

Effects of Targeted, Small Group Instruction on Math Achievement

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## Abstract

The purpose of this study was to determine whether targeted, small group instruction would have an impact on mathematics achievement for Algebra I students. An assessment using released Partnership for Assessment of Readiness for College and Careers (known as the PARCC test) items was used as the measurement tool. The study took place in a high school in southeastern Baltimore County. There were three groups of five students pulled out of three different Algebra I classes. Data was collected for this study using a pretest/posttest design. A pretest was given in December 2018. The intervention took place for three months, occurring once a week for 30 minutes during Algebra I class times. At the end of the intervention, a posttest was administered to the participants. There was no significant growth from the pretest scores to the posttest scores.

## **CHAPTER I**

### **INTRODUCTION**

Success in mathematics in high school is fundamental to future success in mathematics in many careers and everyday adult life. When students arrive in high school, their love or hatred of mathematics has already taken shape. Many students who have struggled in mathematics in middle school are now faced with even more struggles when they reach their first high school mathematics class. Students are often faced with more extended class periods, which can make it more difficult to stay attentive. Students are also faced with their first graduation requirement, scoring at or above proficient level on the state-mandated Algebra I state test. Failure to successfully pass both the course and the test results in the student not being able to graduate with a state diploma. Therefore, teachers and schools are tasked with finding ways to support students in their endeavor to pass algebra and the associated state test.

For most students, high school can be overwhelming, and mathematics class becomes a source of anxiety, fear, and dread, especially if they have struggled in math in middle school. Regardless of their performance in eighth-grade math, students are automatically placed in Algebra I, and this can lead to a skill deficit starting off their high school math career. Therefore, it is imperative for schools and teachers to have structures and programs in place to address these skill deficits before assessments and promotion to higher-level courses. Research and best teaching practices have suggested that meeting students at their skill level prepares them to be active participants in their learning and more effective learners. Research has also suggested that targeted, pull-out instruction in a small group setting can increase students' opportunity to reach their fullest potential, thus making a small group a viable option for remediation and intervention aimed at helping students succeed in their math courses and on state assessments.

## **Statement of Problem**

The purpose of this study is to examine the effectiveness of targeted, small group instruction on ninth-grade Algebra I students. More specifically, the study will look at the impact of targeted, small group instruction on increasing students' level of mathematics achievement as measured by the Partnership for Assessment of Readiness for College and Careers (known as the PARCC test).

## **Hypothesis**

**Null Hypothesis:** The targeted, small group instruction will not affect mathematics achievement.

**Alternative Hypothesis:** The targeted, small group instruction will affect mathematics achievement.

## **Operational Definitions**

The independent variable is targeted small group instruction with a highly trained resource teacher who also serves as the mathematics department chair. The dependent variable is the change in math PARCC scores. The change in PARCC scores will operationally be defined by using a pre and posttest that was created by using released PARCC problems. Targeted small group instruction will be operationally defined as small group instruction with no more than five students where an additional outside of the classroom resource teacher such as a department chair will work more closely with each student on a specific learning objective to reinforce skills learned in the whole group instruction, and check for student understanding.

## **CHAPTER II**

### **REVIEW OF THE LITERATURE**

According to Platas (2012), “Children with persistent problems attaining math skills are less likely to graduate from high school or go to college, and that math achievement in adolescents predicts labor market success” (p. 1). Success in mathematics in high school is fundamental and can be used as a reliable predictor of college graduation rates, postsecondary degrees, and career earnings. Section one of this literature review will discuss the importance of mathematics achievement. Section two will take up the issue of mathematics achievement in high school, including the Partnership for Assessment of Readiness for College and Careers (known as the PARCC test), and section three will examine interventions for improving math achievement.

#### **Importance of Mathematics Achievement**

Mathematics achievement is primarily based upon obtaining a satisfactory score on a standardized test, whether this is on a high school test or a college entrance exam. Dejarnette (2012) used state assessment comparison as a measurement of satisfactory math achievement. In a 2007 study on the role math plays in childhood development, Duncan et al. concluded that elementary math skills are more important than any other subject in predicting a child’s long-term success. Duncan et al. (2007) found that kindergarten math scores are a better predictor of third-grade math and reading scores than a child's kindergarten reading scores. He found that as well as being the most accurate predictor of a child's long-term success, math best prepares and develops a child's mind to accept, analyze, and execute complex ideas. Duncan et al. also stated that compared to literacy and social-emotional skills, that early math concepts were the most powerful predictors of later learning.



Adelman (1999) concluded that "the highest level of mathematics reached in high school continues to be a key marker in precollegiate momentum, with the tipping point of momentum toward a bachelor's degree now firmly above Algebra 2" (p. 3). The study concluded that there is a correlation: the level that a student studies in mathematics in high school has the most substantial continuing influence on bachelor's degree completion. Finishing a course beyond the level of Algebra II, such as trigonometry or pre-calculus, more than doubles the odds that a student who enters postsecondary education will complete a bachelor's degree.

“The Forgotten Middle” (ACT, 2008) reveals eighth grade as the grade that most accurately predicts a child’s success in college and beyond. Students who have received a relevant math education and training by eighth grade have a higher likelihood of going to college. Also, that child will likely be more successful in high school, college, and careers beyond. Research has shown that for women, eighth-grade math test scores positively influenced math course taking in high school, and these scores and classes positively influence later choices of science and math majors (Trusty, 2002). Many ninth-grade students do understand the connection between the success in mathematics for which algebra is the foundation and the career possibilities it opens for the student.

### **Mathematics Achievement**

Hein and Smerdon (2013) state that future success can be determined by whether students were meeting or exceeding set benchmark scores in state and national assessments. A connection exists between future success and specific course pathways such as Advanced Placement classes, and gifted and talented classes. The completion of Algebra I in eighth grade and then Algebra II in ninth grade is “inversely correlated with the need for remediation” (Hein & Smerdon, 2013, p. 7) at the postsecondary level.

Students who participate in dual enrollment or score a three or higher on Advanced Placement (AP) final exams or a four or higher on the International Baccalaureate (IB) final exam in any AP or IB course experience a positive correlation with enrollment in college and persistence rates in the first two years of a degree or certificate-seeking (Hein & Smerdon, 2013). Research conducted by SAT and ACT creators indicate that scores on college entry exams positively correlate with college- and career-readiness outcomes, such as enrollment in a two- or four-year degree program and completion of credit-bearing, entry-level courses without remediation (ACT, 2008).

### **PARCC**

In Maryland, the Partnership for Assessment of Readiness for College and Careers (the PARCC test) is used currently in high school to determine mathematics achievement. The PARCC tests the common core standards, which are the foundation of the assessments. Common core is a set of educational standards for teaching and testing English and mathematics between kindergarten and 12th grade. Common core outlines the skills and knowledge that public-school students should acquire in each grade. The assessments measure whether students are on track to be successful in college and careers. Doorey and Polukoff (2016), who independently evaluated the PARCC assessment in mathematics, state that “PARCC receives a Good Match to the CCSSO Criteria relative to assessing whether students are on track to meet college and career readiness standards” (p. 69). The PARCC test included items with a range of cognitive demand and was aligned with the curriculum in each grade based on Common Core standards (Doorey & Polukoff, 2016).

Phillips (2016) compared several nationally used achievement tests such as the National Assessment of Educational Progress (NAEP) and the Smarter Balanced Assessment System. Phillips concluded that the PARCC test had significantly higher standards than the Smarter

Balance Assessment. The Partnership for Assessment of Readiness for College and Careers college-ready standards are comparable in difficulty to the National Assessment of Educational Progress, NAEP, Basic level for English language arts and comparable to NAEP Proficient in mathematics (Phillips, 2016).

The PARCC test requires the use of problem-solving skills throughout the mathematics sections. The PARCC assessments use multiple representations of context such as word problems, equations, tables, and graphs. The PARCC assessments have questions that require students to think critically and apply knowledge rather than memorize facts. The PARCC breaks down the questions across the common core standards, which allows teachers to identify students' strengths and weaknesses of the students. The PARCC test has questions that require higher cognitive demand and relies less on multiple-choice to create a more diverse level of difficulty from question to question (Phillips, 2016).

### **Interventions**

Boaler (2009) stated that research has shown that every child can achieve at the highest levels in math at school if they are given the opportunities. Haycock (2001) states that there is ample evidence to show that almost all students can achieve at high levels if they are taught at high levels, but that some students require more time and more instruction. Haycock cites examples of how school systems have used programs offered before school, after school, weekends, and summers to provide additional support for students. Other schools have doubled or tripled the amount of time during the day devoted to literacy and mathematics instruction for low-performing students and trained all teachers in using supportive instructional techniques. These interventions have shown to be effective at increasing academic achievement in math.

While none of the students in the study were at-risk English as a second language (ESL) students, Nelson's (2005) research suggests that increased learning time and targeted instruction

will likely help improve content knowledge and increase content fluency. The small group setting, such as six or fewer students, will allow for more individualized and customizable instruction. Research shows that students show more significant achievement when the learning is customized for their skill level or interest. Rowan-Kenyon, Swan, and Creager (2012), stated that students thrive in math in a small group environment. Also, students find math more rewarding when working in small groups. Students are engaged learners in small groups, and that small groups are a crucial way to discover skills that students have mastered or not. Students also build better communication skills and self-confidence when working in small groups (Fry, Ketteridge, & Marshall, 2009).

Special education students who are placed in a general education classroom with additional supports to help them thrive in the classroom are in an inclusion classroom versus when they are pulled out of the classroom environment to be given additional supports in a resource room. Research suggests that students who are in an inclusive classroom and receive additional support show more academic success than those who are placed in a resource room setting (Bottge, Cohen, & Choi, 2018). Wasik (2008) suggested that keeping small groups to five or fewer students increases the chances of successful intervention or remediation additionally, that it is more effective to teach content to a small group than whole group instruction.

### **Summary**

In conclusion, four concepts have been identified in this literature review regarding attaining satisfactory mathematics achievement. First, the importance of mathematics achievement throughout primary schooling up to high school was discussed. Second, the various way that achievement in mathematics is obtained. Third, the review took up the issue of the PARCC test as compared to other nationally recognized tests. Lastly, several interventions for

improving math achievement were examined. The following chapters of this study will examine the impact of small group instruction on ninth-grade Algebra I students.

## **CHAPTER III**

### **METHODS**

#### **Design**

This study examines the impact of participation in a targeted, small group instruction intervention on Algebra I students' achievement on the practice state assessment test. The study used a quasi-experimental design with a pretest/posttest assessment strategy. The students were assessed by the pretest and posttest to measure the impact of the targeted, small group intervention. Some students received traditional, whole group instruction while others received targeted, small group instruction on a PARCC tested skill. Data was collected and compared from the whole group instruction and the targeted, small group instruction to determine if the intervention had an impact on the math achievement of those students who received the intervention.

#### **Participants**

The population for this action research study was ninth grade algebra I students enrolled in a Baltimore County, high school. The high school is an art magnet school whose home school area is a low-income area middle to lower class working class. The high school has approximately 1500 hundred students with a primarily White population and a sizeable African American population. The demographics are as follows: 64.6% of the student population is White, followed by African American (23.6 %), Hispanic (5.3 %), mixed students—of two or more ethnicities (3.1 %), Asian (2 %), Native America Indian (1.2 %), and Pacific Islander (0.2 %).

The total sample size was 34 ninth-grade Algebra I students across three different classes in which 15 students received the intervention and the other 19 received regular instruction.

Students in the classes who were repeating the course were excluded. The sample features 20 females and 14 males of whom there were 19 White students, 12 African American students, two Hispanic students, and one Asian student. The intervention contained three groups of five students from the three different Algebra I classes. Out of the 15 students in the intervention group, seven were female, and eight were male, and there were consisted of nine White students, four African American, one Asian, and one Hispanic student. The researcher used a purposive sampling approach because the students who were targeted were struggling students who performed poorly on their middle school math assessments and enrolled in Algebra I in ninth grade.

### **Instrument**

The instrument used for this study was based on a released Partnership for Assessment of Readiness for College and Careers (the PARCC test) test items. In Maryland, the PARCC is used currently in secondary school to determine mathematics achievement and is a graduation requirement. The PARCC test accesses the common core standards, which are the foundation of the assessments. Common core is a set of nationally recognized educational standards for teaching and testing English and mathematics achievement levels from kindergarten to twelfth grade. Common core outlines the skills, content, and knowledge that public-school students should acquire in each grade. These' standards are measured by the assessments to determine whether students are on track to be successful in college and careers.

A variety of question styles of released PARCC items were selected to create the pretest and posttest to prepare students for the state assessment. The questions were selected also to familiarize the students with the wording, style of questions, using the computer to answer the

questions, and the types of questions that were asked on the test. The pretest and the posttest were designed to be administered on a digital platform. The pretest and the posttest consisted of the same ten multiple choice questions worth one point each, three short answers worth two points each, and one word problem worth four points. The pretest and the posttest were worth a combined total of 20 points. The material selected was aligned with the curriculum that was taught during the three months that the study was conducted.

### **Procedure**

All students in the three selected classes were given the pretest before the standard was studied. Students in the classes that were not currently ninth graders were excluded from the study. Five students from each class were randomly selected to be in the targeted, small group instruction; the rest of the students in the class were in the whole group instruction control group. Students in the targeted, small group participated in the daily warm-up exercises, and agenda review with the regular class then were pulled out into a neighboring classroom or the back of the classroom for targeted instruction for 30 minutes of intervention. The targeted, small group then participated in the regular whole group classwork or activities and the exit ticket that was used as a formative assessment.

The formative assessment checks were used during the intervention as well the exit tickets were reviewed to see if the strategies during the intervention were successful and should be continued or if other strategies should be used. During the targeted, small group instruction, students were provided immediate feedback on common math errors, solving equations, and setting up problems. Students' progress was continually monitored during the intervention sessions. During the intervention, students were given a chance to ask for peer assistance, direct



teacher instruction, and other additional help. Additional resources, such as online reference materials, study aids, and graphic organizers, were provided based on student needs and interests.

All students in the classes were given a posttest at the end of the intervention period. The posttest measured the same standards as the pretest using the same questions and grading scale. The posttest data was collected and compared to the pretest data to determine whether the intervention affected the math achievement of the students in the study.

## CHAPTER IV

### RESULTS

This study was conducted to determine the impact of targeted, small group instruction on ninth-grade Algebra I students' achievement on the PARCC test. Pretest and posttest data were collected on two groups of ninth-grade students, one receiving whole group instruction and the other receiving targeted, small group instruction. Data were analyzed to determine whether there were any significant differences in growth between the whole and targeted instruction using an independent samples  $t$  test at the  $p < .05$  level of significance. There were no statistically significant findings.

Table 1 illustrates the number of participants as well as the pre-assessment, post-assessment, and growth means for both student groups. With regard to those students receiving whole group instruction, there was a total of 19 participants with a pre-assessment mean of 7.84 and a post-assessment mean of 10.11. The mean growth for the students receiving whole group instruction was 2.27. With regard to those students receiving targeted, small group instruction, there was a total of 15 participants with a pre-assessment mean of 10.40 and a post-assessment mean of 13.27. The mean growth for the students receiving whole group instruction was 2.87.

Table 1

*Pre-assessment, Post-assessment, and Growth Means for Students Receiving Whole Group  
Compared to Targeted, Small Group Instruction*

Group Name/ Instruction Type:	N	Pre-Assessment Mean Score:	Post-Assessment Mean Scores	Mean Difference/Growth:
Whole Group	19	7.84	10.11	2.27
Targeted Group	15	10.40	13.27	2.87

Table 2 shows that in this study there was not a statistically significant difference between student growth when comparing whole group instruction to targeted, small group instruction. The growth mean for students receiving whole group instruction was 2.27, with a standard deviation of 2.70. The growth mean for students receiving targeted, small group instruction was 2.87 with a standard deviation of 2.20. The significance level for this *t*-test analysis was  $p > .05$  at .489, and therefore, there was a failure to reject the null hypothesis.

Table 2

*Independent Groups t-Test Analysis for Whole Group Versus Targeted, Small Group Means*

Group Name/ Instruction Type	N	Average Growth Score	SD	t	df	p
Whole Group	19	2.27	2.70	-.700	32	.489
Targeted Group	15	2.87	2.20			

The data collected showed that there was no significant difference between the whole group instruction group and the targeted, small group instruction intervention. The implications, consequences, threats to validity, and impacts on future research are presented in Chapter V.

## **CHAPTER V**

### **DISCUSSION**

This study was conducted to determine the impact of targeted, small group instruction on ninth-grade Algebra I students' achievement on the released PARCC mock assessment. The null hypothesis stated that targeted, small group instruction would have no effect on math achievement when compared to whole group instruction. The null hypothesis was retained.

#### **Implications of Results**

Although the gain was not significant, student achievement increased during the study. The targeted, small group intervention had a higher growth rate than the whole group instruction. Students who received the intervention showed growth and increased their assessment scores. These increases translate into better understanding, which could lead to better grades on quizzes, unit tests, and ultimately quarter grades. The researcher fostered relationships with these 15 students throughout the study, which gave the students another resource inside the school building that they might not have had prior to the study. These relationships could impact behavior management and climate in the building.

The researcher and the teacher of record needed to co-plan to create lessons that focused on the same content standards but were delivered in two different learning environments. While this would be difficult to duplicate regularly in most schools due to limited resources, this created a professional learning environment based on collaboration, long term planning, and flexible thinking that can increase student achievement. Further research is needed to establish whether significant gains could be made over time if threats to validity were addressed.

### **Connection to Previous Studies**

Wasik (2008) suggested it is more effective to teach content to a small group and small group instruction increases the chances of success for the intervention or remediation. Nelson's (2005) research suggests that targeted instruction will likely help improve content knowledge and increase content fluency. In this study, students' skill deficits were targeted, and learning was customized for the group, to determine whether there was an effect on achievement. The small group setting allows for more individualized and customizable instruction, and research shows a more significant achievement when the learning is customized. Rowan-Kenyon et al. (2012) stated that students thrive in math in a small group environment. Students also build better communication skills and self-confidence when working in small groups (Fry et al., 2009).

### **Theoretical Consequences**

Wasik (2008) suggested that small groups increase the chances of successful intervention or remediation and that it is more effective to teach content to a small group than to a whole group. Students process and understand the content better when it is delivered to them in smaller groups. In this study, there was not a significant difference between the intervention group and non-intervention group, yet there was still an increase in achievement. Whether the lower number of students in the small group allowed for more customization of material or more individual attention would need to be explored further.

### **Threats to Validity**

There are always threats to validity with any research study. This study had several threats to the validity that might have affected the results. The small sample size of only 34 ninth-grade Algebra I students across three different classes that were taught by the same teacher

is an external threat to the validity. The sample is small considering there are almost 1500 students in the school and five different teachers who teach Algebra I. The fact that all the students were from the same school and the same low socioeconomic status also contributes to this threat to validity. The fact that the students were purposively selected from three classes chosen by the author of the study is an external threat to validity. Although students were selected at random from the designated Algebra I classes, this lack of randomization further exacerbates this external threat to validity.

The short, three-month length of the study is a threat to internal validity. Another internal threat that was not initially foreseen was a lack of motivation and attendance issues. In the whole group instruction, the absenteeism rate was 26%, which is above the recommended rate of no more than 10% absenteeism. Within the intervention group, students had a 13% absenteeism rate. The attendance rate affected participation in instruction regardless of the method and this threat could impact the success of the intervention and the validity of the study.

### **Implications for Future Research**

Future research would be needed on targeted, small group instruction to address some of the threats to validity raised in this study. A larger sample size of students in the intervention group (targeted, small group instruction), and whole group instruction would be needed to demonstrate whether the intervention is an effective strategy to improve test scores. If this larger sample size could pull students from across various Algebra I classrooms across the county, this would help demonstrate whether targeted, small group instruction is an effective intervention regardless of the school and the socioeconomic status.

The study would be more valid if the length of the study increased beyond three months. Since Algebra I is only a yearlong course in the study district, the intervention (targeted, small group instruction), could be put in place during the first few weeks of a school year and evaluated during the last few weeks. If the focus of a new study was solely on the intervention's ability to raise math achievement, the study could focus on the effect of the intervention on student math achievement from ninth through 12th grade. The increased length would give researchers a chance to assess more frequently to determine whether the intervention works better on one skill or content than others.

### **Conclusion**

The study was conducted to determine the impact of targeted, small group instruction on ninth-grade Algebra I students' achievement on the released PARCC mock assessment. Most students showed improvement but not to a significant degree compared to their whole group counterparts. For those students, the gain was significant, which made the intervention worthwhile. Most students showed significant gains in the multiple choice section of the assessment. It is difficult to determine whether the students' math skills improved, or their test-taking skills improved. Further research would be needed to determine this.

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