommendation for future research I could make after completing this study is that the seventh grade Algebra 1 Honors student be tracked for the next several years. These students will need to take three additional mathematic courses after Algebra 1 Honors, with Geometry Honors as an eighth-grader being one of those three. Tracking the students through their high school years would allow a researcher to establish if the students stopped at enrolling in the minimum two additional mathematic courses in high school, what mathematic courses they did proceed to take. Establishing if they continued to pursue those higher level mathematic courses could address the original goal and/or reasoning of the educator leaders that pushed for earlier enrollment of seventh grade students into Algebra 1 Honors. Extending the study to track the students following high school graduation would be a recommendation that would be useful in establishing long-term outcomes resulting from this push for the earlier enrollment in advanced high school level mathematic courses.

Recommendation for Practice

Enrollment of seventh graders into an Algebra 1 Honors course appears to be a practice that will continue at the district, state, and national level. There continues to be a gap between the increase in seventh grade student enrollment and an increase in percentage of these students demonstrating mastery of algebraic concepts and skills. This study examined the effectiveness

of a summer intervention program that might help to bridge that gap. A few areas of recommendations could assist with future studies regarding this gap.

In the Harley School District one of the factors that is considered when placing a rising seventh grader into Algebra 1 Honors is the upcoming academic year course recommendation of the sixth grade mathematics courses teachers. The certification requirements for a sixth grade mathematics teacher in Florida is an Elementary Education (grades K-6) certificate or a Middle Grades Mathematics (grades 5-9). Many sixth grade mathematics teachers hold the Elementary Education (grades K-6) certificate, as is the case of all sixth grade mathematics teachers at the middle school used in this study. Often these teachers have not been exposed to algebra since their college or own high school experience. While these sixth grade mathematics teachers are excellent educators, I find myself wondering if an elementary teacher would have a deep understanding and appreciation of what is necessary to be successful in Algebra 1 Honors.

The second source that is used as a deciding factor in the enrollment of a rising seventh grader in Algebra1 Honors is their Achievement Level on the Grade 6 Mathematics Florida Standards Assessment. This is an assessment that was designed to measure a student's educational gains in sixth grade mathematics. It was not an instrument that was created to evaluate the likelihood of a student's readiness for or the probability of the student's success in an algebra course. The predictive validity of the Grade 6 Mathematics Florida Standards Assessment is questionable (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (2014). Adding a separate assessment or survey that addresses a rising seventh grader's ability to work with

abstract concepts and persevere with problems and concepts inside and outside of the classroom may be beneficial for the success of all students.

A longer period of time to hold the Pre-Algebra 1 Mini-Camp could be more beneficial for the students. As previously stated, it is impossible to compress an academic year of mathematics curriculum in 12-hour time-span. The research shared in the studies related the JEMP, Elevate Math, and the Calculus Project addressed the length of this programs, and each took place over a longer period than the Pre-Algebra 1 Mini-Camp did.

An additional recommendation I would make is to implement an alternative instrument to be used as a pre- and post-assessment instrument during the camp. The instrument used in this study did not offer the opportunity to assess a range of abilities. Administering a test that could determine a wider range of abilities and skills would offer greater insight into the effectiveness of the intervention. This type of assessment would also be beneficial in pin pointing concepts and skills that need to be instructional targets.

Summary

It is my belief that most effective educational leaders and teachers strive to do what is best for students. As we continue to work toward raising the academic achievement of our students, we should evaluate the outcomes of implemented programs and practices along the way. Increasing the percentage of middle grade students who are being enrolled in advanced courses has worked for some students, but it has not worked for all. Evaluating the effects and outcomes of increasing seventh grade student enrollment in Algebra 1 Honors is an area of study that should continue. The purpose of this study was to evaluate the effectiveness of an

intervention designed to support Algebra 1 Honors students who forfeit a seventh grade mathematics course due to earlier Algebra 1 Honors enrollment, compared to a matched sample of students from the same school district who did not participate in the Pre-Algebra 1 Mini-Camp. Results of this study were promising, but additional areas of study related to seventh grade Algebra 1 Honors students and the findings of those studies would offer deeper insight in this topic of study. Findings could help to establish resulting methods that support an even greater percentage of students meeting with success in the Algebra 1 Honors course and those mathematics courses that follow.

APPENDIX A: GRADE 6 MATHEMATICS PACING GUIDE

Grade 6 Mathematics Pacing Guide

Days	Date	Topic	Assessments (window)
5	Aug. 12 – Aug. 16	Building a Community within the Math Classroom	**SMT 1**
19	Aug. 19 - Sept. 13	Focus 1 : Division	**DIA 1 (Oct. 4 – Oct. 18)**
9	Sept. 17 – Sept. 27	Focus 2 : Operations with Decimals	
10	Sept. 30 - Oct. 11	Focus 3 : Integers and Rational Numbers (Part I)	
TDD October 14		**End of 1st Grading Period**	
19	Oct. 15 – Nov. 8	Focus 4 : Ratios and Rates	**DIA 2 (Nov. 1 – Nov. 15)**
19	Nov. 12 – Dec. 13	Focus 5 : Data Analysis	**DIA 3 (Dec. 5 – Dec. 19)**
3	Dec. 16 – Dec. 18	Review / SMT 2 Administration	**SMT 2**
TDD December 19		**End of 2nd Grading Period – Winter Break**	
19	Jan. 6 – Jan. 31	Focus 6 : Expressions	**DIA 4 (Feb. 21 – Mar. 6)**
19	Feb. 3 – Feb. 28	Focus 7 : Equations and Inequalities	
9	Mar. 2 – Mar. 12	Focus 8 : Integers and Rational Numbers (Part II)	**DIA 5 (Apr. 10 – Apr. 24)**
TDD March 13		**End of 3rd Grading Period – Spring Break**	
20	Mar. 23 - Apr. 17	Focus 9 : Relationships in Geometry	
29	Apr. 20 – May 1	**FSA Review**	
	May 4 – May 29	**FSA Administration Window**	
		7th Grade Jumpstart Operations with Integers & Simplifying Algebraic Expressions	
May 29		**End of 4th Grading Period – Last Day for Students**	

APPENDIX B: GRADE 6 MATHEMATICS ADVANCED PACING GUIDE

Grade 6 Mathematics Advanced Pacing Guide

Days	Date	Topic	Assessments (window)
5	Aug. 12 – Aug. 16	Building a Community within the Math Classroom	**SMT 1**
14	Aug. 19 - Sept. 6	Focus 1 : Dividing Fractions	**DIA 1** (Sept. 17 – Oct. 1)
11	Sept. 9 – Sept. 24	Focus 2 : Operations with Decimals	
13	Sept. 25 - Oct. 11	Focus 3 : Ratios and Rates	**DIA 2** (Oct.11 – Oct. 25)
TDD October 14		**End of 1st Grading Period**	
4	Oct. 15 – Oct. 18	Focus 3 : Ratios and Rates (continued)	
24	Oct. 21 – Nov. 22	Focus 4 : Data Analysis	**DIA 3** (Nov. 15 – Dec. 6)
10	Dec. 2 – Dec. 13	Focus 5 : Integers and Rational Numbers	
3	Dec. 16 – Dec. 18	Review / SMT 2 Administration	**SMT 2**
TDD December 19		**End of 2nd Grading Period – Winter Break**	
5	Jan. 6 – Jan. 10	Focus 5 : Integers and Rational Numbers (continued)	**DIA 4** (Jan. 28 – Feb. 11)
16	Jan. 13 – Feb. 4	Focus 6 : Relationships in Geometry	
26	Feb. 5 – Mar. 12	Focus 7 : Expressions, Equations and Inequalities Part 1	**DIA 5** (Mar. 2 – Mar. 27)
TDD March 13		**End of 3rd Grading Period – Spring Break**	
20	Mar. 23 – Apr. 17	Focus 8 : Operations of Integers and Rational Numbers	
7	Apr. 20 - Apr. 28	Focus 9 : Expressions, Equations and Inequalities Part 2	
22	Apr. 29 – May 1	**FSA Review**	
	May 4 – May 29	**FSA Administration Window**	
		Focus 10: Proportional Relationships	
May 29		**End of 4th Grading Period – Last Day for Students**	

APPENDIX C: GRADE 6 HONORS MATHEMATICS PACING GUIDE

Grade 6 Honors Mathematics Pacing Guide

Days	Date	Topic	Assessments (window)
5	Aug. 12 – Aug. 16	Building a Community within the Math Classroom	**SMT 1**
10	Aug. 19 - Aug. 30	Focus 1 : Number Sense	**DIA 1** (Sept. 24 – Oct. 8)
20	Sept. 2 – Oct. 1	Focus 2 : Proportionality, Ratios and Rates	
8	Sept. 30 - Oct. 11	Focus 3 : Understanding and Operations of Rational Numbers	
TDD October 14		**End of 1st Grading Period**	
9	Oct. 15 – Oct. 25	Focus 3 : Understanding and Operations of Rational Numbers (continued)	**DIA 2** (Oct. 18 – Nov. 1)
29	Oct. 28 – Dec. 13	Focus 4 : Expressions, Equations and Inequalities	**DIA 3** (Dec. 5 – Dec. 19)
3	Dec. 16 – Dec. 18	Review / SMT 2 Administration	**SMT 2**
TDD December 19		**End of 2nd Grading Period – Winter Break**	
14	Jan. 6 – Jan. 24	Focus 5 : Geometry Part 1	**DIA 4** (Jan.17 – Jan. 31)
15	Jan. 27 – Feb. 14	Focus 6 : Statistics Part 1	**DIA 5** (Feb. 7 – Feb. 21)
18	Mar. 2 – Mar. 12	Focus 7 : Statistics Part 2	
TDD March 13		**End of 3rd Grading Period – Spring Break**	
15	Mar. 23 - Apr.10	Focus 8 : Functions	
15	Apr. 13 – May 1	**FSA Review**	
19	May 4 – May 29	**FSA Administration Window**	
		Focus 9: Geometry Part 2	
May 29		**End of 4th Grading Period – Last Day for Students**	

APPENDIX D: GRADE 7 MATHEMATICS PACING GUIDE

Grade 7 Mathematics Pacing Guide

Days	Date	Topic	Assessments (window)
5	Aug. 12 – Aug. 16	Building a Community within the Math Classroom	**SMT 1**
23	Aug. 19 - Sept. 20	Focus 1 : The Number System	**DIA 1** (Sept.13 – Sept.23)
15	Sept. 23 – Oct. 11	Focus 2 : Expressions, Equations and Inequalities	
TDD October 14		**End of 1st Grading Period**	
19	Oct. 15 – Nov. 8	Focus 2 : Expressions, Equations and Inequalities(continued)	**DIA 2** (Nov. 1 – Nov. 15)
19	Nov. 12 – Dec. 13	Focus 3 : Ratios and Proportional Relationships	
3	Dec. 16 – Dec. 18	Review / SMT 2 Administration	**SMT 2**
TDD December 19		**End of 2nd Grading Period – Winter Break**	
24	Jan. 6 – Feb. 7	Focus 3 : Ratios and Proportional Relationships(continued)	
23	Feb. 10 – Mar. 12	Focus 4 : Geometry	**DIA 3** (Mar. 2 – Mar. 27)
TDD March 13		**End of 3rd Grading Period – Spring Break**	
10	Mar. 23 – Apr. 3	Focus 4 : Geometry(continued)	
15	Apr. 6 – Apr. 24	Focus 5 : Statistics and Probability	
24	Apr. 27 – Apr. 30	**FSA Review**	
	May 1 – May 29	**FSA Administration Window**	
		Pre-Algebra Jumpstart Introduction to Functions	
May 29		**End of 4th Grading Period – Last Day for Students**	

APPENDIX E: GRADE 7 MATHEMATICS ADVANCED PACING GUIDE

Grade 7 Mathematics Advanced Pacing Guide

Days	Date	Topic		Assessments (window)
5	Aug. 12 – Aug. 16	Building a Community within the Math Classroom		**SMT 1**
8	Aug. 19 - Aug. 28	Integer Review (7.NS.1.1; 7.NS.1.2; 7.NS.1.3 - Grade 7 Focus 1)		**DIA 1** (Sept. 20 – Oct. 4)
20	Aug. 29 - Sept. 27	Focus 1 : Expressions, Equations and Inequalities		
10	Sept. 30 – Oct. 11	Focus 2 : Real Numbers		
TDD October 14		**End of 1st Grading Period**		
14	Oct. 15 – Nov. 1	Focus 3 : Ratio, Proportion and Percent (7.RP.1.1; 7.RP.1.2; 7.RP.1.3)		**DIA 2** (Oct. 25 – Nov. 8)
12	Nov. 4 – Nov. 20	Focus 4 : Probability		**DIA 3** (Dec. 5 – Dec. 19)
12	Nov. 21 – Dec. 13	Focus 5 : Statistics		
3	Dec. 16 – Dec. 18	Review / SMT 2 Administration		**SMT 2**
TDD December 19		**End of 2nd Grading Period – Winter Break**		
10	Jan. 6 – Jan. 17	Focus 6 : Angles		**DIA 4** (Jan. 10 – Jan. 24)
9	Jan. 21 – Jan. 31	Focus 7 : Pythagorean Theorem		
28	Feb. 3 – Mar. 12	Focus 8 : Geometry		**DIA 5** (Mar. 2 – Mar. 27)
TDD March 13		**End of 3rd Grading Period – Spring Break**		
15	Mar. 23 – Apr. 10	Focus 9 : Functions		
14	Apr. 13 – Apr. 30	**FSA Review**		
20	May 1 – May 29	**FSA Administration Window**	Focus 10: Scientific Notation	
			Focus 11: Transformations	
May 29		**End of 4th Grading Period – Last Day for Students**		

KEY: Additional 7th Grade assessed standards that are NOT included in 7th Grade Advanced Course Description

APPENDIX F: GRADE 8 PRE-ALGEBRA PACING GUIDE

Grade 8 Pre-Algebra Pacing Guide

Days	Date	Topic	Assessments (window)
5	Aug. 12 – Aug. 16	Building a Community within the Math Classroom	**SMT 1**
10	Aug. 19 - Aug. 30	Focus 1 : Rational and Irrational Numbers	**DIA 1** (Sept. 24 – Oct. 8)
9	Sept. 3 – Sept. 13	Focus 2 : Properties of Exponents	
11	Sept. 17 – Oct 1	Focus 3 : Scientific Notation	
8	Oct 2 – Oct 11	Focus 4 : Solving Multi-step Equations	
TDD October 14		**End of 1st Grading Period**	
7	Oct. 15 – Oct. 23	Focus 4 : Solving Multi-step Equations (continued)	**DIA 2** (Oct. 29 – Nov. 12)
9	Oct. 24 – Nov. 5	Focus 5 : Pythagorean Theorem	
9	Nov. 6 – Nov. 22	Focus 6 : Transformations	**DIA 3** (Dec. 5 – Dec. 19)
12	Dec. 2 – Dec 13	Focus 7 : Angle-Pair Relationships	
3	Dec. 16 – Dec. 18	Review / SMT 2 Administration	**SMT 2**
TDD December 19		**End of 2nd Grading Period – Winter Break**	
14	Jan. 6 – Jan. 24	Focus 8 : Introduction to Functions	**DIA 4** (Mar. 2 – Mar. 27)
19	Jan. 27 – Feb. 21	Focus 9 : Applications of Functions	
14	Feb. 24 – Mar. 12	Focus 10 : Systems of Equations	
TDD March 13		**End of 3rd Grading Period – Spring Break**	
13	Mar. 23 – Apr. 8	Focus 11 : Statistics	**DIA 5** (Apr. 1 – Apr. 15)
		Focus 12 : Frequency Tables	
10	Apr. 9 – Apr. 22	Focus 13 : Volume	**DIA 6** (Apr.15 – Apr. 29)
6	Apr. 23 – Apr. 30	**FSA Review**	
20	May 1 – May 29	**FSA Administration Window**	
		Focus 14: Jumpstart to Algebra	
May 29		**End of 4th Grading Period – Last Day for Students**	

APPENDIX G: ALGEBRA 1/ALGEBRA HONORS PACING GUIDE 1ST SEMESTER

Algebra 1 / Algebra 1 Honors Pacing Guide 1st Semester

Days	Date	Topic	Math Nation	McGraw Hill
5	Aug 12 – Aug 16	Prerequisites and Prior Knowledge / **SMT 1**	*6.EE.1.3, 6.EE.2.7, 8.EE.3.7*	Lesson 1-4 and 1-5 Lesson 2-2 and 2-3
5	Aug 19 – Aug 23	UNIT 1: Basics of Expressions and Equations	Section 1, Topics 1-4	Lesson 1-3 Lesson 2-1
14	Aug 26 – Sep 13	UNIT 2: Solving Equations & Inequalities	Section 2	Lesson 1-1 Lesson 2-4 and 2-8 Lesson 5-1, 5-2, 5-3, 5-4
		DIA 1 – Units 1 and 2 (9/9 - 9/20)		
14	Sept 17 – Oct 4	UNIT 3: Introduction to Functions	Section 3, Topics 1-2 Section 3, Topics 7-10 Section 8, Topic 10-13	Lesson 1-6 thru 1-8
		DIA 2 – Unit 3 (10/7 - 10/18)		
5	Oct 7 – Oct 11	UNIT 4: Linear Equations, Functions, and Inequalities	Section 4, Topics 1-4	Lesson 3-1, 3-5, 3-6 Lesson 4-5 Lesson 5-6 Lesson 7-8
		TDD October 14 End of 1st Grading Period		
5	Oct 15 – Oct 21	UNIT 4: Linear Equations, Functions, and Inequalities (continued)	Section 4, Topics 1-4	Lesson 3-1, 3-5, 3-6 Lesson 4-5 Lesson 5-6 Lesson 7-8
9	Oct 22 – Nov 1	UNIT 5: Systems of Linear Equations and Inequalities	Section 4, Topics 5-10	Lesson 6-1 thru 6-6
		DIA 3 – Unit 4 and 5 (10/28 – 11/8)		
24	Nov 4 – Dec 13	UNIT 6: Exponential and Radical Functions	Section 1, Topic 5-9 Section 7	Lesson 7-1 thru 7-3 Lesson 7-5 thru 7-8 Lesson 10-1
3	Dec 16 – Dec 18	***Review/SMT 2***		
		TDD December 19 End of 2nd Grading Period – Winter Break		

APPENDIX H: ALGEBRA 1/ALGEBRA 1 HONORS PACING GUIDE 2ND SEMESTER

Algebra 1 / Algebra 1 Honors Pacing Guide 2nd Semester

Days	Date	Topic	Math Nation	McGraw Hill
8	Jan 6 – Jan 15	UNIT 6: Exponential and Radical Functions (continued)	Section 1, Topics 5-9 Section 7	Lesson 7-1 thru 7-3 Lesson 7-5 thru 7-8 Lesson 10-1
DIA 4 – Unit 6(1/8 - 1/24)				
11	Jan 16 – Jan 31	UNIT 7: Polynomial Functions	Section 3, Topics 3-6	Lesson 8-1 thru 8-4
19	Feb 3 – Feb 28	UNIT 8: Quadratic Equations and Functions Part I	Section 5	Lesson 8-5 thru 8-9 Lesson 9-1 thru 9-6
9	Mar 2 – Mar 13	UNIT 9: Quadratic Equations and Functions Part II	Section 6	
DIA 5 – Units 7, 8 and 9 (3/9 - 3/27)				
TDD March 13		**End of 3rd Grading Period - Spring Break**		
10	Mar 23 – Apr 3	UNIT 10: Summary of Functions and Additional Functions	Section 8, Topics 1-4, 6-9, 14, 5	Lesson 9-7 Lesson 10-1
15	Apr 6 – Apr 24	UNIT 11: Statistics	Sections 9 and 10	Lesson 12-3 and 12-4
Optional DIA 6 – Unit 11 (4/27 – 5/8)				
24	Apr 27 – May 29	**Review and FSA Administration**		
		Geometry Jumpstart		
	May 29	**End of 4th Quarter Period – Last Day for Students**		

APPENDIX I: PRE/POST ASSESSMENT

Pre/Post-Assessment
Name_____

1. What does 2^3 equal?
   A) 5
   B) 6
   C) 8
   D) 9

2. 12 – 5(2) =?
   A) 2
   B) 10
   C) 14
   D) 22

3. Four notebooks cost $5.60. Antonio needs 5 notebooks. How much will 5 notebooks cost?
   A) $4.48
   B) $6.60
   C) $7.00
   D) $8.40

4. Tasha has $33.00. The music store has a sale on CDs and cassettes. CDs are $8.00 and cassettes are $5.00. Which of the following could she buy with the money she has?
   A) 2 CDs and 4 cassettes
   B) 3 CDs and 1 cassette
   C) 1 CD and 6 cassettes
   D) 2 CDs and 5 cassettes

5. The 6:00 a.m. temperature was -15°F. The noon temperature was 3°F. How many degrees difference was there between the two temperatures?
   A) -12
   B) 12
   C) -18
   D) 18

APPENDIX J: PRE/POST ASSESSMENT

6. A sandwich shop made a 12-foot-long sandwich and is going to cut it into pieces that are each $\frac{1}{2}$ -foot long. How many pieces will there be?
   A) 6
   B) 10
   C) 20
   D) 24

7. Thad can ride his bike 120 miles in 6 hours. At the same rate, how many hours would it take him to ride his bike 140 miles?
   A) $6\frac{1}{7}$
   B) 7
   C) $7\frac{1}{2}$
   D) 8

8. Brent bought 4 packages of pencils last school year. Each package contained 6 pencils. If he broke x pencils from the first package and y pencils from the second package, how many pencils does he have left?
   A) $4(6) - x - y$
   B) $4(6) + x - y$
   C) $4(6) - x + y$
   D) $4(6) + x + y$

9. There are x students in Mr. Walker's geometry class. If there are y male students in class, how many of his students are female?
   A) $y + x$
   B) $x - y$
   C) $y - x$
   D) $\frac{x}{y}$

10. Sandy sold m magazine subscriptions this year. Last year, she sold 14 fewer subscriptions. How many subscriptions did she sell last year?
   A) $\frac{m}{14}$
   B) $14 - m$
   C) $m + 14$
   D) $m - 14$

APPENDIX K: PRE/POST ASSESSMENT

11. Ms. Choi bought x equally priced movie tickets. The total cost was $32. How much did each ticket cost?
    A) 32 - x
    B) $x + 32$
    C) $32 \div x$
    D) $x - 32$

12. If $5 + 4 = 17 - x$, then what is the value of x?
    A) 8
    B) 9
    C) 17
    D) 26

13. If $y = -4$, then $3y =$?
    A) -34
    B) -12
    C) -7
    D) -1

14. $3(3x - 2y) =$?
    A) $3x$
    B) $6x - 5y$
    C) $9x - 2y$
    D) $9x - 6y$

15. $X = Y + Z$
    If Y is made one greater and Z is made one less, what must happen to X?
    A) X remains the same.
    B) X becomes greater.
    C) X becomes less.
    D) Not enough information is given.

16. $Z = XY$
    If Y is made greater and X is made greater, what must happen to Z?
    A) Z remains the same.
    B) Z becomes greater.
    C) Z becomes less.
    D) Not enough information given.

APPENDIX L: PRE-ALGEBRA 1 MINI-CAMP PARTICIPANT COMMENTS

- I liked group work.
- This was a refresher, and I learned new things.
- I liked the little “brain breaks”.
- I disliked the balance beam for expressions.
- I felt like the camp helped me because some of the stuff I forgot, and I learned new stuff that will give me a jump-start to next year.
- What I liked about this class was the progressing in knowledge.
- I am glad I did this camp because it revised the little things I had forgotten. It reminded me which ones were less than, more than, etc. I think you should do this camp for 5^{th} graders before they go into sixth and teach them some parts of the sixth grade standards.
- I learned how to cube numbers and now I know what the symbol is for cubing and squaring numbers.
- I think that the camp was really fun. I like how it was only four days. Also, I appreciated getting breaks to go on our phones. The only thing I would change is if it could start later and last for only two hours. Other than that, I really liked getting a review on math.
- I like that we went over square roots because in 6^{th} grade we did not do square roots.
- I think the camp really helped me and just want to say thank you and you helped me be a better student for algebra.

APPENDIX M: PRE-ALGEBRA 1 MINI-CAMP PARTICIPANT COMMENTS

- Cool teacher. Cool class
- Class was too early.
- I liked this camp because we are all going into algebra next year and this is a little heads up for all the students. We should have more hands-on activities because in my personal opinion I learn better when it's hands on.
- The best part about the camp was that I learned more about mathematics than before.
- At the start of the camp a few questions on this quiz were confusing, but I mostly understood everything on the test.
- This is the best camp ever!
- The camp was chill. I liked the review.
- Camp was better than I expected it to be and I remembered a lot.
- I feel like the camp was very informational and really helped me with my understanding on very many 7^{th} grade mathematics skills. Ms. Haught was very helpful to me by making sure I did not stop until I knew exactly what I was doing so thank you and have a great rest of your summer.

APPENDIX N: IRB HUMAN SUBJECTS PERMISSION LETTER

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

APPROVAL

May 30, 2019

Dear Deanna Haught:

On 5/30/2019, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title:	Evaluating the Effectiveness of a Pre-Algebra 1 Mini-Camp Summer Intervention Program for Rising Seventh-Grade Algebra 1 Students
Investigator:	Deanna Haught
IRB ID:	STUDY00000524
Funding:	None
Grant ID:	None
IND, IDE, or HDE:	None
Documents Reviewed:	• Child Assent Form, Category: Consent Form; • Parent Letter for Mini-Camp, Category: Consent Form; • HRP-502, Category: IRB Protocol; • HRP-502, Category: Consent Form; • Faculty Advisor Review Form, Category: Faculty Research Approval; • Mini-Camp Assessment, Category: Other;

The IRB approved the protocol on 5/30/2019.

In conducting this protocol, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Racine Jacques, Ph.D.
Designated Reviewer

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