IMPROVING REMEDIAL MIDDLE SCHOOL STANDARDIZED TEST SCORES

by

Roger Lee Keaton, III

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

The purpose of this applied study was to solve the problem of low standardized test scores in a remedial class for a middle school in southern Virginia and to formulate a solution to address the problem. The central research question that data collection attempted to answer was: How can the problem of low standardized test scores in a remedial math class be solved in a middle school in southern Virginia? Data were collected in three ways. First, interviews of teachers and administrators of the remedial math class, called Math Lab, were conducted. These interviews were transcribed and coded, with the codes collected into themes and then displayed visually. Second, an online discussion board was conducted with current and former teachers of Math Lab, school administrators, and classroom math teachers. Third, surveys of teachers and administrators with knowledge of Math Lab and how it impacted students were completed. The quantitative surveys were analyzed by finding descriptive statistics of the data. After reviewing all data sources, a solution to address the problem was created that included designing a curriculum for Math Lab, requiring communication between Math Lab teachers and general classroom math teachers, and professional development of the Math Lab teacher about teaching remedial classes.

Keywords: remedial math instruction, middle school instruction, student motivation, learned helplessness, low-income students, self-efficacy

Dedication and Acknowledgements

I am dedicating this manuscript to my family. My wife, Emily, has put up with me always having to do "homework" whenever she wanted to do something more fun. I'm thankful for my daughter, Sophie Claire, who hopefully has no memory of her daddy being so busy while she was so young. I want to thank my parents for always supporting and encouraging me throughout this whole postgraduate process, from beginning my M.Ed. at Averett then deciding to go ahead and start an Ed.S. and then being crazy enough to continue to a doctorate. I also dedicate this to my friends who always understood when I couldn't do something with them because I had a big assignment due or because I had to work on my dissertation.

I want to thank all the teachers and professors who helped me along the way. So many educators inspired me along the way, encouraging me and teaching me lessons and sometimes giving some leniency that was not always deserved. Not to be forgotten, I must thank my classmates throughout the way who have helped me learn, grow, and persevere along a journey that felt like it would never end.

Altogether, I hope that I have made all of the aforementioned people proud. Many people besides myself have sacrificed so that I could get to this point. Again, I am thanking all of you for everything you've done to make this possible. Thank you and God bless! Amen and amen.

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List of Abbreviations

Affective tutoring system (ATS)

Assistive technology (AT)

Computerized adaptive testing (CAT)

Computer assisted instruction (CAI)

Dynamic Strategic Math (DSM)

Elementary and Secondary Education Act (ESEA)

Every Student Succeeds Act (ESSA)

Exploring metacognitive (EM)

Implementing metacognitive (IM)

Instructional scaffolding (IS)

Learned helplessness (LH)

Least restrictive environment (LRE)

Massive open online course (MOOC)

Math instruction methods (MIM)

Measuring Academic Progress (MAP)

No Child Left Behind (NCLB)

Northwest Education Association (NWEA)

Professional Development (PD)

Reading instructional methods (RIM)

Second Step Early Learning (SSEL)

Self-regulated learning (SRL)

Self-regulated strategy development (SRSD)

Standards of Learning (SOL)

Student attitudes (SA)

Word problem solving (WPS)

CHAPTER ONE: INTRODUCTION

Overview

The purpose of this applied research study was to determine how to increase standardized test scores in a particular remedial math class in a public middle school in southern Virginia. Many schools struggle with how to increase pass rates among their lowest performing students and this study looks to find a solution to this issue in a particular school. Chapter One provides the background of the need for this research, which includes historical, social, and theoretical context related to the problem. The historical context focuses on the beginning of remedial classes and how they were implemented with respect to government legislation. The social context focuses on student opinions and reactions to being in remedial classes. The theoretical context focuses on educational theories that explain remedial instruction and challenges therein. Chapter One also includes the problem statement and the purpose statement. The significance of the study and the research questions are then detailed. Finally, definitions relevant to the study are listed, which is followed by a summary.

Background

Teachers and school system administrators constantly work to find ways to minimize standardized test failure rates, especially as government regulations have become stricter than in the past. One attempt at minimizing this failure in mathematics is to put struggling students in a remedial math class in addition to their normal math class. Placing students in remedial classes can lead to challenging situations for both the student and the teacher. Often these classes are full of students with discipline issues that can create difficult instructional situations (Greathouse, 2018). Students sometimes get frustrated with being in these classes instead of other, more enjoyable classes they could be taking (Ljusberg, 2011). The first theoretical

framework utilized in this study is Bandura's (1977) self-efficacy theory, which postulates that students with more confidence in their abilities are better able to achieve their goals. The second theoretical framework utilized in this study is learned helplessness theory which postulates that after repeated failures at attempting a task a person will not even make a further attempt to accomplish a goal (Abramson, Seligman, &Teasdale, 1978).

Historical Context

Postsecondary remedial classes, also known as development instruction (DI) or supplemental instruction (SI), began in 1973 at the University of Missouri-Kansas City (UMKC) to help an increasingly diverse student body catch up academically after the school started accepting students who were weaker academically (Lundell & Higbee, 2002). This was only eight years after the original signing of the Elementary and Secondary Education Act (ESEA) in 1965. Title I of the ESEA provided funding to low-income schools to help educate students that may not receive a proper education without this funding (Archambault & St. Pierre, 1980). In the earliest days of ESEA, the use of funding provided to school districts was extremely flexible. Some schools used this money for pull-out programs to remediate students (Puma & Drury, 2000). These pull out programs took students out of their regular classroom and oftentimes these students did not receive the same quality of instruction as those students who remained in the general education classroom. As a result, in 1978 the schoolwide option for Title I was implemented; this started the creation of remedial classes in Title I schools. As ESEA was reauthorized, the spending requirements became more stringent and districts funded what the federal government required, leading to the Title I remedial pull out programs (Puma & Dreary, 2000). Many districts now use ESEA Title I funds for remedial teaching positions. What happens in many remedial classes is that students are seen as problems to be fixed (Damon,

2004). As a result, pedagogy in these classes is oftentimes completed through a deficit approach where the focus is on improving students' weaknesses rather than building on students' strengths (Allington, 2011). This may lead to students lacking self-confidence since they may realize they are perceived as problems and teachers consistently focus on their weakness. Some students never feel that they have strengths and never gain confidence when taught in this manner.

No Child Left Behind (NCLB, 2001) and Every Student Succeeds Act (ESSA) were enacted to ensure that all students received a quality education. Part of NCLB act created high-quality assessments for students to measure student achievement. Some remedial classes were already in place before NCLB and ESSA but some have been added in order to reach the requirements enacted by those laws (Dee, Jacob, Hoxby, & Ladd, 2010; Taylor, 2014). Even though these remedial classes are for the general population, they also serve some students with disabilities. Students continue to learn in the regular classroom, their least restrictive environment (LRE), which requires that students are only removed from the regular educational environment when learning cannot be satisfactorily achieved in the regular classroom (Individuals with Disabilities Education Act, 2004; Morningstar, Kurth, & Johnson, 2017). On the other hand, students can have other classes outside of the LRE to help them master a topic (Morningstar et al., 2017).

Social Context

Students can become frustrated by being placed in remedial classes (Greathouse, 2018). This placement can happen against the wishes of the students as they would rather be taking a class of their choosing or something to help them to progress toward graduation instead of a developmental class (Koch, Slate, & Moore, 2012). There is a certain stigma related to being in a remedial class (Koch et al., 2012; Ljusberg, 2011). Students may sense that their peers

watching them walk to a remedial class while their peers go to chosen electives, causing some students in remedial classes to feel inferior. What oftentimes happens in remedial classes is a frustrating experience geared solely towards passing a standardized test (Greathouse, 2018). Attending these classes turns school into a place where learning is rarely fun and causes students to lose interest in education. Students in remedial classes are not just viewed differently by peers; they can be labeled as "at-risk" by teachers and be viewed negatively before the first day of school (McNulty & Roseboro, 2009). Slater (2006) found that some teachers viewed students in remedial programs as being there to be "flushed out" of the normal school population; these programs were primarily all-inclusive and pulled students from the regular classroom all day (19). Teachers having negative views of remedial classes may increase the negative perception of these programs and may cause students to be cast out socially.

Making a remedial class into an enjoyable learning experience, such as a game, rather than punishment, is an important aspect of remedial classes. Educators should create remedial classes so that students are excited to learn, rather than ones where students feel ashamed to attend (Szymanski & Benus, 2015). Instead of fun, enjoyable experiences that can incentivize learning, remedial programs are often taught by less capable teachers, so students are offered less instructional and emotional support than in the regular classroom (Marsh & Noguera, 2018).

Theoretical Context

Supporting the implementation of remedial math courses is Bandura's (1977) self-efficacy theory. This theory suggests that students will gain confidence and by gaining confidence, they will become more capable students. Abramson et al.'s (1978) learned helplessness (LH) theory is also related to this research in that students who learn to be helpless may struggle academically. Many remedial math courses attempt to overcome learned

helplessness and give students confidence in their abilities, allowing them to overcome once impenetrable walls.

Bandura's self-efficacy. One theory that helped explain this study is Bandura's (1977) self-efficacy theory. Bandura proposed that people with more confidence in their abilities are better able to achieve their goals. This confidence may grow out of success in a remedial math course. Remedial math classes can help build basic math skills and help students become more confident in their abilities. One impact of Bandura's (2012) theory was that it specified "the theoretical, methodological, and analytical requirements essential to the advancement of knowledge" of how self-efficacy works (p. 1). Greathouse (2018) said that students with low self-efficacy were disengaged and lacked motivation to read. While not directly related to math, reading is an essential skill for solving word problems and it is likely that Greathouse's findings apply to math as well. Pressley (1998) found that students must see themselves as successful in order to be successful in remedial classes. This remedial class may help students make a personal change and start to see themselves as successful. Students with higher self-efficacy put forth more effort in class and participate more often, which may result in better academic performance (Usher & Pajares, 2008). Using a remedial math class to increase self-efficacy may help students in the remedial math class, in the regular math class, and in all other classes. Gürefe and Bakalım (2018) found significant relationships between self-efficacy, anxiety, and learned helplessness in mathematics students; self-efficacy was negatively related to learned helplessness. Essentially, as self-efficacy increased learned helplessness would decrease. As students increased in confidence and self-belief they would not feel helpless and they would be able to overcome obstacles. Remedial math classes offer the opportunity for students to gain

self-efficacy, decrease learned helplessness, increase in math knowledge, and pass standardized tests when taught is a way that promotes self-efficacy.

Learned helplessness. Another theory that explains this study is the learned helplessness theory, the idea that after repeated failures humans expect to fail again and feel that they cannot be successful (Abramson et al., 1978). In this remedial math class, many students have repeatedly failed past math classes and standardized tests, in addition to struggling to learn math concepts. This repeated failure is the heart of learned helplessness. Prior to Abramson et al., research about learned helplessness focused on animals and only touched on humans in the five years before the research was published (Nuvvala, 2016). The theory of learned helplessness initially explained laboratory animals who were trained that it was impossible to escape or avoid shock in certain situations; when the situations changed the animals could not overcome their previous training. Students repeatedly failing a standardized test, like many in remedial math classes in middle school, are like the laboratory animals who ran into those walls. Once the situation changed for those animals, they could escape, but they had been trained that escaping was impossible. Teachers must ensure that students are trained that passing a standardized test is possible. Abramson et al. conducted the first research that distinguished between universal and personal helplessness and when helplessness is general or specific and chronic or acute. The different types of learned helplessness help explain how students repeatedly struggle in math but perform well in other subjects; these students have specific learned helplessness related to mathematics. Learned helplessness is passive, causing unsuccessful problem solving and a lack of control in nerve-wracking situations (Bahadir-Yilmaz et al., 2015). This takes place in the classroom for some students.

Mueller (2001) found that a student's self-image was also affected by the repeated failures that relate to learned helplessness. Greathouse (2018) discovered that students that had repeatedly failed a standardized test in reading decided that they were unable to read, often giving up before even attempting to read, especially after repeated failures. Even before standardized testing it is often due to classroom teachers that students develop learned helplessness (Miller, 2015). Students habitually fail and only succeed when teachers are there to help them, creating a sense of learned helplessness where students only succeed with the support of a teacher. Research by Goodall and Johnston-Wilder (2015) found that a parent's struggles in mathematics could be transmitted to a child, creating another version of learned helplessness, which may be the case in this study. The student may not actually struggle in mathematics, but the struggles of the parent could be learned by the child and create a future of helplessness. This study proposes to solve the problem of low standardized test scores; thus, this theory may help explain why some of the students in the study struggle to acquire adequate skills in mathematics to pass standardized tests.

Problem Statement

For this study, the problem is that there are low standardized test scores in a remedial math class in a middle school in southern Virginia. The proposed research is needed because in the past two years the standardized test pass rate for the remedial class was 57% and 52%, with a total of 54% over the two years (Employee 1, personal communication, December 17, 2019). When looking at the overall student population and including all students in grades six through eight, 86% scored in the passing range in 2017-18 and 85% scored in the passing range in 2018-2019 (Virginia Department of Education, n.d.). Economically disadvantaged students even were at 81% and 83%, so the issue is not solely due to economic disadvantage. The Virginia

Department of Education expects mathematics pass rates to equal or exceed 70%, so the school is doing well with the overall population and economically disadvantaged students but not with remedial students enrolled in the remedial math class. In addition to the low passing scores in the remedial math class, both school administrators noted that pass rates in the remedial math class still needed to improve (Employee 2 & Employee 3, personal communication, January 8, 2020).

Over the years, educational researchers have investigated a variety of factors that affect student learning, but there is disagreement among researchers, showing this proposed research is relevant. Data from the school indicates that there is a problem since over the past two years 57% and 52% of students enrolled in the remedial math class passed their standardized test in math while 86% and 85% of the student body passed (Virginia Department of Education, n.d.). The current research is lacking because this school in southern Virginia is underperforming and current research fails to address the problem specific of these students at the school in southern Virginia, so research is needed to devise a plan to increase standardized test scores in this class at this school. Data collection methods include interviews with teachers and administrators who can explain successful strategies with remedial mathematic students, an online discussion board including teachers who teach remedial math classes, and a survey of classroom teachers who may be able to help solve the problem of low standardized math scores.

Purpose Statement

The purpose of this applied study was to solve the problem of low standardized test scores in a remedial class for a middle school in southern Virginia and to formulate a solution to address the problem. A multimethod design was used consisting of both qualitative and quantitative approaches. The first approach was semi-structured interviews with remedial math

teachers. The second approach was an online discussion board including teachers and administrators. The third approach was surveys of teachers and administrators.

Significance of the Study

As federal testing standards have increased the importance of student performance on standardized testing, teacher stress has increased (Gonzalez, Peters, Orange, & Grigsby, 2017; Saeki, Segool, Pendergast, & Embse, 2018; Youn, 2018). Anything put into place to decrease teacher stress may help overall instruction and school morale (Gonzalez et al., 2017). Having a remedial, extended time class should help a school's overall math standardized test pass rates. Having a well-designed curriculum can save time and make the class more beneficial for students (Dombrowski, Wrobel, Dazert, & Volkenstein, 2018). Saving time will increase efficiency in the workplace and allow teachers to focus on increasing student engagement (Lonn & Teasley, 2009). Administrators may see improved learning and increased pass rates from the higher quality instruction that would take place in this class (Mattis, 2015). Eventually, the results of this applied study may be shared with other schools in the district that offer the same class. This would help the entire district instead of just the one school where the study is being completed. Depending on the results from this research some educational software companies may find this interesting as their products may be in use in this class. Specifically, the Northwest Education Association's (NWEA) Measuring Academic Progress (MAP) Skills, Prodigy Game, and Edmentum's Study Island are popular games that may have been used by these teachers. Ultimately, the people that this study will impact the most are students. They may see more engaging instruction from their teachers in their remedial math class (Lonn & Teasley, 2009). Instead of being frustrated they are in a remedial class (Koch et al., 2012), they may receive highly effective instruction. Beyond this specific school, district, and community this research

may be used by other researchers looking for remedial math instruction suggestions in a low socio-economic, rural community.

Research Questions

Central Question: How can the problem of low standardized test scores in a remedial math class be solved in a middle school in southern Virginia?

Sub-question 1: How would educators in an interview solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia?

Sub-question 2: How would educators and administrators in an online discussion board solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia?

Sub-question 3: How would educators and administrators in a survey solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia?

Definitions

1. *Extended time* – giving students additional time with a subject rather than taking an easier class (Ngo & Kosiewicz, 2017).
2. *Learned helplessness* – Humans who have routinely failed eventually decide to give up before giving a real attempt (Abramson et al., 1978).
3. *Motivation* – an individual's own desire to achieve (Ackerman, 2018).
4. *Self-efficacy* – Greater confidence in one's abilities makes the person better able to achieve goals (Bandura, 1977).

Summary

Chapter One provided a description of the basic situation, beginning with the background of remedial education. The first part of the background to be explained was the history of

remedial education and why these classes are being implemented more often, focusing on improving standardized testing scores. Chapter One then explained the social situation, especially the challenges that students face while taking remedial classes. Afterwards, the theoretical base for this research was introduced with the primary focus being Bandura's (1977) self-efficacy theory and the learned helplessness theory. The problem statement followed, which focused on the need to increase standardized test pass rates in a remedial math class. Following the problem statement was the purpose statement, the need to find a solution to the problem, that remedial standardized test pass rates must be improved. Finally, the significance of the study was explained, demonstrating how improving remedial standardized test pass rates proposes to help not only this school, but this district and other remedial math classes. Chapter One concluded with the research questions and definitions.

CHAPTER TWO: LITERATURE REVIEW

Overview

This chapter discusses the theoretical framework upon which the research is based. The theories used to guide this research are Bandura's (1977) self-efficacy theory and learned helplessness theory by Abramson et al. (1978). Bandura's self-efficacy theory focuses on how a person's confidence in his or her own abilities makes the person better able to achieve goals, like passing a standardized math test. Learned helplessness theory from Abramson et al. focuses on the belief that humans experiencing repeated failures will not even attempt a similar task, similar to what happens once students repeatedly fail to learn math concepts and fail standardized tests. A discussion of how these theories affect classroom learning and standardized test pass rates is included. After the theoretical framework, a review of related literature is presented. Specific themes found in the literature include motivation, extended time, remedial instruction, and teacher training.

Theoretical Framework

A theory is defined as "a set of related concepts, assumptions, and generalizations that systematically describe and explain behavior" (Joyner, Rouse, & Glatthorn, 2013, p. 57). Having a theory in place to guide research is important for effective research as it helps to frame the research proposal and the data collection part of the research (Creswell & Poth, 2018). Placing a study within an existing theory also helps establish the significance of the study. The theories upon which this study is based are Bandura's (1977) self-efficacy theory and the learned helplessness theory by Abramson et al. (1978).

Self-efficacy Theory

Bandura's (1977) self-efficacy theory was first introduced in 1977. Self-efficacy is often thought of as being the same as confidence but there is a distinct difference (Pajares, 1996). Self-efficacy is a specific confidence where a person is confident that he or she can reach a certain goal (Bandura, 1997). Self-efficacy is the belief that a person with confidence in his or her own abilities can overcome the challenges that may present themselves and achieve a certain goal (Bandura, 1986). This is an important trait in a classroom as students with high self-efficacy are more willing to push through challenging questions in search of an answer (Pajares, 1996). Students with less self-efficacy are likely to become frustrated and give up before finding the correct answer.

Ferla, Valcke, and Cai (2009) found a difference in self-efficacy and self-concept. Self-concept is an individual's knowledge and awareness of his or her academic abilities while self-efficacy is an individual's belief that he or she can accomplish a task. Self-concept more closely connects to motivation while self-efficacy closely relates to academic performance (Ferla et al., 2009). Self-efficacy does closely relate to student learning and academic achievement (Zimmerman, 2000).

Self-efficacy is an important factor affecting academic performance in all students, not just academically gifted or struggling students (Lane & Lane, 2001). A 2007 study by Siegle and McCoach in 15 upper elementary classrooms found that strategic instruction increased self-efficacy in mathematics students. More specifically, this instruction focused on constantly reviewing the previous day's instruction and reviewing that day's instruction at the end of each mathematics lesson; this process resulted in greater self-efficacy among students (Siegle & McCoach, 2007). It has also been found that self-regulated strategies and teacher lesson

structures increased self-efficacy in students (Usher, 2009). Altogether, increased self-efficacy improves instruction and helps teachers and students succeed by giving students confidence in themselves in reaching their goals.

Learned Helplessness Theory

The learned helplessness theory is not as widely cited as Bandura's (1977) self-efficacy theory even though it has been around for about the same length of time. Abramson et al. (1978) produced the first major article about learned helplessness in humans. Prior to this publishing, all research had been about learned helplessness in animals. Learned helplessness is the expectation that someone cannot accomplish a goal due to past shortcomings (Abramson et al., 1978). Aside from societal behaviors, learned helplessness plays a major role in the classroom. Learned helplessness can lead to frustrating situations in the classroom. Students will not attempt to work through problems because of past failures (Yates, 2009). In essence, they have learned that they cannot do something and are helpless so they do not even attempt it. Overcoming this learned helplessness is one of the goals of remedial math classes, teaching students that they are able to do math problems and giving them back confidence that was lost (Wang, Sun, & Wickersham, 2017).

Related Literature

Researchers have sought to determine what impacts instruction and students gaining knowledge in the classroom. This instruction includes math instruction, remedial instruction, instructing poor students, and instructing rural students. Other factors that may affect instruction include teacher attendance and student attendance. Some teachers may use games to help students learn while other teachers may find other ways to motivate students. Ultimately, teachers must be trained to instruct properly in ways that work for them and their students. The

following research ties together all of these factors to find instructional methods that work for a particular school.

Instruction

Academic instruction is the primary goal of a school, alongside developing young people into young adults. The following research strives to find what makes quality instruction in a particularly challenging environment. Math instruction is a challenge itself, as is remedial instruction. Those challenges are compounded in schools that have a high number of low-income students and are rural schools. Teaching remedial math in rural schools with a number percentage of low-income students is as challenging a job as there is and this research looks for ways to decrease those challenges.

Math instruction. Math and English are different from other subjects in that so much of what is taught in these classes builds on previous classes. Mathematics is special in that students need not only to understand how to complete a process but the concept behind the process (Bottge et al., 2014). Students may be able to survive another subject while forgetting a previous topic but in math that leads to failure. For example, understanding whole and rational numbers is a foundation that supports future levels of mathematics (Nelson, Parker, & Norman, 2018). Bosch and Bowers (1992) offered math instructional strategies for the discouraged learner, a way of describing many students in a remedial class. Math-specific tips offered by Bosch and Bowers are, as follows:

1. Convince the student of the value of math.
2. Connect math topics to the concerns and values of the student.
3. Conduct the student on a guided tour of math as an exciting adventure.
4. Convert a boring classroom into an exciting hands-on mathematics “theme park.”

5. Correlate math with topics in other content areas.

6. Compare the educational and career options of a mathematically literate person with those of a person who lacks competence in math.

7. Combine mathematics instruction with real-world problems.

8. Correct a student's math errors immediately and precisely.

9. Couple your teaching with varied instructional strategies and enthusiasm about math.

10. Commit yourself to ensure the success of every student in your mathematics class.

Multiple researchers agreed that a key to quality math instruction is helping students see that math is worthwhile (Bottge et al., 2014; National Research Council, 2001). The person who helps students see that math is worthwhile is a differentiator in certain circumstances. Krämer et al. (2016) found that students in STEM classes responded better to motivating agents of the opposite gender. They responded least positively to unmotivating agents of the opposite gender. In this study, motivating agents were teachers making positive comments towards students to boost their confidence while unmotivating agents made neutral comments. Agents of the same gender had middle results on student performance (Krämer et al., 2016).

Certain strategies work from a young age to create mathematical thinking. Larson and Rumsey (2018) found success by using math manipulatives to connect math to children's literature plot lines. Bintz and Ciecierski (2017) suggested that using hybrid texts, or texts that can teach a subject other than basic reading, can be beneficial to learning mathematics. Hybrid texts could help students understand the history of a mathematician or a short story explaining how to count or the benefits of learning subtraction and how to subtract. Using hybrid texts maximizes the usage of time, especially at a lower level, while showing students that the whole school is working together toward a common goal (Bintz & Ciecierski, 2017).

Many researchers have found success with having students verbally discuss their strategies to finding solutions to mathematics problems (Cuenca-Carlino, Freeman-Green, Stephenson, & Hauth, 2016; Murata et al., 2017). This strategy is more successful when teachers are involved, helping spur conversation forward and working with students as they explain their problem-solving decisions (Murata et al., 2017). Using this strategy allows students to better understand how they got to a solution instead of just saying "I did it in my head" and allows other students to learn other methods of solving a problem. Teaching students cognitive strategies to solve word problems is beneficial except when those students have low working memory capacity (Cuenca-Carlino et al., 2016; Swanson, 2014). Students with low working memory capacity have been found to have their mental resources overtaxed and actually perform worse after being taught cognitive problem-solving strategies (Swanson, 2014). A simpler way of thinking about this issue is that students focused more on remembering the strategy than actually learning the math and solving the problem. There must be improvement in problem-solving strategies for students with low working memory capacity; the strategies that work for some students do not work for all, especially those with low working memory capacity. Kong and Orosco (2016) found success in students solving word problems by first teaching students using instructional scaffolding (IS) to create a word problem solving (WPS) strategy called Dynamic Strategic Math (DSM). This strategy focuses on creating individual scaffolds for students that are determined by their individual strengths and weaknesses related to both math, since this took place in a math class, and reading, since reading is essential to solving word problems.

In a meta-analysis of mathematics instructional strategies the Center for Instruction found seven important instruction practices (Cuenca-Carlino et al., 2016). The first strategy was to use

explicit instruction, which the teacher could do by "(a) clearly modeling the solution specific to the problem, (b) thinking aloud the specific steps during modeling, (c) presenting multiple examples of the problem and applying the solution to the problem, and (d) providing immediate corrective feedback to the students on their performance" (Cuenca-Carlino et al., 2016, p. 76). The second strategy was to use multiple instructional examples, giving a variety of problems and solutions and presenting them easy to hard, concrete to abstract, and simple to complex. The third strategy has already been discussed: having students verbalize their problem-solving strategy, which can aid in self-regulation. Students should also visualize their problems. Teachers should constantly evaluate data from formative assessments and use that data to guide instruction. Finally, teachers should use multiple heuristic strategies during instruction (Cuenca-Carlino et al., 2016). A heuristic strategy gives a general method for solving a multi-step problem and has been found to be effective by multiple researchers (Freeman-Green, O'Brien, Wood, & Hitt, 2015; Montague, Krawec, Enders, & Dietz, 2014).

A similar study of third grade math instructional strategies found five key instructional strategies suggested (Kingsdorf & Krawec, 1983). The first, third and fifth strategies are similar to the first, second and fourth strategies suggested by Cuenca-Carlino et al. (2016), direct or explicit instruction and giving multiple examples of problems (Kingsdorf & Krawec, 1983). The second strategy is called problem-type, referring to connecting a problem to a previous similar type of problem; this helps students connect the new problem to prior knowledge. The fourth strategy is summarized as self-strategies, which refers to students using self-monitoring as they work through problems, such as having a checklist to make sure they are following a problem solving strategy. The final strategy is also similar to a strategy from Cuenca-Carlino et al.:

students visualizing the problem. This strategy is especially useful with students with disabilities (Kingsdorf & Krawec, 1983).

According to Thunder and Demchak (2016), the five components needed to develop young mathematicians are counting, subitizing, conceptual understanding, strategic competence, and procedural fluency. Learning these skills at a younger age will help students to avoid the pitfalls that entrap many math students later in life. These skills are sort of like a math diet that will ensure students are getting the proper math nutrients to succeed mathematically in life (Thunder & Demchak, 2016). Also important for young learners is instruction that stresses critical reasoning and problem solving in order to develop students who "learn to think mathematically and think mathematically to learn" (Jitendra et al., 2015, p. 51).

Self-regulated strategy development (SRSD) is a strategy used to improve writing skills primarily but has occasionally been used in mathematics problem-solving research studies (Baker, Chard, Ketterlin-Geller, Apichatabutra, & Doabler, 2009; Case, Harris, & Graham, 1992; Cassel & Reid, 1996; Losinski, Cuenca-Carlino, Zablocki, & Teagarden, 2014). SRSD is used to help students gain self-regulation skills, gaining abilities to solve problems in all classes (Cuenca-Carlino, 2016). SRSD has six steps: "(a) developing and activating background knowledge, (b) discussing the strategy including benefits and expectations, (c) cognitive modeling of the strategy, (d) memorization of the strategy, (e) collaborative support of the strategy, and (f) independent practice" (Cuenca-Carlino, 2016, p. 76; Harris, Graham, Mason, & Friedlander, 2008). SRSD also includes the use of mnemonics, an effective strategy for remembering information (Scruggs, Mastropieri, Berkeley, & Marshak, 2010).

Besides instructional methods a mathematics classroom can be affected by the instructional setting. Sitting on stability balls has been found to increase standardized test scores

in sixth grades when compared to sitting in regular chairs or taking short breaks for physical activity (Mead, Scibora, Gardner, & Dunn, 2016). The success from activity balls could have been due to a number of factors, including the fact that sitting on a stability ball required the students to stay alert, lest they fall off the ball. Sitting or bouncing on a ball also makes it more difficult for a student to quickly turn to a peer, a task that is much easier in a normal chair. Much research says that academic achievement is increased with physical activity during the school day but this study included physical activity in lieu of ten minutes of instruction, likely negating any added benefits (Mead et al., 2016).

Another way to find success in math instruction is using tablets to support the connection between the concrete, visual, and abstract (Volk, Cotič, Zajc, & Starcic, 2017). Research found a medium effect size for procedural knowledge and problem-solving abilities from the multi-sensory human-computer touch capabilities.

Remedial instruction. Using specific instructional strategies for remedial classes is important; remedial classes must be taught differently than regular or advanced classes (Smart & Saxon, 2016). Remedial classes often have students who have struggled in the past or are discouraged learners, as students take developmental classes due to scores on a placement test or teacher suggestion (Moss, Kelcey, & Showers, 2014). Bosch and Bowers (1992) suggested three primary strategies for teaching discouraged learners: confront the problem, combat the way discouraged learners think about school, and care for the student. Nelson et al. (2018) found that the three primary underlying characteristics behind all good remedial instruction are modeling, immediate feedback, and giving opportunities to respond.

Bottge et al. (2014) found success for low-achieving students by using explicit instruction and anchor problems. Explicit instruction refers to giving detailed instructions and explanations

for each step in a process and each math problem while anchor problems are example problems that students can refer to when issues arise (Bottge et al., 2014). Younger and weaker students may benefit from more procedural instruction while more advanced students may learn from conceptual instruction (Heatly, Bachman, & Votruba-Drzal, 2015). Procedural instruction focuses on basic skills while conceptual instruction focuses on critical thinking skills.

Students must also learn how to make inferences based on what they read, an essential skill for all students learning any subject (Barth & Elleman, 2017). There are two types of inferences from reading: text-based inferences and knowledge-based inferences. Text-based inferences connect what was just read to what was previously read. Knowledge-based inferences connect what was just read to prior knowledge. Being able to make these inferences makes it easier for students to learn from reading, a valuable skill for remedial learners.

Teaching students to self-regulate and self-evaluate has been found to cause positive increases in the quality and length of written assignments (MacArthur, Philippakos, & Ianetta, 2015). According to Stevenson (2016), self-regulation is extremely important, especially among remedial learners. Self-regulation through planning and goal setting can help struggling leaners regain focus and spend more time on task. Staying on task and limiting lost instructional time can greatly enhance learning. Keeping students engaged directly correlates to academic performance. This is especially important since as much as half of the time in a class is spent on non-academic tasks. Transition time can be especially costly and using some type of self-regulation to limit lost instructional time during transitions can greatly increase the academic growth that takes place in a remedial class (Stevenson, 2016).

The need for having a strategy to solve problems is undisputed, especially when it comes to academically weaker learners (Jitendra et al., 2015). Krawec, Huang, Montague, Kressler, and

Melia de Alba (2013) found success teaching a problem-solving strategy called *Solve It!* to students; their research showed a medium effect size. Krawec et al. showed that remedial math students do better when they have a specific strategy already in place to follow instead of needing to use critical thinking strategies to devise a strategy, although Jitendra et al. noted the importance of teaching critical thinking skills as part of normal classroom instruction. Kong and Orosco (2016) found similar success with implementing word problem solving strategies that were independently geared toward each student, based on individual strengths and weaknesses. This research found that focusing on weaker learners as individuals is important and may be a key to their success. Jitendra et al. agreed and added that instruction must be flexible and adaptable for students.

During remedial instruction, immediate and adaptive teaching materials must be provided to the student, whether through an adaptive program or by having a quickly reactive teacher (Hsiao et al., 2016). Dai and Huang (2015) found e-learning caused more growth than blended instruction or traditional instruction in a remedial math class. Kumar & Chaturvedi (2014) found success with implementing computer assisted instruction (CAI) with fifth grade students. CAI is valuable because it adapts to each student as they work, allowing them to work and learn at their own pace. CAI also allows one teacher to help more students more quickly since the computer is doing part of the work and the teacher only must intervene during especially difficult times.

Wu, Kuo, and Wang (2017) found similar results using computerized adaptive testing (CAT) to determine which areas students needed more practice and implementing the practice. CAT allowed the computer program to find exactly what skill practice was needed and to give students more instruction in those areas. The computerized instruction was found to be both more effective and efficient than traditional classroom whole class instruction and individualized

class instruction (Wu et al., 2017). The efficiency gains were rooted in being able to adapt the instruction to exactly what each individual student needed instead of covering topics that a student may not need in whole class or even small group instruction. Another study across four subjects found gains in chemistry but no benefit in math, biology, or literacy (Liu, McKelroy, Corliss, & Carrigan, 2017). The researchers felt this failure to grow was due to the remedial program being voluntary and students using the program on their own time. Many students had a noted weakness in chemistry and focused on improving in chemistry while it is believed that students felt comfortable in their knowledge in the other subjects and only took a cursory look at the remedial modules. Sometimes it is necessary for individualized, computerized programs to scale learning back up for a term so that students who show great growth can still benefit from being in a remedial class; programs that scale back up are highly beneficial to the remedial classroom (Campbell & Cintron, 2018).

A common limitation of computer-based learning is that it does not have the personal touch of working with a human that can read a student's facial expressions and connect to the emotional side of the student. Mio (2018) stressed the importance of understanding the physiological/ psychological wellbeing of every student, especially when teaching remedial students. Lin, Wu, and Hsueh (2014) used affective tutoring system (ATS) to combat this issue. ATS uses facial recognition software built in to the instructional software to determine a learner's emotional wellbeing and adjust the pace and complexity based on the facial recognition results. Using ATS was found to cause more growth than the same tutoring system without the facial recognition software being implemented (Lin et al., 2014).

Effective remedial instruction takes place at a student's current academic level but must be increased as students grow, else they will never improve from their current level (Kingsdorf &

Krawec, 1983). Remediation may need to begin below a student's grade level before providing support for on grade-level content (Nelson et al., 2018). Remedial instruction must stay connected to what is happening in the regular classroom. Higher gains come from remedial classes that complement the regular core class instead of remedial classes that solely focus on gaps of knowledge (Campbell & Cintron, 2018). Remedial instruction must include conceptual knowledge that connects to the concept taught in the classroom instead of focusing solely on missing procedural skills (Opitz et al., 2017).

Assistive technology (AT) can help remedial students with certain needs overcome disabilities (Embley, 2019). The goal of technology is not to create a permanent crutch but to build up skills in order for learners to transition away from technology or only use AT when necessary. Assistive technology is a tool that helps a learner accomplish a task with usage lessening as the learner progresses, except in certain permanent cases like vision impairment where a learner may always use AT. Assistive technology, like other previously discussed strategies and tools, can aid in remedial instruction.

Instructing low-income students. Teaching in a school with high a high percentage of poverty-stricken students includes specific challenges that wealthier schools and teachers do not experience (Ömür, 2018). The lower academic performance of disadvantaged students is a problem at all levels of education throughout the world (Chen, Shih-Jay, & Chu, 2015; López, Erwin, Binder, & Chavez, 2018). In the United States, many of these poorer schools receive Title I funding; Title I schools have large numbers of students enrolled in the free and reduced lunch program due to low family income for the number of family members in a household (U.S. Department of Education, 2018).

Duncan, Kalil, and Ziol-Guest (2017) found that increases in the economic gap between high- and low-income children account for approximately three-quarters of the increasing gap in completed schooling, one-half of the gap in college attendance, and one-fifth of the gap in college graduation. Duncan et al. also found that maternal age directly correlated to income discrepancy among parents. Children born into low-income homes had younger parents who were not as prepared to rear children, compounding the issues from the income difference (Duncan et al., 2017).

Wealthier students often have greater opportunities as their families have greater access to resources, they spend more time with their children and support them more, and wealthier students participate in more extra-curricular activities (Ömür, 2018). Wealthier families are always able to provide the basic necessities for students such as food, clothing, shelter, and healthcare but can also provide enrichment opportunities (Owens, 2018). Wealthier parents can buy more books and technological resources and can splurge on higher quality childcare, an integral part of helping low-income families catch up to their wealthier peers. Enrollment in a Head Start or other preschool facility can be beneficial to students preparing for elementary school, especially if that facility has a research-based program they use, such as the Second Step Early Learning (SSEL) curriculum (Wenz-Gross, Yoo, Upshur, & Gambino, 2018). Beyond the typical benefits to children wealthier parents themselves are less stressed and in better physical shape and typically are better role models to children (Owens, 2018).

Foorman et al. (2006) found that the incoming level of a student relates less to the outgoing level of a student than teacher effectiveness. Teachers in high poverty areas must be careful not to assume weakness of a student; past performance and present level may relate to a student's socioeconomic status more than any other factor (Foorman et al., 2006; Rogers,

Robinson, Maxwell, 2018). Creating a positive environment inside the classroom is one way to overcome any possible predispositions for both the teacher and the student (Cuthrell, Stapleton, & Ledford, 2009; Rogers et al., 2018). Teachers must remember to have high expectations for all students, especially those from low-income backgrounds, as they may subconsciously expect lower performance from those students (Rogers et al., 2018).

Teachers instructing students in high poverty areas must be prepared to teach these students because research shows these teachers are more stressed, have higher job turnover, and these students cause more discipline issues than the national average (Reddy et al., 2019). Teachers in low income schools must have well thought out instructional and discipline strategies for the issues that are inevitably going to arise (Reddy et al., 2019). Reeves (2003) found six strategies for success in low income schools: hire and retain teachers who believe their students can be successful; focus on small, achievable academic goals; make assessment an important daily activity; collaborate throughout the school; creatively schedule; and spend money on things that actually help, like supporting teachers instead of buying the newest educational product. In order to help teachers develop and learn about these populations one researcher has suggested using massive open online courses (MOOCs) to increase knowledge (Laurillard, 2016). Similar MOOCs could also be open to potential students in high poverty areas to decrease the achievement gap and education gap.

Culturally responsible teaching focuses on instructing to student strengths (Harris et al., 2016). Teachers must be aware of their students' interactional styles so their instructional techniques will make an impact. One method of instructing involves telling stories to enhance learning in the core subjects. Harris et al. found success with using stories that portray activities and situations that resembled the lives of their students. As Harris put it, "making the effort to

creatively blend education and entertainment through story will not only engage students cognitively and emotionally, but it will give them an experience they can remember, recall, and retell" (p. 68).

In reviewing the achievement gap between black and white students, Owens (2018) found that the achievement gap more closely connected with income rather than race. Owens found many black students struggled because of living in poorer areas with fewer resources. Even better off black students lived in areas that would be considered poorer for many white students. Still, the achievement gap was because wealthier areas performed better rather that lower income areas performing worse. A gap still exists but in this study the gap was because of wealthier areas performing well above average while poorer areas performed at the average (Owens, 2018).

An aspect of the comparison between low income areas and higher income areas that is often overlooked is the connection between parents (Owens, 2018). In higher income areas parents connect in social networks and work together to share information. These are also highly competitive, academically focused areas. Poorer areas frequently lack this and schools must encourage this commitment from parents while working with neighboring districts to increase the collective achievement of the area (Owens, 2018; Rogers et al., 2018). Even though resources are not always available in low-income areas, the previously discussed strategies show ways to increase learning by creatively improving school instruction and working with parents and the community.

Instructing rural students. About 50% of school districts, 33% of schools, and 20% of students in the United States are rural (Brenner, 2018). Rural areas include large swaths of undeveloped land which has a lower value than a comparable urban piece of land, meaning local

governments in these areas pull in less tax revenue and schools districts have less funding than similar urban and suburban districts. Federal funds typically fund based on formulas tied to the number of low-income students and the total number of students. Rural areas with less crowded classes get less funding even though the cost of educating 20 students and 25 students is not substantially different. Employee salaries and building costs are the two greatest expenses for a school district but having five more students in a classroom requires no change in either of those two primary costs but that urban district will receive 25% more funding than the rural district.

Teaching students in rural areas can bring challenges that require a certain understanding to implement new instructional methods (Sandholtz & Ringstaff, 2014). Many rural students, especially in low income areas, rarely have experiences outside their communities (Ledger, 2019; Lester, 2012). One way to overcome this lack of life experiences is virtual field trips (Lester, 2012). Place-based education can help students make a real-life connection to abstract ideas from a story or lesson. Teachers must work to mentor and be role models for students and encourage aspirations beyond what may be available in a rural area (Ledger, 2019). Teachers can also share experiences from college and help rural students understand the benefits of higher education.

One way to improve instruction in rural schools is to increase cooperation and collaboration among teachers (Harmon, 2018; Sandholtz & Ringstaff, 2014). Rural schools are often small and teachers can feel isolated; school districts must ensure that teachers are comfortable working together with other teachers in the school, district, and even across districts in truly desolate areas. Successful collaboration time included three parts: having an actual scheduled time to collaborate instead of just being told to collaborate, collaboration time being structured and focused on instruction and student needs, and leadership that focuses on students

and teacher and student accountability (Harmon, 2018). School-to-school collaboration is important as schools that have struggled in certain areas can help those with similar issues. Schools must be receptive to help and always look to grow instead of seeing each other as competition.

Collaboration can also happen via technological advances so that teachers in different districts can collaborate during a designated collaboration time instead of having to drive from one's school to the other's school, which could be an hour or more each way in rural areas (Harmon, 2018; Ledger, 2019). Technology not only helps with collaboration but also in providing resources to students for learning and to experience opportunities never available before. Also, community-driven approaches help students grow together and can help isolated rural areas have a sense of togetherness (Ledger, 2019). Districts that go through rapid changes such as a large influx of English language learners must work with the community to adapt faster than possible using only school resources (Harmon, 2018). In an increasingly global society schools must help communities transform to take advantage of opportunities that exist with the correct educational structure in place. This could include providing adult education opportunities in addition to educating traditional students. Altogether, the approach to instructing rural students must be multi-faceted, using focused instruction, technology, and community support to improve rural instruction.

Attendance

Attendance is a major factor when it comes to the instruction that takes place in a classroom (Heyne, Gren-Landell, Melvin, & Gentle-Genitty, 2019). Both teacher attendance and student attendance affect the situation (Okeke Shumba, Rembe, & Sotuku, 2015). Teachers must be present in order to provide their subject expertise. Students must be present in order to grasp

that knowledge (Heyne et al., 2019). When teachers are absent learning is disrupted and repeated absences can negatively impact student performance (Okeke et al., 2015). This is especially true in the time period leading up to formal assessments.

Teacher attendance. To combat the issue of poor teacher attendance some incentive must be offered (Glewwe, Ilias, & Kremer, 2010). Some districts offer pay increases for teachers using fewer vacation days while some offer other prizes (Duflo, Hanna, & Ryan, 2012; Glewwe et al., 2010). Some incentives are tied to student performance and teachers understand that their presence in the classroom will help increase student performance, so teachers take fewer days off. One study found that simply increasing the monitoring of teachers decreased absenteeism (Duflo et al., 2012).

Student attendance. If students are not in a classroom then they cannot learn from the classroom teacher. Online resources have made absenteeism less of an issue, but the issue still exists in many classrooms across the world, especially in classrooms filled with low-income students since they have fewer resources at home (Heyne et al., 2019; Ömür, 2018). One study found that students show up more often if their teachers came to school more often (Banerjee, King, Orazem, & Paterno, 2012). Another study found girls were more likely to attend when there was a college scholarship incentive (Kremer, Miguel, & Thornton, 2009). Some studies have found that school attendance is not as closely tied to academic achievement as previously thought (Andrietti, 2014; Andrietti & Velasco, 2015; Eisen et al., 2015; Kim, Shakory, Azad, Popovic, & Park, 2019; Stanca, 2017). Class participation is more closely tied to academic achievement than class attendance but when controlling for participation attendance is still a slight factor.

Student Motivation

Motivation can relate to self-efficacy as students with more confidence in their abilities are more likely to be motivated to work their way through a challenging path (Alivernini & Lucidi, 2011). Self-efficacy relates to an individual's own belief in their capacity to achieve while motivation is based simply in an individual's own desire to achieve (Ackerman, 2018). Self-efficacy can affect motivation both directly and by affecting social structure factors and outcome expectations which in turn affect motivation. It has been found that self-efficacy is highly connected to student motivation (Zimmerman, 2000). Much research says that lowly motivated students will struggle academically (Alivernini & Lucidi, 2011; Kind, 2019; Liu et al., 2019; Usán Supervía, Salavera Bordás, & Teruel, 2019). Students who are motivated, whether intrinsically or extrinsically, will outperform their less motivated peers (Trevino & DeFreitas, 2014).

Student motivation, especially in a remedial math class, can be narrowed down to a few primary areas: metacognition, cooperative learning, and using games. Metacognition in education relates by giving students some control of what and how they are going to learn since they know themselves better than anyone else (Jones et al., 2015; Marks, 2015). Cooperative learning allows students to work together and learn from their peers (Munir, Baroutian, Young, & Carter, 2018). Using games refers primarily to using electronic, computer-based games to learn topics but can refer to any types of games used in a classroom to increase student motivation (Landers, 2014; Zainuddin, 2018).

There is a collection of other ideas that may assist in increasing student motivation but many still need further research or have obvious negatives related to them. The Committee on Increasing High School Students' Engagement and Motivation to Learn (Stipek, 2004) said that

keys to increasing student motivation in academia today are having different, varied methods of instruction and assessment, decreasing school size, and offering more vocational classes. Rizkallah and Seitz (2017) said that because of students changing throughout the course of an academic year and especially throughout the course of a collegiate experience, different motivational strategies are needed at different points in time. McKay (2015) said that in order to increase student motivation that instructors should offer rewards. McKay admitted that students may lose intrinsic motivation and instead work for a reward instead of working for their own satisfaction. Achievement goal theory suggests that students are more highly motivated and learn more when schools focus on improving skills and knowledge rather than competing to be the best (Meece, Anderman, & Anderman, 2006). This is a leading topic in school reform: whether students should strive for mastery or for growth. Meece et al. said that setting measurable, attainable goals can help students be more motivated. Siefert's (2004) research found that pursuit of mastery, avoidance of failure, learned helplessness, and passive aggressive behaviors all are motivational factors. A final, somewhat obvious method of increasing student motivation is to show interest in a topic. Research by Schiefele (2017) found that the more interested a teacher was in a subject the more the students were motivated and the more they learned.

Metacognition. Originally seen as "knowledge and cognition about cognitive processes," metacognition closely connects to student motivation (Flavell, 1979, p. 906). Metacognition is now commonly considered "thinking about thinking" (Moritz & Lysaker, 2018, p. 20). Students learning by a metacognitive process are able to take control of their own education since they know themselves better than anyone else. Some students are more motivated who follow the metacognitive theory where they set their own learning goals and track

themselves, making sure that they make enough progress to meet their own goals (Marks, 2015). Giving students the power to make choices to determine the course of action in how to solve problems increases motivation (Jones et al., 2015; Zainuddin, 2018). Students are encouraged to think about their learning, which stimulates higher-level thinking and goes together with meaningful exchanges between students and between students and teachers. Billingsley, Thomas, and Webber (2018) found that students often can determine which types of instruction methods are best for them.

Giving students options in the classroom is broken down into two categories, within-activity and across-activity (Ennis, Lane, & Oakes, 2018). Within-activity choices are choices about how an activity is to be completed, which include choices of partner and notetaking style or how to solve a problem. Across-activity choices are giving students choices of what activity they would like to do, such as completing research on the internet or using a textbook for research (Ennis et al, 2018). Varied levels of success have been found with these choices, and the success has depended on the students; some students have performed better with one type of choice while peers have performed better with the other type (Lane et al., 2015).

Cozza and Oreshkina (2013) found that explorative metacognitive processes or understanding what exactly needs to be figured out and needs to be done, contributed most to the learning process. Students in this study would reflect back on what was already known or learned recently and figure out how to start from there and explore outward, looking for a solution to a problem. Cozza and Oreshkina also found that the problem-solving process, similar to what would be used during problem-based learning, was recursive between exploring metacognitive (EM) and implementing metacognitive (IM). In EM a student “monitors the progress, comments and determines whether to continue or stop working through the steps”

(Cozza & Oreshkina, 2013, p. 277). In IM a student "engages in metacognitive decisions to build on, check, or revise previously considered steps and decisions" (Cozza & Oreshkina, 2013, p. 277). This recursive nature of problem-solving shows the complexity of working challenging problems and why doing so in the classroom with an instructor present and able to assist is more beneficial than attempting to work these thought-provoking problems at home, increasing student motivation at school.

Tanner's (2012) research into metacognition in an undergraduate biology class reaffirmed the necessity of teaching students metacognitive strategies. Instead of assuming that students will think about what they know and need to know it would be useful to teach students strategies about how to investigate and solve problems. Not doing so sets up an experiment to fail, something that may cause research in education to have negative results but only because the students lack knowledge of metacognitive processes. This error in reasoning could cause false negatives in experimentation that need to be carefully avoided.

Tanner (2012) also found that an increased focus on active learning was causing students to be active while learning instead of actively learning. During the 1980s there was a push for hands-on learning that got students to be active and involved but that did not always translate to actively learning. The 1990s led to a push towards minds-on learning, where students are focused on what they were learning while being active in their learning. This was found to still be an issue by Tanner, that students would be active while learning but not actively learning, another reason for needing to teach the metacognitive learning skills where students would stop and evaluate what they were doing, why they were doing it, and what to do next.

Hypermedia, which is a computer-based system that incorporates text, audio, video, animations, and graphics, puts the student cognitively and metacognitively in charge (Moos &

Bonde, 2016). The student decides how and how quickly to progress in this system, which directly ties into the field of self-regulated learning (SRL). Students who are motivated to learn are highly self-regulated learners which also increases self-efficacy (Cuenco-Carlino et al., 2016; Macklem, 2015; Usher, 2009). Students taking control of their own learning by using SRL prompts to decide how much they want to learn is the heart of metacognition (Moos & Bonde, 2016). These prompts allow students to test themselves; if students do not know the answer or if they do not even understand the question they can go back in the video and figure out what they missed. This gives the students full control and allows them to review a topic that was missed, something that cannot be done in a regular classroom. This immediate feedback incentivizes and motivates students to do better. While some students have accommodations that allow them to record lectures this is not for all students. Being in control and being able to rewind a lecture can allow all students to get closer to mastery. The metacognition theory is satisfied as more students are able to take control of their learning destiny, increasing student motivation and increasing academic achievement (Tanner, 2012).

Cooperative learning. Many researchers believe working with a partner increases student motivation, which in turn increases the need for cooperative learning (Fernandez-Rio, Sanz, Fernandez-Cando, & Santos, 2017). As the ever-changing world becomes a more global society more cooperative learning and teamwork will be required to solve problems, and if students can learn these skills and be more motivated to learn at the same time, then they should do so. Simply completing work cooperatively can increase intrinsic motivation. Wax (as cited in Kohn, 1986, p. 147) also strongly defended the importance of cooperative learning:

> One must marvel at the intellectual quality of a teacher who can't understand why children assault one another in the hallway, playground, and city street, when in the

> classroom the highest accolades are reserved for those who have beaten their peers. In many subtle and some not so subtle ways, teachers demonstrate that what children learn means much less than that they triumph over their classmates. Is this not assault? … Classroom defeat is only the pebble that creates widening ripples of hostility. It is self-perpetuating. It is reinforced by peer censure, parental disapproval, and loss of self-concept. If the classroom is a model, and if that classroom models competition, assault in the hallways should surprise no one.

Cooperative learning attempts to solve some of this problem, giving students greater opportunity to interact with each other and with their teachers, working together as one society to achieve a common goal, the education of all students. There is one drawback of this approach that was found in research by Blair, Maharaj, and Primus (2016): this approach may limit the achievement of the highest performing students. The higher performing students may spend more time assisting other students instead of maximizing their own abilities. Those students will learn what they teach to the lower-achieving students but will not be able to explore higher-level thinking unless they are grouped homogenously (Blair et al., 2016). This grouping is up to the classroom teacher and that decision should come after much thought.

Researchers have found success from students working cooperatively and discussing their problem-solving strategies (Murata et al., 2017). Higher-performing and weaker students often have different problem-solving strategies and discussing how they came to a solution helps students of all ability levels learn new strategies. Slavin (2015) warned of offering rewards for the group product during cooperative learning as the higher-performing students are likely to turn in their work and leave the weaker students behind. The jigsaw method of cooperative learning, where each member focuses on one part and the group combines the individual pieces

into one whole, is not as effective as group exploration, where the group researches everything together. The jigsaw method causes greater knowledge in one focused area but less knowledge in other parts (Slavin, 2015). Cooperative learning can be a great instructional method but teachers must be careful when implementing it to have selective grouping and avoid the pitfalls that can happen when students work together.

Gamified learning. Many researchers have theorized that implementing more technology in the classroom will help students become more motivated and therefore learn more (Aldemir, Celik, & Kaplan, 2018; Barata, Gama, Jorge, & Gonçalves, 2014; Buckley & Doyle, 2016; Ciampa, 2014; Hung, Sun, & Yu, 2015; Molins-Ruano et al., 2014; Roh & Kim, 2015; Subhash & Cudney, 2018; Zainuddin, 2018). Although people think of technology when they hear the term *gamified learning*, this term really applies to any type of game played in an educational environment, which typically includes some form of technology now. Gamified learning captures students' attention, motivates students, promotes healthy competition among students, teaches students to work as part of a team, and teaches students to communicate (Barata et al., 2014; Subhash & Cudney, 2018). Buckley and Doyle (2016) found that creating a gamified learning environment by using an internet-based game had a positive correlation with student learning, along with increasing student participation. A student's primary type of motivation, whether intrinsic or extrinsic, played a role in their motivation level.

Ciampa (2014) found that using touchscreen tablets increased student intrinsic motivation. These findings agreed with Malone and Lepper's (1987) taxonomy of intrinsic motivations for learning which says that motivation can be increased by challenging students, allowing students to explore their curiosity, control their learning, recognize their mistakes and learn from them, compete both against themselves and against each other, and work together

(Ciampa, 2014; Subhash & Cudney, 2018). Offering students more challenging games causes students to be more fully immersed into the game and therefore are more motivated, more satisfied, and learn more. Just playing games, whether on computers or touchscreen tablets, while being helpful, can be much more beneficial if they challenge the students. Games that are below level allow students to play while being distracted and lessen the focus required, limiting the benefits gained (Barata et al, 2014; Hung et al., 2015).

Molins-Ruano et al. (2014) and Roh and Kim (2015) connected the use of technology with problem-based, hands-on learning. Computer science students over the course of three years designed a video game for the history department (Molins-Ruano et al., 2014). It was found that students were highly motivated to complete this technological problem-based learning project. This being an interdisciplinary project may have also contributed to student motivation. Roh and Kim found that implementing both problem-based learning and technology-enhanced simulation increases motivation more than either did individually. This showed that combining methods in efforts to increase motivation will likely be more productive than any individual method. Jones et al. (2015) found that hands-on activities, like those completed by Molins-Ruano et al. and Roh and Kim, help students to be highly motivated. Supporting the idea of using hands-on learning with tablets is Volk et al. (2017). They found benefits for second grade math students using tablets to connect the concrete, visual, and abstract along with improved problem-solving skills.

Orhan Göksün and Gürsoy (2019) found benefits from using gamified applications Kahoot and Quizizz. In this particular experiment students using Kahoot showed the most growth followed by the control group with students using Quizizz showing the least growth. The researchers noted that Quizizz had limited visual feedback for incorrect answers and that many

students had internet issues when using this piece of technology. Therein lies an issue that arises with technology; it sometimes fails and teachers must always have a backup plan. In the case of an experiment this failing can cause false negatives.

Bury (2017) found that students enjoyed using digital quiz tools because they give extra stimuli and immediate feedback about correct and incorrect answers. Turan and Meral (2018) found that game-based systems improved student achievement and participation and test anxiety was lessened. Fotaris, Mastoras, Leinfellner, and Rosunally (2016) determined that each of three gamified systems increased student motivation, academic performance, and knowledge retention. Students said they really enjoyed the ability to get instant feedback from the programs.

Gamification can be an excellent motivator for students but students must be reminded that the game is for fun and for learning. In Cahyani's (2016) experience, students had fun in gamified environments. Licorish, Owen, Daniel, and George (2018) noted that sometimes students can become overly competitive and create environments where winning is the only goal, putting negative pressure into the learning environment. Gamified learning does increase student-teacher interactions, making students more comfortable to ask questions in the classroom, therefore increasing learning (Licorish et al., 2018).

Gamified learning is not limited to the instruction; assessments can also be gamified (Kocadere & Çağlar, 2015). Gamifying the assessment is a game-changer with instructional outcomes. The benefits of a gamified assessment can be summarized with five words: enjoyment, flow, motivation, learning, and low-anxiety. Students enjoy gamified assessments, something that is rarely said about summative assessments. Because they are enjoying the assessment the time quickly flows by, instead of slowly ticking by as an assessment drags on.

Students are motivated to complete a gamified assessment since it is more fun than regurgitating information or answering writing prompts (Kocadere & Çağlar, 2015). Unlike in traditional summative assessments, a gamified assessment often gives students an opportunity to learn as they progress through a game, similar to what happens in real life. Finally, a gamified assessment is low-anxiety when compared to a traditional assessment. There are a couple of drawbacks to gamified assessments, primarily being the fact that students who are progressing slowly may get discouraged and that struggling students may not have the opportunity to complete all questions since they have not progressed completely through the game.

Teacher Training

Bottge et al. (2014) noted the importance of professional development for teachers, especially with multimedia, hands-on projects, and complex math concepts. Having some sort of instructional coaching in place can be highly beneficial, especially in challenging situations, such as a low income school (Reddy, Dudek, & Lekwa, 2017; Shernoff, Lekwa, Reddy, & Coccaro, 2017). One study showed that top-performing teachers produce three times the growth in students as low-performing teachers (Hanushek, 2011). Working with low-performing teachers and turning them into top-performing teachers would revolutionize education.

Effective professional development instead of time-wasting professional development (PD) is a goal for all educational administrators and teachers; the question is how to achieve that effective PD (Hunzicker, 2011). Quality teacher PD encompasses sustained and intense learning rather than shorter PD (Garet, Porter, Desimone, Birman, & Yoon, 2001). Hunzicker explained that part of what makes professional development ineffective is how it is delivered. In their daily work teachers are on their feet, walking around a classroom explaining things to students.

Ineffective PD flips that around and puts teachers in a chair for an hour or more at a time and expects them to retain what they were just told. Effective PD finds ways to keep teachers active so that they are doing the things they do during a normal day as they learn from a trainer (Hunzicker, 2011). Teachers also felt that PD related to their subject matter and learning that allows them to participate, or complete hands-on learning, is most useful (Garet et al., 2001). Garet et al. found that PD related to instructional delivery was less beneficial than PD related to instructional areas, particularly math and science.

Summary

Student self-efficacy and learned helplessness greatly affect the learning that takes place in a classroom. When students have confidence in their own abilities they are better able to achieve their goals. When students develop learned helplessness they are unable to achieve their goals because they are unwilling to attempt to overcome any obstacles that may present themselves. Remedial math instruction in a low income, rural school is a complex task. Teachers must make themselves aware of the conditions their students undergo. Math instruction is challenging because of the way math builds on itself. Remedial instruction is challenging because students in these classes often have disciplinary issues. Instructing low income students can be a challenge because these students often cause disruptions in class and have little support at home. Instructing students in rural areas carries its own specific challenges such as a lack of resources and a lack of peers to work with to develop instruction.

Furthermore, attendance is an important part of schooling. Teachers and students must both be present for quality instruction and learning to take place. Teachers must be present so that they can use their content knowledge to instruct students. Students must be present in order to learn directly from said teachers. Student motivation also is another important part of the

learning process. Metacognition, or students having some control over their learning, increases student motivation. Cooperative learning helps students learn by working with their peers. Gamified learning can make the classroom more fun for students and increase student motivation. Teacher training is also important as it helps teachers stay up-to-date about educational trends. Better professional development helps increase teacher effectiveness and can help turn low-performing teachers into high-performing teachers.

Ultimately, the question that still exists is how this conflation of factors affects instruction and what leads to quality instruction in this specific environment. The research gives a variety of ideas that may help make instruction more effective in individual situations. This proposed study looks to address this specific situation that includes remedial math instruction in a low income, rural school. Knowing how to motivate students is beneficial and the teachers in this proposed study may have found success using some of the motivational strategies or using other strategies of their own.

CHAPTER THREE: METHODS

Overview

The purpose of this applied study was to solve the problem of low standardized test scores in a remedial class for a middle school in southern Virginia and to formulate a solution to address the problem. Some students take a remedial math class and experience limited success in this class. Some students' standardized test scores increase while others remain low. Improving instruction so that all students experience success may help increase standardized test scores. An applied research design was used that incorporated quantitative survey data and qualitative interviews and an online discussion board. Five teachers of the remedial math class were interviewed about their experiences while peer math teachers, special education teachers, and administrators were surveyed about their experiences. Interviews were semi-structured. They were recorded and then transcribed and coded to determine what teaching methods worked in their remedial instruction. An online discussion board allowed for conversations about successes from the remedial math class and what may need to be improved. Survey responses were collected and analyzed then represented pictorially. Included in this chapter are the research design, research questions, and setting, including school, district, and course. Also discussed are the participants, the researcher's role, procedures, and data analysis. The chapter concludes with a summary.

Design

This research used an applied research design. Applied research seeks to solve a problem in a particular field (Bickman & Rog, 2009). Applied research is often on a more hurried timetable than basic research since there is a problem that needs swift action (Bickman & Rog, 2009). The applied design is appropriate in this situation because a problem, low standardized

test scores in a remedial math class in a middle school in southern Virginia, exists and a solution for this problem is needed.

This applied research design included both quantitative and qualitative forms of data collection to solve a problem in a specific classroom in a specific school. The first approach was qualitative, in the form of interviews that were completed with teachers with direct knowledge of the remedial class. The second approach was qualitative in the form of online discussion boards that were completed with teachers and administrators with knowledge of this remedial math class. The third and final approach was quantitative, in the form of surveys sent to teachers and administrators with knowledge of low standardized test scores for this class. This research was explained using Bandura's (1977) self-efficacy theory and learned helplessness theory (Abramson et al., 1978).

Research Questions

Central Question: How can the problem of low standardized test scores in a remedial math class be solved in a middle school in southern Virginia?

Sub-question 1: How would educators in an interview solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia?

Sub-question 2: How would educators and administrators in an online discussion board solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia?

Sub-question 3: How would educators and administrators in a survey solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia?

Setting

The setting for this study is a primary school location in a school district and a particular class that is offered in that school. All names used throughout this study are pseudonyms to protect the identity of the participants.

School and District

Freedom Middle School (FMS) is a middle school serving grades 6-8 in southern Virginia. FMS is one of four middle schools in Washington County. Freedom Middle School offers a remedial math class that students take in place of two electives. Two of the other three middle schools in Washington County, Glory Middle School (GMS) and Patriot Middle School (PMS), offer the same remedial math class as FMS. The class size depends on the school and the classroom. Some schools fill every seat in the room like a regular math class while other schools try to make the classroom have a small group atmosphere. This location was chosen due to the researcher's familiarity with the school and district and knowledge of the problem that needs a solution.

Course

The remedial math class is called Math Lab and is located in a computer lab. Washington County Schools (WCS) has site-based management and each principal and Math Lab teacher has great flexibility in how the class is taught. Different schools and teachers have found success with different instructional approaches. Math Lab is offered during elective time, but students are required to take it based on principal and teacher decision. Most students have the option to take four electives, one of which is the required physical education class. Some students receiving specialized services have two periods of Resource, a small-group class with a Special Education teacher. Those students are unable to take Math Lab due to not having

enough availability in their schedule. Some students receive specialized services but are not enrolled in Resource, therefore having availability in their schedule to take Math Lab. The majority of students in Math Lab have underperformed in math in the past, making this class challenging to teach. Many students have discipline or attendance issues, other factors that make this class challenging to teach.

Participants

Two different types of participants were included. Current and former Math Lab teachers were interviewed. Teachers and administrators with knowledge of Math Lab were surveyed for quantitative data and were included in an online discussion board for qualitative data. These two types of participants gave a variety of information about this class.

Teachers and Administrators

The survey participants were all teachers and administrators in the same building that offers the Math Lab class. General classroom math teachers, special education teachers who have co-taught classes of students that take Math Lab, and building administrators were surveyed. FMS has nine math teachers, four special education teachers, and two administrators. Twenty total survey invitations were sent to current and former teachers and administrators. A survey sample size of 15 was achieved with a response rate of 75%. This high response rate was achievable because of the researcher's role. Survey participants included one female administrator and nine female and five male teachers. All participants are white. Participants had an average of 17 years of experience with an average age of 43 years.

Math Lab Teachers

The interview participants were five current and former Math Lab teachers. There were only five current and former teachers available, and the response rate was 100%. For this class, there is only one teacher per school, but this class has an abnormally high teacher turnover rate compared to other teaching positions. The teachers were all white and three were male and two were female. Purposeful sampling was used and is important because the goal of qualitative research is to ensure the data is information rich (Patton, 2015). Interviewees had an average experience of 17 years and an average age of 42 years.

The Researcher's Role

I am a former teacher at FMS and taught math at the school for five years. My current position is working as an Instructional Technology Research Teacher (ITRT) at two of the three schools in the Washington County School district that offers Math Lab. I know the teachers and administrators at FMS on a personal basis. My current work entails advising teachers on strategies and training them in how to use various technologies. I believe that the flexibility that this class allows does not give teachers enough guidance in how and what to teach, causing teachers to become frustrated, success in the class to be limited, and for teachers to request a transfer. This class could be effective but has so little guidance and teacher training that the effectiveness is limited. I rarely go into the classroom while instruction is taking place except in case of emergencies when a teacher needs technological assistance. Since my job is to train teachers, on technology instruction more than subject instruction, I feel that I was able to honestly review the data that had been collected and analyze it with a teacher trainer's mentality, looking for ways to improve instruction in this course.

Procedures

Procedures began with securing Institutional Review Board (IRB) approval. Ethical implications were considered both for IRB approval and out of respect of the research participants. Quantitative and qualitative data were collected. Logistics related to IRB approval and data collection were discussed. Permission from the IRB was obtained (see Appendix A for IRB approval). Written permission to conduct the study was obtained from the superintendent and the principal of the participating school (see Appendix B for permission letter). Since all participants were adults, consent to interview was granted as a survey question and before starting each interview (see Appendices C and D for recruitment letters and Appendixes E and F for consent forms).

Data Collection and Analysis

Three data collection approaches were used in this applied research study. The first approach was qualitative, in the form of interviews. The second approach was qualitative, in the form of an online discussion board. The third approach was quantitative, in the form of surveys.

Interviews

The first sub-question for this study explored how educators in an interview would improve instruction of remedial math classes in a middle school in southern Virginia. There are five current or former teachers of this class. The interviews were semi-structured with a script of questions to be followed, but the semi-structured approach allowed the researcher freedom to ask for clarification as needed (see Appendix G for the interview script). As the interviews were conducted, the script was followed, but the goal was always to understand the central phenomenon and to answer the research questions (Creswell & Guetterman, 2019). Some scripted questions changed when other questions became necessary during the interview process.

Interviews lasted between thirty minutes and one hour. The focus of each interview was what methods have been successful and what have been unsuccessful at aiding student instruction and helping them pass their standardized tests. This success in aiding instruction could be based on whatever the interviewee felt has caused success. For some students success in Math Lab may have been a gain in confidence while for others it may have been passing a standardized test for the first time. Math Lab success may also have been based on classroom teacher feedback. The primary goal of the interviews was to solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia. The interviews looked to answer the research sub-question of "how would educators in an interview solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia?"

The interview questions are listed below and a discussion of how they are grounded in the literature follows:

1. Describe your students' comfort level in mathematics.
2. How would you describe how being in Math Lab has helped or hindered their understanding of the process of mathematics?
3. What activities in Math Lab have helped them learn the most?
4. What activities in Math Lab have helped them learn the least?
5. How has your students' self-confidence (in relation to math) changed since they started in Math Lab?
6. What experiences in Math Lab have contributed to that change?
7. What could help them be more confident with their math abilities?
8. What from Math Lab has made them less confident in their math abilities?

9. How would you describe your students' progress in mathematics since entering Math Lab?
10. How has your students' self-confidence (in relation to school) changed since they started in Math Lab?
11. How has Math Lab helped students overcome past struggles?
12. How has Math Lab helped students see math as being worthwhile?
13. If you have any students who are taking Math Lab for the first time, please explain how their motivation has changed as a part of taking Math Lab.
14. How has cooperative learning affected your instruction in Math Lab?
15. How has gamified learning affected your instruction in Math Lab?

The interviews were completed online using Google Meet. This allowed for a quiet, comfortable, safe, and controlled environment, as interviewees got to choose their exact location to partake in the interview. This was a change due to the COVID-19 crisis that closed schools before this research took place. Keeping the interviewee comfortable leads to more open and honest answers (Pedersen, Delmar, Falkmer, & Grønkjær, 2016). The interviewees were sent a script of the questions one week before the interview so they could prepare for the questions and possibly bring artifacts or web examples of especially beneficial instructional methods. Sending the script of the questions helped build rapport with the interviewees, an important first step in ensuring that quality data arise from the interview (DiCicco-Bloom & Crabtree, 2006). The interviews were audio recorded and video recorded with digital versions of documents shared with the interviewer.

Questions one, five, six, seven, eight, and ten all related directly to student confidence and how their confidence helped them learn. This ties in directly to Bandura's (1977) self-

efficacy theory. Question two related to how understanding math requires understanding the whole process (Bottge et al., 2014). Questions three and four related to activities that help students learn math; some specific ones to spur discussion are given by Bosch and Bowers (1992). Question nine related to how mathematical growth is a continual process and not just a quick fix (Bottge et al., 2014). Question 11 related to overcoming learned helplessness, a major issue in learning after repeated failures (Abramson et al., 1978). Question 12 related to see math as a worthwhile subject (Bottge et al., 2014; National Research Council, 2001). Question 13 related to student motivation and how motivated students perform better than their less motivated peers (Alivernini & Lucidi, 2011; Trevino & DeFreitas, 2014). Question 14 related to how cooperative learning has affected instruction (Fernandez-Rio et al., 2017). Question 15 related to how learning by playing and competing in games affects instruction effectiveness (Buckley & Doyle, 2016).

The interviews were analyzed first by transcribing them within 48 hours after they were conducted and utilizing member checks to verify accuracy and understanding. Having interviewees verify data when it is still fresh in their minds can be a useful part of the interview process, helping the researcher ensure that a response was not misunderstood (Bickman & Rog, 2009). The researcher coded interview data and created themes, suggested by Creswell and Poth (2018). Coding allows data from interviews and surveys to be categorized before further analysis. Coding the data creates categories in which the researcher places the qualitative data. These categories can be created from the research or inductively generated based on interview responses. The researcher took special precaution to repeatedly read the interview transcription to avoid missing how the coded results related, a danger of coding qualitative data (Bickman & Rog, 2009). Also completed was representing the data terminology used by Creswell and Poth

meaning to put the themes in a visual presentation that can easily be grasped. Tables 1-3 are the visual presentation of the coded data from the interviews and are included in the data results in Chapter 4.

Online Discussion Board

The second sub-question for this study explored how online discussion boards would inform the problem of remedial math standardized test pass rates in a middle school in southern Virginia. A Google Classroom was setup by the researcher and all participants were sent an invitation to join. Joining is a simple process that only required participants to click one button in an email. After joining, all participant were able to read through the discussion questions and answer them (see Appendix H for a list of discussion board questions). The online discussion boards were open for three weeks, which gave the participants enough time to read through the posted questions and to respond with thorough feedback to other participants. The researcher was able to spur discussion by asking for more information to help answer the interview sub-question which was: how would educators in an interview solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia?

This discussion board was limited to seven open-ended questions in hopes that the participants would answer the majority of the questions and be willing to partake in the discussion part of the discussion board, not just simply answering questions without returning to the Google Classroom. The questions were all grounded in the literature, as explained below. The questions were:

1. How would you describe how being in Math Lab has helped or hindered their understanding of the process of mathematics?
2. What activities from Math Lab have helped students learn the most?

3. What activities from Math Lab have helped students learn the least?
4. How has your students' self-confidence (in relation to math) changed since they started in Math Lab?
5. What experiences in Math Lab have contributed to that change?
6. What could help them be more confident with their math abilities?
7. What from Math Lab has made them less confident in their math abilities?

Questions four, five, six, and seven all related directly to student confidence and how their confidence helps them learn. This ties in directly to Bandura's (1977) self-efficacy theory, as greater self-confidence leads to increased confidence in achieving their own goals. Question one related to how understanding math requires understanding the whole process (Bottge et al., 2014). Questions two and three related to activities that helped students learn math; some specific ones to spur discussion are given by Bosch and Bowers (1992). Strategies to help spur discussion that could be used in Math Lab included connecting topics to the interests of students and combining instruction with real-world problems (Bosch & Bowers, 1992).

Surveys

The third sub-question for this study explored how educators and administrators in a survey would solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia. Surveys were completed with general education classroom math teachers and special education co-teachers of math classes, all having experience teaching students who take Math Lab. Also surveyed was one school administrator. These surveys were created using Google Forms due to the familiarity of the researcher with Google Forms. It is an easy-to-use web-based survey program that can limit access to within the district. This district never removes access to email, even for retired or departed employees, so this ensured that only

the appropriate people were able to respond. Emails were sent to invite teachers and administrators to complete the online surveys. A follow-up email was sent weekly until 75% of participants had completed the survey; 75% was needed due to only having 20 possible participants. Fifteen responses were needed for statistical reliability. Once the survey had 15 responses the researcher deactivated the survey.

The surveys included quantitative questions with Likert scale responses (see Appendix I for the list of survey questions). These questions gauged the quality of instruction in Math Lab and determined which parts of Math Lab have been successful in helping students pass their standardized math test and which parts have not helped students to be successful. Survey questions were asked in order to summarize how students' knowledge and confidence has been affected by taking Math Lab, along with determining whether specific instructional strategies had helped students learn and pass their standardized test. Short surveys can be a valuable source of information for large groups where completing interviews would be too time consuming (Bickman & Rog, 2009; Creswell, 2009). The usefulness of a survey varies directly with the quality of questions included (Bickman & Rog, 2009). Ultimately, all survey questions were grounded in the literature. Below are the survey questions grounded in the literature.

All questions are on a scale of 0-5 with zero meaning little to none shown and five representing exceeding expectations.

1. Rate your students' growth from taking Math Lab.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

2. Rate your students' progress in mathematics since entering Math Lab.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

3. Rate how your students' self-confidence (in relation to school) changed since they started in Math Lab.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

4. Rate how Math Lab has helped students overcome past struggles.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

5. Rate how Math Lab has helped students see math as being worthwhile.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

6. Rate how student motivation has changed as a part of taking Math Lab.

0	1	2	3	4	5
Little to no	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

growth shown					

7. Rate how gamified learning has helped students learn in Math Lab.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

8. Rate how technology-based learning has helped students learn in Math Lab.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

9. Rate how cooperative learning has helped students learn in Math Lab.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

10. Rate how giving students more choice has helped them learn in Math Lab.

0	1	2	3	4	5
Little to no growth shown	Barely met expectations	Partially met expectations	Met expectations	Partially exceeded expectations	Exceeding expectations

Question one asked simply for growth from taking Math Lab, relating to how students must always grow, especially in remedial classes (Bottge et al., 2014). Question three related directly to student confidence and how their confidence helps them learn. This ties in directly to

Bandura's (1977) self-efficacy theory. Question two related to how mathematical growth is a continual process and not just a quick fix (Bottge et al., 2014). Question four related to overcoming learned helplessness, a major issue in learning after repeated failures (Abramson et al., 1978). Question five related to see math as a worthwhile subject (Bottge et al., 2014; National Research Council, 2001). Question six related to student motivation and how motivated students perform better than their less motivated peers (Alivernini & Lucidi, 2011; Trevino & DeFreitas, 2014). Question seven related to students learning using games, typically technology-based games but also including other table-based games, a strategy that has found success by multiple researchers (Buckley & Doyle, 2016; Ciampa, 2014; Hung, Sun, & Yu, 2015). Question eight connected the use of technology to student learning, an idea supported by many researchers (Buckley & Doyle, 2016; Ciampa, 2014; Hung, Sun, & Yu, 2015; Molins-Ruano et al., 2014; Roh & Kim, 2015). Questions nine asked the teacher to judge how cooperative learning has helped remedial students, a teaching strategy that has been found to be very successful (Fernandez-Rio et al., 2017). Question ten related to the concept of metacognition and how giving students more control over their educational choices will incentivize them to be more successful academically (Cozza & Oreshkina, 2013; Jones et al., 2015; Marks, 2015).

The surveys included quantitative data so the data analysis included analyzing descriptive data. This descriptive data informed the researcher which instructional techniques in Math Lab have been the most beneficial. The data analysis consisted of creating frequency tables of responses and finding means and standard deviations for each question. Themes found from analyzing qualitative data were also applied to the quantitative survey questions.

Ethical Considerations

Respect must be paid to certain situations in order to ensure the collected data is valid. Researchers must be careful not to ask leading questions in interviews and to ensure that all questions asked in all data collection methods be fair and unbiased (Creswell, 2009). Pseudonyms were used for participants and schools so that everyone could be honest in the surveys, discussion board, and interviews and in hopes that the district would grant approval to use one of its schools. Anytime interviews are used negative information could arise so pseudonyms were used to protect the identities of teachers, administrators, and schools. Interviews were conducted virtually so the interviewees were able to choose a location where they had complete privacy. There was some inherent researcher bias due to the researcher being a current employee at the school and having a belief about the possibilities that exist within this remedial class. Considerations were also made to safeguard data throughout the researcher, storing data on a password protected computer and keeping the list of pseudonym identifiers separate from all other data.

Summary

A remedial math class, Math Lab, offered in Washington County Schools has the potential to make a great difference in this district. An applied research design was used to solve the problem of low standardized test scores in a remedial class for a middle school in southern Virginia and to formulate a solution to address the problem. Applied research was used because its goal is to solve a problem in a particular field (Bickman & Rog, 2009). The setting was a remedial math class, Math Lab, which is offered in three middle schools in Washington County Schools. Participants included teachers and administrators with knowledge of Math Lab and current and former Math Lab teachers. The researcher works at the site but has no supervisory

authority over teachers in this school. Data collection included interviewing current and former Math Lab teachers, leading an online discussion board, and surveying teachers and administrators. Data analysis methods were explained, including using descriptive statistics for quantitative data and by coding and finding themes then graphically representing qualitative data, all to be discussed and presented in Chapter 4.

CHAPTER FOUR: FINDINGS

Overview

The purpose of this applied study was to solve the problem of low standardized test scores in a remedial class for a middle school in southern Virginia and to formulate a solution to address the problem. The problem is that there are low standardized test scores in a remedial math class in a middle school in southern Virginia. Therefore, the central question that guided the research was: How can the problem of low standardized test scores in a remedial math class be solved in a middle school in southern Virginia? This chapter will detail the results of the research, including a description of the participants and a presentation of the results of the collected research data. Data results in this chapter reveal remedial math class teacher interview participants' experiences detailed in themes correlated with teacher and administrator participants' experiences provided by surveys and an online discussion board. The analysis of these data culminated into three themes. The themes produced from the data included math instructional methods, remedial instructional methods, and student attitude.

Participants

Bickman and Rog (2009) wrote that it is impossible for researchers to study the entire population related to a problem; therefore, sampling a select group of individuals who are related to the problem from a population must be completed to acquire information connected to the problem; that sample will be the participants. This research used participants who have close knowledge of a particular remedial math class, Math Lab, by either teaching remedial classes or teaching students enrolled in a class at FMS. The participants included faculty who have taught Math Lab, taught students in Math Lab, been co-teachers of students in Math Lab, or been school administrators for students enrolled in Math Lab.

Interview Participants

Five current or former Math Lab teachers were purposefully selected to be interviewed in semi-structured interviews regarding their experiences in Math Lab. The teacher participants included five faculty members with an average age of 42-years-old. There were three male and two female participants. The Math Lab teacher participants were ethnically similar; all five were Caucasian. One of the teachers had a master's degree, and one was enrolled in a master's degree program at the time of the interview. The teachers had an average teaching experience of 17.2 years. Throughout this research, the teachers are referred to as Interviewee One, Interviewee Two, Interviewee Three, Interviewee Four, and Interviewee Five.

Survey and Discussion Board Participants

The survey and discussion board participants were purposefully selected from educators who had experience working with students taking Math Lab. The participant sample included 15 educators who had experience with these students; two had experience as co-teachers of math classes, one had experience as a school administrator, and 12 had experience as math teachers. The average age was 43-years-old. There were five male and ten female participants. The survey and discussion board participants were ethnically similar; all were Caucasian. Four participants had a master's degree, and two were enrolled in master's degree programs at the time data were collected. The survey and discussion board participants had an average teaching experience of 17.4 years. Throughout this research, each of the survey and discussion board participants (who were the same people for each of these two data collection methods) are referred to as Participant 1 through Participant 15.

Results

Data for this research were collected through personal, semi-structured interviews with

five Math Lab teachers, surveys of 15 educators and administrators with experience working with Math Lab students, and an online discussion board with the 15 educators and administrators with experience with Math Lab students. Teachers interviews were conducted confidentially using Google Meet; surveys were completed through Google Forms, and responses were kept confidential; and the online discussion board was closed after two weeks, and participants were reminded that the discussion needed to remain private. The teacher interviews and online discussion board responses were coded and then organized into themes, which were then connected to the quantitative data represented by Likert-scale survey scores.

Sub-question 1

Sub-question one for this study was: How would educators in an interview inform the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia? Interviews were conducted with remedial math class teachers from a middle school in southern Virginia to find themes related to improving standardized test pass rates. Interview responses were coded to find themes (see Appendix J). The frequency of codes showed which areas were most prevalent in answering the sub-question and are presented in Table 1. The major themes that arose from the qualitative interview data were math instructional methods used to teach Math Lab, remedial instructional methods used to teach Math Lab, and student attitudes in Math Lab.

Table 1
Frequency of Codes and Connected Themes

Code	Theme	Frequency
Gamified learning	MIM	22
Cooperative learning	MIM	10
Giving fewer worksheets	MIM	6
Making connections between topics	MIM	6
Giving instant feedback	MIM	2
Knowledge gap between topics exists entering class	MIM	2
Reteaching topics covered in past grades and earlier in the regular math class	RIM	13
Using technology to aid instruction	RIM	13
Making competition a level playing field	RIM	11
Allowing time for individualized instruction	RIM	5
Teaching topics at their instructional level	RIM	5
Pre-teaching topics that are coming up soon in their regular math class	RIM	4
Decreasing rigor	RIM	2
Making sure the class is very structured	RIM	2
Helping students gain self-confidence	SA	24
Helping to motivate students	SA	17
Low comfort level entering Math Lab	SA	15
Making students more comfortable	SA	9
Helping students see math and Math Lab as worthwhile	SA	8
Ensuring students do no lose confidence	SA	6
Giving rewards	SA	2
Having patience with students	SA	2

Theme #1: Math instructional methods. The first of three themes that became evident from the interviews of Math Lab teachers was math instructional methods. Every teacher interviewed made references to a variety of ways they worked to maximize the mathematical learning that took place in Math Lab to help students pass their standardized tests. The most common codes that arose, in order of most frequent to least frequent, were gamified learning, cooperative learning, giving fewer worksheets, making connections between mathematical

topics, giving instant feedback to students, and eliminating the knowledge gap that exists when students enter Math Lab.

Gamified learning was mentioned most of all codes, with quotes like “they loved playing games” (Interviewee One) and “it really gives them that extra motivation” (Interviewee Three). One interesting point about gamified learning was made by Interviewee Three, who said, “The great thing about gamified instruction is it gives instant feedback.” Interviewee Two made a special note that “gamified learning is great if you can make it competitive without adding more stress to it and that’s the key with it because it’ll increase that engagement.” Overall, there was a feeling that gamified learning can really aid in math instruction and create an environment where students enjoy participating but teachers must be careful not to create stressful games.

Cooperative learning was the second most prevalent code that fell into the mathematical instruction theme. Cooperative learning was loved by some teachers and not used by others, while one teacher laid out specific precautions for using any type of peer-to-peer instruction, especially in a math class. On the positive side, Interviewee One noted that, “they all worked together well because they were all on the same level” while Interviewee Four noted, “getting with a partner … has helped them with confidence.… Cooperative learning also helps build kind of a community in Math Lab.” Interviewee Two was hesitant about using cooperative learning, saying:

> You should not do cooperative learning in Math Lab. You should not have someone weak in math trying to explain a math topic that they don’t know to someone else who doesn’t know it. You’ll be fixing more problems then. I don’t think you should use it as a strategy; you let it happen naturally. Your stronger kids are the only ones going to step up. They’re say things like, “Let me help you with that” because they know how to do it

> instead of me saying, "Okay guys, we're going to do peer-to-peer stuff today." Don't plan it. You can't plan it. It has to happen on its own for it to actually work, otherwise you're just going to instead of having to fix one kid's misconceptions you have to now fix two or three, because they spread it around…They're only going to do it when they know they're doing it correctly, when they've been seeing or getting it right, so they're going to help others…If you're doing cooperative learning, group where you have a student with a relative strength in every group. There aren't necessarily stronger students but students with relative strengths on certain topics. Some don't struggle as much with some of the geometry stuff. You can't group when you're starting topics but you can at the end of the week and you have your data showing who is stronger on a particular topic.

The biggest change that all five teachers mentioned was that they would give fewer worksheets. Interviewee Two found that students would show more work when completing assignments on a small dry erase board and entering them into a computer than doing the same assignment on paper. Interviewee Four felt that, "worksheets can be useful; I just have to monitor how I use them and put them in at the right time."

Theme #2: Remedial instructional methods. The second of the three themes that arose through interviews of Math Lab teachers was specific instructional methods that were used because this was a remedial class. Those remedial instructional methods included reteaching and pre-teaching topics, using technology to aid instruction, Math Lab allowing classroom competitions to take place on a level playing field, allowing time for individualized instruction, and making sure to teach topics at the level that students need and can understand.

Reteaching topics was a primary instructional component for every interviewed teacher, whether it was reteaching a topic that was already covered by the general classroom teacher or

whether it was reteaching a skill from a past grade that would be needed in the future. Interviewee Three put it this way:

> I had success with going back and working on skills that they needed to help them be successful in the classroom without actually working on grade-level stuff. I think that actually builds their confidence to go back and build off than to just stick them with the grade level concepts they may not know.

Similarly, Interviewee Four said:

> Hearing a second voice and a second lesson or a second approach on a topic helps them, especially kind of going slower than the regular math class so we can make sure they pick up on it and giving extra time on that topic.… Building up their confidence with reteaching of a topic and showing them that they can do it and them seeing that "Yes, I can do this," so they have more confidence.

Both interviewees felt that reteaching was the most important part of their remedial instruction, as evidenced by it having the highest frequency among codes that fell under the remedial instructional methods umbrella. Pre-teaching, or teaching the basic concepts or skills from a lesson before the classroom teacher was to teach it, was used by a couple of teachers, but that may have been because those Math Lab teachers were also general classroom math teachers for some of their students.

Using technology to aid instruction tied reteaching among remedial instructional methods. Interviewee One put it best:

> They really liked playing the games related to the topics, using the technology.… They didn't enjoy activities that are more written down type activities like worksheets and things they have to do independently that are not technology-related. I think the

> technology gives them extra motivation. When they're expected to do a worksheet on their own after we've gone over a concept I didn't get as good of results.

This quote demonstrated the positivity that can come from using technology instead of just paper-based practice.

The final codes related to remedial instructional methods were competing in a classroom on a level playing field, having time for individualized instruction, and making sure to teach at their level. Interviewee one put the level playing field this way: "In Math Lab they get to be the rock stars because they don't have those higher-level students competing against them. They all worked together because they were all on the same level." Interviewee One also mentioned how computer games helped with individualized instruction so that students "could learn exactly what they needed and not be on the same thing as everyone else in the class." Finally, Interviewee Four discussed a specific part of remedial instruction, specifically stating: "You're always teaching every topic to who happens to be at the lowest level of that topic."

Theme #3: Student attitudes. The third and final theme that emerged through interviews of Math Lab teachers was that precautions had to be taken to account for student attitudes. Student attitudes summarize student self-confidence and motivation, looking at their comfort level entering Math Lab and how to make them more comfortable, ensuring they do not lose confidence while in the class, and helping them see math and Math Lab as worthwhile. Increasing student confidence was the most common code, overall; it was mentioned by every teacher interviewed and was constantly referenced throughout the interviews. Finding ways to motivate students was the third most prevalent code, and that was followed by students having a low comfort level when entering Math Lab. Other common codes related to ways to help students mentally, such as making students more comfortable, helping students see math and

Math Lab as worthwhile, and ensuring students do not lose confidence.

In speaking about improving student self-confidence, Interviewee Two said:

> You've got to find what's going to make them feel better about themselves. For some kids it might be as simple as passing an SOL or it could be getting an A and it could be just passing the math class. That's something that's going to be different for every student. They're going to have their own idea of what a goal would be but you're got to have conversations with them and figure it out because they probably never have thought about it.

Getting to know students is important as it helps teachers know what can be done to help motivate and encourage students and how to keep mentally on track. When students get comfortable in Math Lab, "they actually start asking questions about the math and that's one big thing in Math Lab is trying to get them to open up" (Interviewee Four). Helping students gain confidence, by letting them make small gains and reach their own goals, helps them learn and eventually pass standardized tests.

Student motivation was another common code. Many students coming into Math Lab are unmotivated and lacking confidence, as showed by the low comfort level code. Interviewee Two said, "They need their first win," showing how essential it is to find a way to get students motivated. In discussing possible ways to have taught Math Lab differently, Interviewee Three put it this way: "I wish I would have focused more on the relationship side of it and keeping it lighter and motivating them that way instead of coming down hard on them." Interviewee Four discussed how important it was that students know that the teacher cares for them by saying: "They want to do more work because they know you care."

Having a low comfort level was the fourth most common overall code that emerged during data analysis of the interviews. According to Interviewee Four, "Their comfort level in doing math is very low and that's the first thing you have to solve if you're going to make Math Lab work …They felt like they were there because they were outcasts and they wanted to show off." Interviewee One stated it more bluntly: "They're almost scared of math." Because of the low comfort level entering Math Lab, teachers must be careful to create an environment where students are "more comfortable to ask questions" (Interviewee Four). Some parts of Math Lab are controlled by the school administrators and guidance counselors who schedule students, where they purposefully limit the number of students in the class. Interviewee One made this point clear by saying, "It's a smaller environment and they get to share more and they get excited more when they get a question right … It's just that small group setting that makes them feel more comfortable. They learn to trust you."

Related to helping students gain self-confidence and be motivated, as well as being more comfortable in the class, teachers need to help students see math and Math Lab as being worthwhile. Interviewee Three gave advice on helping students see math as being worthwhile with the following comment: "relating math and helping them see how important it is to that dream they have." Interviewee Four was a little more direct, saying simply that students "see Math Lab as worthwhile when they start seeing their math grade go up." Both of these points support the theme that teachers need to help students see math and the Math Lab class as being worthwhile and help them to be more motivated to participate, learn, excel academically, and eventually pass their standardized test.

Three interviewees discussed situations that caused students to get frustrated and lose confidence, things that must be avoided in Math Lab. Those situations included "when they

would miss an answer and try to look at the explanation that was presented to them and still didn't understand it" (Interviewee Five) and "getting answers wrong multiple times in a row, especially when it's the same topic" (Interviewee two). Also mentioned was "not just struggling on the grade-level material but they were struggling on stuff from a couple years behind" (Interviewee Three). A way to overcome these struggles was by "doing something that they are good at" (Interviewee Two).

Sub-question 2

Sub-question two for this study was: How would educators and administrators in an online discussion board inform the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia? Educators and administrators from a middle school in southern Virginia who had experience working with students enrolled in Math Lab were invited to join a Google Classroom forum where seven discussion questions were posted. The responses to the questions were intended to help identify themes related to improving standardized test pass rates. Discussion responses were coded to find themes (see Appendix K). The frequency of codes showed which areas were most prevalent in answering the sub-question and were presented in Table 2. The major themes that arose from the online discussion board data were math instructional methods used to teach Math Lab, remedial instructional methods used to teach Math Lab, and student attitudes in Math Lab.

Table 2
Frequency of Codes and Connected Themes

Code	Theme	Frequency
Fewer worksheets	MIM	10
Knowledge gap	MIM	6
Gamified learning	MIM	2
Instant feedback	MIM	2
Reteaching	RIM	19
Individualized instruction	RIM	9
Pre-teaching	RIM	5
Technology	RIM	4
Instructional level	RIM	3
Rigor	RIM	2
Communication between teachers	RIM	1
Structure	RIM	1
Self-confidence	SA	22
Lose confidence	SA	5
Small successes	SA	5
Comfortable	SA	4
Low comfort	SA	4
Motivation	SA	2
Patience	SA	2
Reward	SA	2

Theme #1: Math instructional methods. One theme that was revealed during analysis of the interview codes was math instructional methods. The most frequent code related to math instructional methods was giving fewer worksheets in Math Lab while making sure to give quality worksheets when they are given. Participant 7 said, "Worksheets can be valuable but only after the student has grasped the topic." Participant 12 followed with "worksheets without the foundation are useless." Participant 3 went a little lighter on worksheets, saying that "handouts that break down the concepts further and are used as a reference are helpful."

Participant 15 noted that an online instructional program, MAP Skills, "helped close the gaps where information was missing." This program seemed to come under fire as some participants mentioned an overuse of it in the past, being thankful that it was only used to help

with math instruction rather than being the primary method of instruction. Participant 13 said, "To me, when it was 100% computer based, it was less effective. Now with less focus on just doing MAP Skills over and over I see more improvement." Participant 4 supported that idea, saying, "They need direct instruction to support the online activities."

Theme #2: Remedial instructional methods. When reviewing codes, a theme that kept being referenced was remedial instructional methods, and the most common code, by far, was reteaching. This code appeared second most overall, just behind self-confidence. Many classroom teachers commented on how the Math Lab teacher reteaching concepts from past grades and things that they were covering in class helped their students learn and get ready to pass their standardized tests. Specifically, Participant 12 said, "Another person saying the same things you did in class, maybe in a slightly different way, just cannot be beat." Participant 7 agreed, saying "The biggest experience would be when Math Lab became consistent in reteaching the topics the student was currently working on in their regular class." Related to reteaching, Participant 8 found that pre-teaching was helpful in that previous exposure to the topic "helped them learn in class better when we covered those topics."

The code individualized instruction appeared second most of all codes that fell under the remedial instruction theme. Quotes such as, "the individualized help makes all the difference" (Participant 8) and "the individualized instruction absolutely helped my students the most" (Participant 8) demonstrated how classroom teachers felt about the personalized instruction that took place in Math Lab. Participant 14 revealed an added benefit of individualize instruction in saying, "by receiving individualized help, the students were more successful in the lab, and that helped them feel more confident in class."

Giving students work at their ability levels and with appropriate rigor was also popular among codes that related to remedial instruction methods. Participant 8 said it was beneficial to "give them problems on their current level then building their success up to the harder problems." Participant 12 said, "finding a student's present level of performance and then continuing to work past their comfort zone will eventually give them confidence. When they see they are actually doing more than they thought they could, their confidence will improve."

Theme #3: Student attitude. The most common theme in student attitude was self-confidence. Every participant made a comment related to self-confidence, whether it was the need for student self-confidence to increase or that Math Lab had helped student self-confidence increase. Many participants agreed with Participant 12, who said, "with understanding comes confidence." Participant 14, however, mentioned that, sometimes increased confidence led to overconfidence, saying "some students became very confident, maybe thinking they understood better than they actually did."

Participants 13 and 15 provided their honest perspectives about confidence and math and what they had seen from Math Lab, one positive and one negative. Participant 13 said, "A lot of kids shut down in math class because of lack of confidence in doing math, and numbers can be intimidating! Math lab has given my kids confidence coming into my room that I cannot do alone!" Participant 15 did not experience the same growth in confidence from Math Lab that other participants saw, lamenting:

> It was hard to tell with some of the students because they never asked for help in class and rarely passed the assessments given. They did not communicate at all with me and I saw no change in their confidence level.

Finding ways to ensure students did not lose confidence was another prevalent code.

This is important because students in Math Lab already sometimes "viewed their assignment to Math Lab as validating their poor self-image as 'a dumb student in the dummies' class'" (Participant 3). Examples of when they would lose confidence were: "hen others in Math Lab picked up a topic before they could" (Participant 7) and "when they were failing the assessments despite being able to do it in Math Lab" (Participant 15). Participant 12 said, "The key lies in the teacher's ability to re-direct and boost their self-esteem to keep them focused on the journey and not the bump in the road."

Two keys to success in Math Lab emerged in the online discussion board. One of these was related to the need for the teacher to have patience, and the other was creating small goals for the students to achieve. Participant 4 said, "having a Math Lab teacher that refuses to give up and is willing to go the extra mile to help students build that confidence" is important in this setting. Participant 7 said there was a need for "a system of setting up attainable goals that would bring opportunity for small victories and positive returns" and the "Math Lab teacher and math classroom teacher acknowledging the effort and improvement" by students.

Sub-question 3

Sub-question three for this study was: How would educators and administrators in a survey inform the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia? Educators and administrators a were sent an email with the quantitative survey about their experience with a remedial math class. Fifteen educators and administrators completed the 10-question survey. The responses represent growth shown in Math Lab related to different factors, with 0 representing little to no growth being shown and 5 representing exceeding expectations. The mean value and standard deviation was calculated for

each of the questions (see Table 3). Themes used were math instructional methods, remedial instructional methods, and student attitude.

Table 3

Participant Responses to Likert-scale Survey Questions

Responses by Question									
Question	Theme	0	1	2	3	4	5	Mean	Standard deviation
1. Rate your students' growth from taking Math Lab.	MIM	0	0	2	5	6	2	3.53	0.92
2. Rate your students' progress in mathematics since entering Math Lab.	MIM	0	1	3	3	6	2	3.33	1.18
3. Rate how your students' self-confidence (in relation to school). changed since they started in Math Lab.	SA	1	1	2	5	3	3	3.13	1.46
4. Rate how Math Lab has helped students overcome past struggles.	RIM	0	1	2	4	7	1	3.33	1.05
5. Rate how Math Lab has helped students see math as being worthwhile.	SA	0	1	5	6	2	1	2.80	1.01
6. Rate how student motivation has changed as a part of taking Math Lab.	SA	1	1	2	5	5	1	3.00	1.31
7. Rate how gamified learning has helped students learn in Math Lab.	MIM	0	2	0	5	4	4	3.53	1.30
8. Rate how technology-based learning has helped students learn in Math Lab.	RIM	0	1	1	3	5	5	3.80	1.21
9. Rate how cooperative learning has helped students learn in Math Lab.	MIM	0	1	0	7	3	4	3.60	1.12
10. Rate how giving students more choice has helped them learn in Math Lab.	RIM	1	1	2	5	2	4	3.20	1.52

Note. MIM = math instructional model; SA = student attitude; RIM - remedial instructional model.

Theme #1: Math instructional methods. Questions one, two, seven, and nine related to math instructional methods. Question one asked about student growth from taking Math Lab and had a mean of 3.53 and standard deviation of 0.92. Question two asked about student progress in mathematics since starting Math Lab and had a mean of 3.33 and standard deviation of 1.18. Question seven asked about how gamified learning has helped students learn and had a mean of

3.53 and standard deviation of 1.30. Similarly, question nine asked about how cooperative learning has helped students learn and had a mean of 3.60 and a standard deviation of 1.12.

All four questions were in the upper half of the means of all questions. None of the four questions about math instructional methods had high standard deviations, and question one had the lowest standard deviation, showing that the surveyed teachers and administrators felt like there had been growth in students from taking Math Lab. Overall, based on analysis of the statistics, the means indicate that classroom teachers felt Math Lab had a modicum of success using these math instructional methods, but the means were still barely above average and not at the top of the range.

Theme #2: Remedial instructional methods. Questions four, eight, and ten related to remedial instructional methods. Question four asked about how Math Lab has helped students overcome past struggles and had a mean of 3.33 and a standard deviation of 1.05. Question eight asked about how technology has helped students learn in Math Lab and had a mean of 3.80 and a standard deviation of 1.21. Question ten asked about how giving students more choice has helped them learn and had a mean of 3.20 and a standard deviation of 3.52.

Questions four and eight were in the top half of the means with question eight having the highest mean. Question ten had the fourth lowest mean and the highest standard deviation. The standard deviation for question four was third lowest while the standard deviation for question eight was in the middle. Based on the statistical analysis, overall, teachers felt that students showed growth by using technology and were somewhat able to overcome past struggles. Giving students more choice was not as helpful the other two survey options, using technology and helping students overcome past struggles.

Theme #3: Student attitude. Questions three, five, and six related to student attitude. Question three asked about how Math Lab has helped student self-confidence grow; it had a mean of 3.13 and a standard deviation of 1.46. Question five asked about whether Math Lab has helped students see math as being worthwhile and had a mean of 2.80 and a standard deviation of 1.01. Question six asked about how student motivation has changed as part of taking Math Lab and had a mean of 3.00 and had a standard deviation of 1.31.

These questions had the three lowest means, indicating that teachers did not believe Math Lab had resulted in an increase of self-confidence, encouraged students to see math as worthwhile, and had a positive impact on motivation. Question five actually had the lowest mean and the second lowest standard deviation, showing that teachers had not seen much growth in the area of students viewing math aa important and were confident in this assertion, as indicated by the tight grouping.

Discussion

The section provides a discussion of the findings of the research in relation to the literature review in Chapter Two. The triangulation of data from each of the methods of data collection provides support for each of the themes that emerged, which are further explained below as to how they relate to the empirical and theoretical research previously presented.

Empirical Literature

In examining results from the three data collection methods (interviews, an online discussion board, and surveys), three themes emerged that deeply intertwined with the learning that takes place in a remedial math classroom and therefore are closely connected to standardized test pass rates. Those three themes are mathematical instructional methods, remedial instructional methods, and student attitude.

Theme #1: Math instructional methods. Remedial math class teachers must use the best instructional methods available to them. Survey results indicated that gamified learning and cooperative learning were both effective methods of instruction. Gamified learning was one of the most common codes that appeared during the interviews; some interviewees said that it was used nearly daily. Buckley and Doyle (2016) found gamified learning to have a positive effect on student learning and participation. Gamified learning only appeared a couple of times during the online discussion board but was discussed with positivity in both instances.

Survey results indicated cooperative learning was a positive instructional method, but it was not mentioned in the online discussion board and was discussed with trepidation in the interviews. Some interviewees discussed using cooperative learning frequently while others did not mention it. Cooperative learning can be beneficial as it can increase motivation in students (Fernandez-Rio et al., 2017). One interviewee cautioned against using cooperative learning in a math classroom with a remedial group of students, a detail that shows the importance of this particular research.

Utilizing fewer worksheets was discussed by multiple interviewees and every participant in the online discussion board. Worksheets are not interactive and do not give instant feedback, an instructional concept that was mentioned repeatedly. Instant feedback is an essential part of remedial instruction (Nelson et al., 2018). Worksheets are boring for students and should have examples that break down the concepts. They should not be used as a primary instructional method and should never be used to simply keep students busy, as evidenced by the resounding support of giving fewer worksheets in Math Lab. As previously mentioned, giving instant feedback is essential with math students so that they do not continuously repeat an incorrect

process. Letting students know that they are doing the work correctly helps them to gain confidence, a great by-product of instant feedback.

Overcoming the knowledge gap that students have when entering Math Lab is another important part of the class. This knowledge gap was mentioned repeatedly in both the interviews and the online discussion board. Students in Math Lab often lack certain skills from previous grades that limit their potential success in their current grade. Math Lab teachers must work to close those gaps so that students are able to learn new material. This is more important in a math class than other subjects because of the way that math builds on itself.

Theme #2: Remedial instructional methods. Certain strategies must be used when teaching a remedial math class such as Math Lab. Many of these instructional methods relate directly to the remedial part of a remedial math class; they include reteaching and pre-teaching, using technology to aid instruction, being sure to teach at the instructional level that students can understand, and taking advantage of the time that allows for individualized instruction.

Reteaching and pre-teaching were common themes that arose during the interviews and the online discussion board. Reteaching was one of the most common themes that came out of the online discussion board, with many classroom math teachers preferring the Math Lab teacher to teach the same topic that was being taught in class. This reteaching and pre-teaching is in addition to teaching basic skills that are needed to achieve success on the topic being taught. Staying connected to the students in the general math class was a major point found by Campbell and Cintron (2018). The extra time an additional math class period allows gives students another chance to hear math instruction, possibly in a different way that students may understand better. A few classroom teachers mentioned that it was beneficial for the Math Lab teacher to cover

basic skills needed and introduce lessons before the regular class got to the topic, giving the remedial students in Math Lab a head start on the rest of the class.

Interviewees and discussion board participants mentioned using technology to aid in instruction, specifically using instructional programs that could help them work on specific skills they were missing. Both groups also mentioned that just letting an online program do everything was not successful; there had to be a human component to the instruction. It was mentioned that students enjoyed the online gaming aspect of using technology for instruction and seemed to get extra motivation when using technology, an assertion backed by many researchers (Aldemir et al., 2018; Barata et al., 2014; Buckley & Doyle, 2016; Ciampa, 2014; Hung, Sun, & Yu, 2015; Molins-Ruano et al., 2014; Roh & Kim, 2015; Subhash & Cudney, 2018; Zainuddin, 2018).

The final two themes related to remedial instruction that emerged were teaching at students' instructional level and the benefits of individualized instruction. These two codes are closely related and will be discussed together. Multiple interviewees mentioned how teachers must explain topics at students' levels of understanding, an assertion backed by Kingsdorf and Krawec (1983). This is true in all classes but especially true in a remedial class where students are likely to quickly get confused if teachers give explanations that are above what their students can understand. Every topic should be explained at the lowest level possible then slowly increased or expanded as understanding improves. Because of this need to build, remedial classes purposely have small class sizes and allow teachers to enjoy the time that they are able to spend working one-on-one with students to help them with their specific needs. This type of interaction also helps the Math Lab teacher explain topics at the levels that students need since the teacher should be able to get to every student individually during every class.

Theme #3: Student attitude. The third and final theme that arose through the research study may be summarized as student attitude. Themes that fell under the student attitude theme include students having a low comfort level entering Math Lab, helping students to feel comfortable in Math Lab, student self-confidence, making sure students do not lose confidence, student motivation, helping students see math and Math Lab as worthwhile, and Math Lab teachers having patience. These themes all were found to be important to Math Lab teachers and general classroom math teachers; some of these themes also resulted from the survey.

When students enter Math Lab, most are uncomfortable doing math assignments; this has to be cognizant in every Math Lab teacher's mind. As mentioned by many interviewees and discussion board participants, students in Math Lab are weaker mathematically. Some students also enter the class frustrated because they are being forced to take a remedial math class instead of a fun elective. This combination of weaker math students who are frustrated with being required to take a remedial math class creates a challenging instructional environment. To combat this situation, teachers must strive to help students feel comfortable in Math Lab. One interviewee mentioned how the small group environment inherently helps with the comfort level. Also mentioned in the interviews was how the teacher must gain the students' trust, letting them know that Math Lab is not a place where they will be judged. Students must be comfortable asking questions. One interviewee noted that, when students are not afraid to ask questions in the classroom, the teacher knows that students are comfortable.

Helping students gain self-confidence was the most common theme in both the interviews and the online discussion board. Survey responses indicated that helping students gain self-confidence was one of the lower areas of growth. Interviewees mentioned that really getting to know students helped teachers to work with students so as to increase their self-confidence, as

different students had different goals. Most interviewees and discussion board participants felt that when student see some success in learning or improved grades in their math class, it helped students gain self-confidence. Teachers admitted that some students lose self-confidence if those students do not see success in math class while having success in Math Lab. Students also lose confidence when they struggle on certain topics while their remedial peers understand the topic or they struggle with topics from previous grades. A suggestion for combating this possible loss of confidence was to return to a topic that the teacher is sure the struggling student knows.

Many Math Lab teachers mentioned motivating students as being a primary goal of their instruction or something that they should have spent more time doing. Since many students in Math Lab have struggled in the past, some of them "need their first win" (Interviewee Two). Even though many Math Lab teachers mentioned student motivation as a goal in class and a byproduct of many activities in class, survey results indicated that general classroom teachers had not seen much growth in student motivation; growth in students motivation actually had the second lowest survey mean, showing that general classroom teachers did not see the growth in student motivation that Math Lab teachers saw.

The lowest survey mean was from the theme of helping students see math and Math Lab as being worthwhile, which did not seem to be a major goal of the Math Lab teachers based on survey results, interviews, and the online discussion board. One interviewee said that students do not see Math Lab as worthwhile until they see improvement in their regular math class. It is possible that students not seeing math and Math Lab as being worthwhile contributes to the need for Math Lab teachers to have patience. According to the interview responses, teachers must have patience with students as they slowly progress, setting small goals for them to accomplish rather than expecting great growth all at once. Teachers admitted that they have to work to stay

positive themselves, as growth does not always come easily, a fact that can deflate teachers who are initially excited to teach a remedial class.

Theoretical Literature

Extant research supports the theoretical literature related to remedial math instruction at a middle school in southern Virginia. The related theories were previously identified as self-efficacy theory and learned helplessness theory. The data collected and analyzed relate to these theories and inform the problem and potential solution to the problem.

Self-efficacy theory. Bandura's (1997) self-efficacy theory was found to be interconnected with Math Lab instruction as data was collected and analyzed. According to Bandura, self-efficacy is a self-confidence where a person believes that he or she can reach a goal. Similarly, having high self-efficacy means a person can overcome the challenges that arise and eventually achieve a goal (Bandura, 1986). Many teachers described students as having low self-efficacy, even though that specific term was not used by teachers. The term self-efficacy is not common in this school, but the concept was repeatedly discussed; all interviewed Math Lab teachers mentioned students' lack of confidence that causes them to give up quickly.

Teachers discussed ways of slowly increasing self-confidence and therefore increasing self-efficacy, such as starting with basic skills that students could master then advancing to more complex topics. This approach backs the approach used by Siegle and McCoach (2007). Contrary to Usher (2009), no teacher in interviews, online discussion board, or survey thought that using self-regulated strategies was beneficial, although all interviewees agreed that specific lesson structures did increase self-efficacy in students. Overall, self-efficacy was found to be closely related to the problem in Math Lab, demonstrated by the many times that increasing

student self-confidence was discussed and the growth that would take place after self-confidence was increased.

Learned helplessness theory. In analyzing the interview and online discussion board data, learned helplessness theory became apparent. Many Math Lab teachers and general classroom teachers spoke of how students taking Math Lab had low self-confidence and would give up easily or were unwilling to work altogether. Learned helplessness theory is the expectation that someone cannot accomplish a goal due to past shortcomings (Abramson et al., 1978). Data showed this to be a major concern in Math Lab, with some students "looking for their first win" (Interviewee Two). Interviewee Five explained how students were extremely weak in math and unwilling to do work; this interviewee explained that, ultimately, the unwillingness to work was because of a lack of ability related to repeated past failures. This corresponds to Yates (2009), who said that students will not attempt to work through problems because of past failures. Many Math Lab and general classroom teachers agreed with Wang et al. (2017), who stated that overcoming learned helplessness must be a primary focus of remedial classes; one way of doing so is by teaching students basic problems that they are able to work through successfully in order to give them some confidence that was lost.

Summary

This applied research study sought to solve the problem of low standardized test scores in a remedial math class in southern Virginia. The researcher identified stakeholders from whom data needed to be collected; those stakeholders were Math Lab teachers and general classroom math teachers, along with related special education teachers and school administrators. Interviews were conducted with five current and former Math Lab teachers. Surveys were dispersed and taken by 15 teachers and administrators with knowledge of Math Lab from

working with students enrolled in the remedial math class. An online discussion board was conducted with those same 15 teachers and administrators. Data analysis revealed three themes: math instructional methods, remedial instructional methods, and student attitude. Math instructional methods focused on using gamified learning as a primary instructional method in the classroom. The theme remedial instructional methods indicated that Math Lab teachers should focus their time on reteaching topics from the general math classroom at the lowest level possible so that all students understand it. The theme student attitude revealed that Math Lab teachers must constantly strive to increase student self-confidence and motivation, thereby increasing self-efficacy. Chapter Five will include a proposed solution to the central research question.

CHAPTER FIVE: CONCLUSION

Overview

In this applied research study, the researcher sought to solve the problem of low standardized test scores in a remedial math class in a middle school in southern Virginia. The purpose of this study was to solve the problem of low standardized test scores in a remedial class for a middle school in southern Virginia and to formulate a solution to address the problem. In this chapter, the researcher restates the problem and explains the proposed solutions to the central research question. The solutions include a more structured guide to follow when teaching Math Lab, more required communication between the Math Lab teacher and the general classroom teacher, and Math Lab teacher training in how to best reach remedial students. Then the researcher identifies resources needed, expounds upon the need for funds, describes roles and responsibilities, maps a timeline, elucidates solution implications, provides an evaluation plan, and summarizes the chapter.

Restatement of the Problem

In Virginia, students take a standardized test at the end of every math class from grade 3 through algebra II. These standardized tests are called the Virginia Standards of Learning (SOL). One remedial class has especially struggled with test pass rates. The class is offered to each grade at FMS. Research indicated that a variety of factors affect standardized test pass rates, with the most frequent factor being classroom instruction.

Proposed Solution to the Central Question

In search of solutions to inform the problem of low standardized test pass rates in a remedial math class, the researcher interviewed five current and former Math Lab teachers, surveyed 15 teachers and administrators with direct knowledge of the class, and invited the same

15 participants to an online discussion board. The researcher reviewed the data and analyzed overarching themes to determine possible solutions to the research question. The solutions include a more structured guide to follow when teaching Math Lab, more required communication between the Math Lab teacher and the general classroom teacher, and Math Lab teacher training in how to best reach remedial students.

Math Lab Curriculum

Presently, Math Lab has no designated curriculum. Teachers have an online remedial program (MAP Skills) available to them, but they have no other guide for instruction. Teachers have great flexibility in instructional methods, as discovered in the interviews. Some teachers used MAP Skills as a primary method of remediation while others never used it. Some teachers used worksheets frequently while one avoided them completely. The biggest difference came from discussing with Math Lab teachers what their focus of instruction was. Interviews showed a large difference between Math Lab teachers who focused primarily on remediating students with topics from prior grades and teachers who focused on the present and building skills directly related to the topics that were being covered in the classroom.

Putting a curriculum in place will allow or encourage the Math Lab teachers to focus on the instructional methods that this research has found to be more valuable. Instead of spending time using methods that have been found to be less valuable, the Math Lab teacher will only use methods that the Math Lab teachers and classroom teachers agreed had been beneficial to student learning and had helped students pass their standardized tests. This combination of empirical and theoretical research applied to the classroom will allow effective instruction to take place.

The curriculum will include a mix of building foundational skills and reteaching of classroom lessons, an idea supported by multiple researchers (Campbell & Cintron, 2018; Opitz

et al., 2017). The foundational skills will directly relate to lessons being learned in the general classroom. Instead of practicing a jumble of skills, the Math Lab teacher will focus on skills that will help students see an impact on their learning and grade in their general classroom; relating back to the usual classroom is important (Campbell & Cintron, 2018). A designated curriculum to help students prepare for the upcoming lesson will also help with the pre-teaching that some Math Lab teachers found successful. When reviewing easier topics, the Math Lab teacher will have the flexibility to use the extra time to either pre-teach more challenging topics that may be coming or reteach topics that were especially troublesome for particular students.

This designated curriculum will also help teachers encourage students so they gain confidence in their mathematical abilities. This increased confidence will help students believe in themselves more and in their abilities to accomplish their goals, increasing their self-efficacy (Alivernini & Lucidi, 2011). Increased self-efficacy is closely related to student motivation, and students who are motivated learn more (Kind, 2019; Zimmerman, 2000).

The Math Lab teachers must follow this newly developed Math Lab curriculum. Following this curriculum should help students learn more and pass their SOLs. The school administrator will be responsible for ensuring the Math Lab teachers are following the correct curriculum until the school district hires a math coach.

Required Communication

In order to ensure that the curriculum includes what is needed, communication between the Math Lab teacher and the general classroom teacher is required. The remedial teacher and general classroom teacher must be on the same page so that students are given an opportunity to learn what is needed. If general classroom teachers get off the schedule of the district pacing guide, the Math Lab teacher needs to know that topics may be covered at a different time than

expected, showing the importance of communication. Remedial teachers need to know exactly what topics their students need to learn again during the flex time in Math Lab. Without constant communication between the remedial teacher and the general classroom teacher, this needed review is unlikely to happen. Communication will help the Math Lab teacher stay connected to the general classroom, which is an essential part of remedial classes (Campbell & Cintron, 2018).

Communication can happen different ways. Once a month, possibly at the department meeting for math, a face-to-face meeting should happen. Another way of making this meeting happen is for the Math Lab teacher not to have an afternoon duty, and instead use the 15 minutes at the end of the day to meet with math teachers. The classroom math teacher would leave his or her classroom after the first bus load dismisses and meet with the Math Lab teacher. Students riding other busses would go to a peer's classroom until their bus load was called. Holding these meetings every afternoon would allow the Math Lab teacher to meet with all nine classroom teachers in the span of two weeks.

At first, the school administrator responsible for the math department will be in charge of making sure these meetings occur. The Math Lab teacher must type a simple note at the bottom of each day's lesson plans to summarize the meeting held with the classroom teacher. The administrator can also randomly stop in for a meeting throughout the school year. If a district math coach is hired, that person will become responsible for ensuring the meetings happen, along with support from the administrator reviewing the Math Lab teacher's lesson plan notes.

Professional Development

The final part of the proposed solution is implementing professional development (PD) for the Math Lab teacher. PD is important for teachers, as they need to constantly grow (Bottge

et al., 2014). The PD will include other remedial teachers in the school and district as well as special education teachers, since all of these teachers frequently work with students who may need additional support. The PD would be geared towards the importance of building self-confidence and motivation in remedial students. Since self-confidence and motivation are important for remedial students, these teachers must understand how essential it is to integrate practices that help students increase in self-confidence and motivation, since more motivated students learn more (Alivernini & Lucidi, 2011; Kind, 2019; Liu et al., 2020; Usán Supervía et al., 2019). Greater self-confidence and motivation will lead to greater self-efficacy; students are more willing to continue working when they are challenged (Alivernini & Lucidi, 2011).

The first part of the training will be during a PD day at the beginning of the school year followed by a session at the teacher workday during the middle of the first semester. The third and final training for the first year will happen during the January workday to kick off the spring semester. Annual PD time will be at the beginning of each semester, fall and spring, but no longer during the middle of the fall semester. The school administrator responsible for math will be responsible for ensuring PD happens and facilitating the sessions until the district hires a math coach. The school administrator or math coach will continue in those responsibilities if a coach cannot be found or hired.

Resources Needed

The research data analysis, which led to themes that identified problems and the proposed solutions, encouraged the researcher to recommend a designated Math Lab curriculum, require communication between Math Lab teacher and classroom teacher, and propose professional development for the Math Lab teacher. Empirical literature revealed that resources needed to help improve standardized test pass rates include time, a newly developed curriculum, and

properly trained faculty; these resources are necessary to fully implement the proposed solution to increase standardized test pass rates.

Time

The first and greatest resource that is needed is time. More time to accomplish tasks in the proposed solution would allow everything to be accomplished and standardized test pass rates to increase. Relatedly, the need for more time is the whole idea behind the existence of this remedial math class; providing students having more time to learn math will allow them to be more successful learning the topic and ultimately passing their SOL tests. Time is needed as part of all three proposed solutions. Time must be spent to fully develop a curriculum that gives a perfect blend of remediating old skills, reteaching current classroom topics, and pre-teaching upcoming lessons. Time must be afforded to train the Math Lab teacher about emotional aspects that typically affect students in remedial classes. Most importantly, there must be time for the required communication between the Math Lab teacher and the general classroom math teacher.

Time must be included in the daily schedule for the Math Lab teacher to meet with general math classroom teachers. Having a common planning between the Math Lab teacher and general math classroom teacher would be beneficial but this is impossible in the middle school setting. Each grade must have a common planning since that planning time is when students are in their elective classes, one of which is Math Lab. The proposed solution is for the Math Lab teacher not to have afternoon duty, which is required supervision of a common area at the end of the school day. This would give approximately an additional 15 minutes at the end of the day for the Math Lab teacher to converse with the general classroom teachers about their students. Having one teacher not do afternoon duty for the year should be feasible by just spreading out that duty to the other teachers on duty. This added communication time will be valuable in that

it will provide time to ensure that the remedial teacher and general teacher are on the same page about what is needed.

New Curriculum

New curriculum has to be developed so the Math Lab teacher has a guide to work with. Teaching a class without appropriate curricular materials is challenging, and the new curriculum needs to be developed before the next academic year starts. This curriculum could be developed by a team of district or school teachers or by a subject matter expert from outside the district. Regardless, the curriculum must be developed by someone with expertise on the topics being taught in each grade and who has knowledge of how quickly or slowly remedial students grasp these topics. This new curriculum would be used by the Math Lab teacher throughout the year to give the teacher a timeframe for when to remediate skills from previous grades, when to reteach topics being covered in class, and when to pre-teach upcoming challenging topics. Having this laid out ahead of time also expedites some of the communication that has to take place between Math Lab teacher and general math classroom teacher.

Trained Teacher

It is interesting to note that while support services educators have college degrees that specialize in teaching students with disabilities, remedial educators have regular teaching degrees with no specialized training. In many cases, students with disabilities function at a higher level than students in a remedial class (Gatlin & Wilson, 2016). Having a trained teacher in the remedial classroom is a needed resource, as these remedial classes must be taught differently than general or advanced classes (Smart & Saxon, 2016). This training could be instituted because the person is a special education teacher with a strong background in mathematics but most likely will come from PD delivered to a mathematics teacher.

The PD that needs to be delivered must include training on the psychological side of being a remedial student; it is essential to understand the psychological side of remedial students (Mio, 2018). If an outside trainer is not found, PD must be developed in-house, which means someone in the district needs to develop the PD lesson. The designer must include training on student self-confidence and motivation and how they relate to self-efficacy. Once this training module is developed, it could be delivered to all district remedial and support services personnel, as the lessons about student self-confidence, motivation, and self-efficacy relate to all students, especially those who have struggled at times in the past.

Funds Needed

Of the proposed solutions mentioned, many do not require additional funding. PD for the Math Lab teacher would have to take place, and funding for this would come from the division's PD fund but is likely to be challenging to achieve if only the FMS teacher is trained. The district is more likely to pay for funding if Math Lab teachers from all middle schools attend, but that still only includes three teachers. Since the PD would be focused on remedial instruction, it is possible that other remedial class teachers and special education teachers could attend. Including these two other groups gives a much larger number of potential attendees and another possible source of funding; many of the strategies needed for teaching a remedial math class would be effective for teaching students with disabilities. The greatest potential barrier to this resource is that this research is happening during the COVID-19 pandemic. School districts are seeing budget shortfalls currently and are not approving any expenses that are not absolutely essential.

Beyond PD, it would be helpful to the entire district if a math coach to hire a math coach to help facilitate this PD and monitor the Math Labs as well as the entire math department for the district. This math coach position would be an 11-month position with a salary of approximately

$50,000, something that the district would not likely approve unless and until finances improve.

Roles and Responsibilities

To help with the facilitation of this proposed solution at FMS, it is recommended that a new district math coach be hired. Hiring an additional staff member for the district would remove the need for additional burdens being placed on the current administrative staff. The math coach would follow up weekly with the Math Lab teacher to determine how things are going, ensuring that proper communication between the Math Lab teacher and general classroom math teacher is taking place and reminding the Math Lab teacher of the PD that took place before the year started. This math coach would need to come to the schools during the Math Lab teacher's planning periods to discuss specific instructional practices and methods for teaching topics as well as make unannounced visits to ensure proper instruction is taking place in the Math Lab classroom.

Timeline

The timeline for implementing and evaluating the proposed solution for this problem is 25 months from the data of implementation (see Appendix L for a bulleted timeline). The first step is the longest step, developing the Math Lab curriculum, which could take place over a summer using notes from the entire previous school year. The actual writing of the curriculum would be done over one summer but would include purposeful notetaking throughout the previous academic year about how quickly remedial students grasp topics. These notes will provide reminders about which topics need more time and which topics allow for other remediation or pre-teaching. This would culminate in a large curriculum development group during the summer of 2021. Grade level experts would meet independently with the Math Lab teacher or district math coach, if one is hired.

The 2021-2022 school year would begin with PD for the Math Lab teacher about best practices when teaching remedial students. Also, in August 2021, there would be PD explaining to general classroom math teachers about how the proposed required communication is supposed to work, explaining to the teachers that once every two weeks they will dismiss their students waiting for the bus to another teacher and go meet with the Math Lab teacher to discuss their students in Math Lab. The required communication between the Math Lab teachers and general classroom teachers would begin in September 2021. In October 2021, the second PD day for the Math Lab teacher would take place, followed by the third PD day in January 2022. Finally, in May 2022, Math Lab students would take their SOL tests.

During the summer of 2022, review and revision would take place. The review will focus on Math Lab pass rates, such as what went right and what went wrong, in June 2022. July 2022 would be used for making needed revisions to the Math Lab curriculum, modifying the amount of time taken on topics, and moving around when certain skills were taught, as needed. The first PD day for the second year would take place in August 2022 with the second PD day taking place in January 2023. In May 2023, Math Lab students would take their SOLs. Final review and revisions of this solution would take place in the summer of 2023, with review being the focus in June and final revisions being made in July. After those final revisions are made, the program should be ready to be adopted by other schools that offer a similar class.

Solution Implications

The implications of this study come from the central research question: How can the problem of low standardized test scores in a remedial math class be solved in a middle school in southern Virginia? While the primary purpose of this study is to improve remedial students' scores on their SOL in math, many of the strategies recommended relate directly to improving

instruction, which would have a positive impact on their SOL scores. These changes would have an impact on the students, school as a whole, teachers, administrators, school district, and the community.

Students

First and foremost, students will be impacted by these proposed changes. Assuming these strategies are successful in increasing the SOL pass rate, remedial students taking Math Lab will be more likely to pass their SOL (Mattis, 2015). In addition to being more likely to pass, some students may start to excel. Students may learn that, even though they struggled with math in the past, they can now be successful and overcome their learned helplessness (Abramson et al., 1978). This will teach lifelong lessons about the importance of never giving up and always striving for success, even when things have gone poorly. Experiencing some success in math will cause these students to have more self-confidence when challenges arise, increasing their self-efficacy (Alivernini & Lucidi, 2011). There are essentially no drawbacks for students.

School

The students will have high standardized test pass rates in math, and that will reflect favorably on the school. Schools often compete to have the highest test score in different metrics, from test pass rates to student attendance to teacher attendance to fewest disciplinary referrals. Decreasing these math failures would reduce the failure rate so much that almost all students passed, putting this school well above other schools in the district. Also, when remedial students see success, they would to be more positive about school and likely have better grades in all classes, not just math class. Like students, there are few drawbacks for the school.

Teachers

Teachers include three different subgroups. The Math Lab teacher is the first group, followed by other math teachers, and then teachers who do not teach math. The Math Lab teacher would have less instructional freedom and more work to do in order to document the daily meetings. At first, the Math Lab teacher may think that there is more work to be done, but this is not really the case. Because the curriculum will be planned out during the summer, the teacher will not have to constantly look for curriculum to teach; this will save time during the school year. There may be some research needed to cover specific topics that the general classroom teachers request, but that is no different from what currently happens. The only change is that there will be some structure in place for the Math Lab teacher. Also, the Math Lab teacher will receive new training on how to teach remedial students, focusing on the importance of increasing self-confidence in those students.

The math classroom teachers will have to stay in contact with the Math Lab teacher, which is different from current practice. This will take a little time once every two weeks, but this contact will improve the communication between the remedial teacher and the general classroom teachers, which ultimately will help the students. The classroom teachers will look better because of students passing their SOL scores, even though, for some students, it was because of the Math Lab teacher not the teacher of record. For other teachers in the school, students will be more enthusiastic about school since they will not be frustrated about struggling in math or being forced to take a second math class. Making Math Lab an enjoyable place for students to learn will help to motivate them about school in general. Some teachers will also have to supervise more students during afternoon duty than they previously had supervised due to the Math Lab teacher not sharing that responsibility.

Administrators

School administrators will have to implement a process where the Math Lab teacher does not have afternoon duty, which will likely upset those teachers with afternoon duty. This process will need to be explained to the faculty in a way so everyone understands that it is the best choice for everyone. Some teachers may resent the Math Lab teacher for not having afternoon duty, so potential conflicts could arise. An administrator will also need to review the Math Lab teacher's lesson plans for notes from the after-school meetings and occasionally attend the meetings to hear the discussion; this puts a little more work on the administrator that will hopefully be relieved when a district math coach is hired. More work could also come from being the person required to conduct the PD about remedial student self-efficacy to the Math Lab teacher.

School District

The school district will benefit, but there are negative aspects. The greatest benefit will be the increase in standardized test pass rates in one of its schools. The biggest negative aspect, at least in the eyes of the finance department, would be the cost that results from the need to pay another salary. It is possible that the school district initially will resist the idea of hiring a math coach, but hopefully the district staff will see the growth at FMS and the potential for growth elsewhere and decide that this program should be in place at all middle schools in Washington County School District. Seeing this growth may encourage the superintendent to realize the need for and benefit of using a math coach to implement this type of program across the district.

Community

The greatest impact on the community would be the pride residents have of the school due to the pass rates increase. Communities can get behind academically successful schools, so much as making a school's attendance zone a tool that can be used for recruiting businesses to

the area. Increased success in math could lead to other opportunities in the community as businesses decide to relocate here instead of other localities. A potential negative aspect for the community would be a tax increase to fund the district math coach position.

Evaluation Plan

Until a district math coach is hired, the responsibility for all evaluations will fall on a school administrator or the Math Lab teacher. To evaluate the effectiveness of the solutions described in this chapter, both goal- and outcomes-based assessments should be used, targeting both formative and summative needs. Using this approach allows for evaluation as the year progresses instead of only at the end of the school year. It is important that all of these are used together as the year progresses instead of having them reviewed separately.

The goal-based, formative evaluation should be used by the Math Lab teacher as the year progresses. These goals should be in writing so that they can be evaluated after the required meetings with the general classroom teachers. The Math Lab teacher should write goals with measurable objectives, whether in relation to student performance on an upcoming general classroom assessment or in relation to how the conversation with the classroom teacher went. A combination of these methods would be effective for measuring progress.

Reviewing standardized test scores at the end of the school year is an outcomes-based summative approach. The Math Lab teacher and administrator will review student test scores and determine if any pattern exists between students passing and failing and between those showing growth and not showing growth. Reviewing results will prompt the Math Lab teacher and school administrator to devise a strategy to improve upon the previous year, minimizing weakness and maximizing strengths.

Delimitations are purposeful decisions a researcher makes to limit or define boundaries of

the study. The researcher purposefully chose to use only teachers or administrators at FMS with direct knowledge of working with students enrolled in Math Lab. Enough participants were able to be found because of the high turnover at FMS, which eliminated any possible confusion from using multiple sites. There is a remedial English class at FMS, but the researcher decided to focus only on math so that the research could go deeper into the process of mathematics and how it builds on itself. The researcher also decided to consider only SOL test scores and not use Measuring Academic Progress (MAP) scores as a second evaluative tool. The SOL test is required, and passing it is ultimately the goal of every student in Math Lab. The MAP score is used as a universal screening tool, but some students do not have scores from this assessment if they were absent the day of testing and their teacher was not vigilant about making up the test.

Limitations are potential weaknesses of the study that cannot be controlled. The first weakness of the study was the demographic information from the participants. There was good variety in age, teaching experience, and gender of the participants, but there was no variety with respect to race. Each person teaching math, and all but one special education teacher at FMS, is Caucasian; one special education teacher is African-American, who was recruited but chose not to participate. The number of participants in the study was a limitation, but the researcher sampled the entire population of Math Lab teachers and 75% of the population that had direct experience working with students enrolled in Math Lab. Still, a larger sample size would have been useful for obtaining more and varied data.

Further research is recommended to help solve the problem of low standardized test scores among remedial math students. Interviews with more Math Lab teachers who taught this class longer than the teachers at FMS could give a better idea of how the class works for a complete school year. A longer study that reviewed what happens as teachers get to know

students and whether having a personal relationship affects self-confidence, motivation, or self-efficacy. A deeper breakdown into standards that students missed could help understand the exact topics that caused remedial students to struggle the most.

Summary

The goal of this study was to solve the problem of low standardized test scores in a remedial class for a middle school in southern Virginia and to formulate a solution to address the problem. By combining data from interviews, an online discussion board, and a survey, it is obvious that there are areas in which Math Lab can be improved. This study has demonstrated the importance of having a designated curriculum, communication between remedial teachers and classroom teachers, and professional development for remedial teachers.

The greatest of the solutions may very well be the need for PD among remedial teachers. These remedial teachers instruct a population that is academically very similar to students with disabilities, yet the Math Lab teachers have no specific or proper training. The Math Lab teachers are often general classroom teachers who have been moved to a remedial classroom. Having designated PD that prepares teachers for this position and helps them throughout the school year will make for a great change in this remedial class. Also, having a designated curriculum with the teachers of a particular grade working at the same pace will greatly help the Math Lab teacher. With the specific curriculum, the teacher will know what needs to be taught and when; this will seek to maximize the effectiveness of this class and allow greater growth to be shown, impacting the students, teachers, school, and community.

In summary, PD is needed to train Math Lab teachers to help them improve instruction (Smart & Saxon, 2016). A curriculum should be developed so that Math Lab teachers have a guide to follow while teaching, being sure to reteach challenging topics from the general math

class and remediating basic skills (Campbell & Cintron, 2018; Opitz et al., 2017). Requiring communication between the Math Lab teacher and general education classroom teacher will help the different math teachers stay connected so they can better help students (Campbell & Cintron, 2018). In conclusion, these changes may help improve standardized test scores in Math Lab, impacting all stakeholders.

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APPENDIX A

IRB Approval – Research Ethics Office

Date: 5-10-2020

IRB #: IRB-FY19-20-132
Title: Improving Remedial Middle School Standardized Test Scores
Creation Date: 2-11-2020
End Date:
Status: Approved
Principal Investigator: Roger Keaton
Review Board: Research Ethics Office
Sponsor:

Study History

Submission Type Initial	Review Type Limited	Decision Exempt - Limited IRB

Key Study Contacts

Member Russell Claxton	Role Co-Principal Investigator	Contact rlclaxton@liberty.edu
Member Roger Keaton	Role Principal Investigator	Contact rkkeaton@liberty.edu
Member Roger Keaton	Role Primary Contact	Contact rkkeaton@liberty.edu

APPENDIX B

[redacted] [redacted] COUNTY SCHOOLS [redacted] Division Superintendent

April 13, 2020

Mr. Roger Keaton
rkkeaton@liberty.edu

Dear Mr. Keaton:

This letter is written in response to a request you made for permission to conduct a research project in [redacted] as part of your doctoral work at Liberty University. The title of your research project is Improving Remedial Middle School Standardized Test Scores. Specifically, you are requesting approval to conduct the following tasks:

1. Contact members of [redacted] staff to invite them to participate in the study.

It is my understanding that the names of teachers who are participating, the name of the school, and the name of the school division will not be identified and that all data collected will be confidential. From the information that you have provided, the research study will not require any student to participate.

Based on the information included in your e-mail to me that has been clarified herein, I am approving your request with the understanding that participation is voluntary. Your request conforms to School Board Policy JHDA, Human Research, which is included with this correspondence. Please read this policy and notify me immediately if you have questions. Because your study does not involve or identify students, a review by a human research committee and signed parent permission are not required.

I wish you the very best as you complete this research project. If you should have a question relating to the contents of this letter, please contact me.

Sincerely,

[redacted]
Division Superintendent

Enclosure: School Board Policy JHDA, Human Research

C: [redacted], Principal, [redacted]

TELEPHONE NUMBERS: [redacted]

[redacted]

[redacted]
Division Superintendent

February 10, 2020

Roger Keaton
Doctoral candidate
Liberty University
rkkeaton@liberty.edu

Dear Roger Keaton:

After careful review of your research proposal entitled Improving Remedial Middle School Standardized Test Scores, I have decided to grant you permission to conduct your study at [redacted]

Check the following boxes, as applicable:

☑ The requested data WILL BE STRIPPED of all identifying information before it is provided to the researcher.

☐ The requested data WILL NOT BE STRIPPED of identifying information before it is provided to the researcher.

☐ I am requesting a copy of the results upon study completion and/or publication.

Sincerely,

[redacted]

Superintendent
[redacted]

[redacted]

APPENDIX C

Participant Recruitment Letter - Interview

Dear Math Lab teacher:

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a doctoral degree. The purpose of my research is to determine how to increase standardized test scores in a particular remedial math class in a public middle school in south Virginia, and I am writing to invite eligible participants to join my study.

Participants must be 18 years of age or older and have experience teaching Math Lab. Participants, if willing, will be asked to sit for an audio and video recorded interview. They will be asked to bring any paper documents that were helpful in teaching this class or links to any websites or online materials that were helpful while teaching this class; these documents should not have identifiable student information on them or should have been stripped of such information by a guidance counselor. After the interview is completed the participants will be requested to complete member checks and verify accuracy of the transcription (45 minutes altogether). Names and other identifying information will be collected as part of this study, but the information will remain confidential.

In order to participate, contact me at rkkeaton@liberty.edu to schedule an interview.

In addition to the interview, participants, if willing, will be asked to take a survey (five minutes) and participate in an online discussion board (30 minutes spread over two weeks). Names and other identifying information will be requested as part of this study to determine follow up for those who have not completed the survey, but the information will remain confidential.

In order to participate, please click here and complete the survey (about five minutes) within two weeks and follow the email invitation to go into the Google Classroom and respond to the questions and reply to peers (about 30 minutes spread over two weeks). The email invitation to the Google Classroom will be sent once the survey is completed.

A consent document is attached to this email and will be given to participants at the time of the interview. The consent document contains additional information about my research. Please sign the consent document and return it to me at the time of the interview or scan and email it back to me prior to the interview.

Sincerely,

Roger L. Keaton, III
Doctoral candidate
rkkeaton@liberty.edu

APPENDIX D

Participant Recruitment Letter - Survey

Dear Recipient:

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a doctoral degree. The purpose of my research is to determine how to increase standardized test scores in a particular remedial math class in a public middle school in south Virginia, and I am writing to invite eligible participants to join my study.

Participants must be 18 years of age or older and have experience working with students enrolled in Math Lab as a teacher, co-teacher or administrator. Participants, if willing, will be asked to take a survey (five minutes) and participate in an online discussion board (30 minutes spread over two weeks). Names and other identifying information will be requested as part of this study to determine follow up for those who have not completed the survey, but the information will remain confidential.

In order to participate, please click here and complete the survey (about five minutes) within two weeks and follow the email invitation to go into the Google Classroom and respond to the questions and reply to peers (about 30 minutes spread over two weeks). The email invitation to the Google Classroom will be sent once the survey is completed.

A consent document is attached to this email and is provided as the first page of the survey. The consent document contains additional information about my research. After you have read the consent form, please type your name and date into the consent form, then proceed to the survey. Doing so will indicate that you have read the consent information and would like to take part in the survey.

Sincerely,

Roger L. Keaton, III
Doctoral candidate
rkkeaton@liberty.edu

APPENDIX E

Consent Form - Interview

Title of the Project: Improving Remedial Middle School Standardized Test Scores
Principal Investigator: Roger Keaton, Graduate student, Liberty University

Invitation to be Part of a Research Study

You are invited to participate in a research study. Teachers, in order to participate, you must be at least 18 years old and have experience working with students enrolled in the remedial math class Math Lab. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to take part in this research project.

What is the study about and why is it being done?

The purpose of the study is to determine how to increase standardized test scores in a particular remedial math class in a public middle school in south Virginia. Instructional techniques will be reviewed to determine what is most beneficial in helping students pass standardized tests.

What will happen if you take part in this study?

If you agree to be in this study, I would ask you to do the following things:

1. Sit for a face-to-face or virtual interview using Zoom software then review the interview transcript. This should last 45 minutes altogether.
2. Bring archival documents or links to online resources that were helpful in teaching Math Lab; these documents should not have identifiable student information on them or should have been stripped of such information by a guidance counselor.
3. Click an emailed link and complete a survey. This survey has ten questions and asks you to respond with a 0-5 rating. This should take about five minutes.
4. Follow an emailed link to Google Classroom and respond to seven discussion board questions. Also, please reply to the answers of at least two of your peers. This should take about 30 minutes spread over two weeks.

How could you or others benefit from this study?

Participants should not expect a direct benefit from participating in this study.

Benefits to society include increased standardized test pass scores for remedial students which in turn gives the community a sense of pride about the school.

What risks might you experience from being in this study?

The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

How will personal information be protected?

The records of this study will be kept private. Published reports will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records.

- Participant responses will be kept confidential through the use of codes. Interviews will be conducted in a mutually agreed upon location where others will not easily overhear the conversation.
- Data will be stored on a password-locked computer and may be used in future presentations. After three years, all electronic records will be deleted.
- Interviews will be audio and video recorded and transcribed. Participants will review the transcription to verify accuracy. Recordings will be stored on a password locked computer for three years and then erased. Only the researcher will have access to these recordings.
- Confidentiality cannot be guaranteed in online discussion board settings. While discouraged, other members of the focus group may share what was discussed with persons outside of the group.

How will you be compensated for being part of the study?

Participants will not be compensated for participating in this study.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with Liberty University or [redacted]. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

What should you do if you decide to withdraw from the study?

If you choose to withdraw from the study, please contact the researcher at the email address included in the next paragraph. Should you choose to withdraw, data collected from you will be destroyed immediately and will not be included in this study. Online discussion board data will not be destroyed, but your contributions to the online discussion board will not be included in the study if you choose to withdraw.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Roger Keaton. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact him at rkkeaton@liberty.edu. You may also contact the researcher's faculty sponsor, Dr. Russell Claxton, at rlclaxton@liberty.edu.

Whom do you contact if you have questions about your rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu

Your Consent

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

☐ The researcher has my permission to audio-record and video-record me as part of my participation in this study.

_____

Printed Subject Name

_____

Signature & Date

APPENDIX F

Consent Form - Survey

Title of the Project: Improving Remedial Middle School Standardized Test Scores
Principal Investigator: Roger Keaton, Graduate student, Liberty University

Invitation to be Part of a Research Study

You are invited to participate in a research study. Teachers, co-teachers, and/or administrators, in order to participate, you must be at least 18 years old and have experience working with students enrolled in the remedial math class Math Lab. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to take part in this research project.

What is the study about and why is it being done?

The purpose of the study is to determine how to increase standardized test scores in a particular remedial math class in a public middle school in south Virginia. Instructional techniques will be reviewed to determine what is most beneficial in helping students pass standardized tests.

What will happen if you take part in this study?

If you agree to be in this study, I would ask you to do the following things:

1. Click an emailed link and complete a survey. This survey has ten questions and asks you to respond with a 0-5 rating. This should take about five minutes.
2. Go to Google Classroom and respond to seven discussion board questions. Also, please reply to the answers of at least two of your peers. This should take about 30 minutes spread over two weeks.

How could you or others benefit from this study?

Participants should not expect direct benefits from participating in this study.

Benefits to society include increased standardized test pass scores for remedial students which in turn gives the community a sense of pride about the school.

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The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

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- Participant responses will be kept confidential through the use of codes.
- Data will be stored on a password-locked computer and may be used in future presentations. After three years, all electronic records will be deleted.
- Confidentiality cannot be guaranteed in online discussion board settings. While discouraged, other members of the focus group may share what was discussed with persons outside of the group.

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Participants will not be compensated for participating in this study.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with Liberty University or [redacted]. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

What should you do if you decide to withdraw from the study?

If you choose to withdraw from the study, please contact the researcher at the email address included in the next paragraph. Should you choose to withdraw, data collected from you will be destroyed immediately and will not be included in this study. Online discussion board data will not be destroyed, but your contributions to the online discussion board will not be included in the study if you choose to withdraw.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Roger Keaton. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact him at rkkeaton@liberty.edu. You may also contact the researcher's faculty sponsor, Dr. Russell Claxton, at rlclaxton@liberty.edu.

Whom do you contact if you have questions about your rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu

Your Consent

By signing or typing your name/date into this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

Printed Subject Name

Signature & Date

APPENDIX G

Interview Questions

Interviewer:

Interviewee:

Date:

Time:

1. Describe your students' comfort level in mathematics.
2. How would you describe how being in Math Lab has helped or hindered their understanding of the process of mathematics?
3. What activities in Math Lab have helped them learn the most?
4. What activities in Math Lab have helped them learn the least?
5. How has your students' self-confidence (in relation to math) changed since they started in Math Lab?
6. What experiences in Math Lab have contributed to that change?
7. What could help them be more confident with their math abilities?
8. What from Math Lab has made them less confident in their math abilities?
9. How would you describe your students' progress in mathematics since entering Math Lab?
10. How has your students' self-confidence (in relation to school) changed since they started in Math Lab?
11. How has Math Lab helped students overcome past struggles?
12. How has Math Lab helped students see math as being worthwhile?
13. If you have any students who are taking Math Lab for the first time, please explain how their motivation has changed as a part of taking Math Lab.

14. How has cooperative learning affected your instruction in Math Lab?

15. How has gamified learning affected your instruction in Math Lab?

APPENDIX H

Online Discussion Board Questions

1. How would you describe how being in Math Lab has helped or hindered a students' understanding of the process of mathematics?
2. What activities from Math Lab have helped students learn the most?
3. What activities from Math Lab have helped students learn the least?
4. How has your students' self-confidence (in relation to math) changed since they started in Math Lab?
5. What experiences in Math Lab have contributed to that change?
6. What could help them be more confident with their math abilities?
7. What from Math Lab has made them less confident in their math abilities?

APPENDIX I

Survey Questions

All questions are on a scale of 0-5 with zero meaning little to none shown and five representing exceeding expectations.

1. Rate your students' growth from taking Math Lab. 0 1 2 3 4 5
2. Rate your students' progress in mathematics since entering Math Lab. 0 1 2 3 4 5
3. Rate how your students' self-confidence (in relation to school) changed since they started in Math Lab. 0 1 2 3 4 5
4. Rate how Math Lab has helped students overcome past struggles. 0 1 2 3 4 5
5. Rate how Math Lab has helped students see math as being worthwhile. 0 1 2 3 4 5
6. Rate how student motivation has changed as a part of taking Math Lab. 0 1 2 3 4 5
7. Rate how gamified learning has helped students learn in Math Lab. 0 1 2 3 4 5
8. Rate how technology-based learning has helped students learn in Math Lab. 0 1 2 3 4 5
9. Rate how cooperative learning has helped students learn in Math Lab. 0 1 2 3 4 5
10. Rate how giving students more choice has helped them learn in Math Lab. 0 1 2 3 4 5

APPENDIX J

Themes, Codes, and Examples of Interviewees' Words

Themes	Codes	Examples of Interviewees' Words
Math Instructional Methods (MIM)	Gamified learning	"Gamified learning is great if you can make it competitive without adding more stress to it and that's the key with it because it'll increase that engagement" (Interviewee Two). "It really gives them that extra motivation where there, if they didn't have that, the desire to compete, especially for those competitive people...where all of a sudden if you tell them it's a competition, they'll focus and try. The great thing about gamified instruction is it gives instant feedback" (Interviewee Three). "They loved playing games, especially since they were all on the same level" (Interviewee One).
	Cooperative learning	"They all worked together well because they were all on the same level" (Interviewee 1). "You should not do cooperative learning in Math Lab. You should not have someone weak in math trying to explain a math topic that they don't know to someone else who doesn't know it. You'll be fixing more problems then. I don't think you should use it as a strategy; you let it happen naturally. Your stronger kids are the only ones going to step up. They're say things like, 'Let me help you with that' because they know how to do it instead of me saying, 'Okay guys, we're going to do peer-to-peer stuff today.' Don't plan it. You can't plan it. It has to happen on its own for it to actually work, otherwise you're just going to instead of having to fix one kid's misconceptions you have to now fix two or three, because they spread it around … They're only going to do it when they know they're doing it correctly, when they've been seeing or getting it right, so they're going to help others… If you're doing cooperative learning, group where you have a student with a relative strength in every group. There aren't necessarily stronger students but students with relative strengths on certain topics. Some don't struggle as much with some of the geometry stuff. You can't group when you're starting topics but you can at the end of the week and you have your data showing who is stronger on a

		particular topic" (Interviewee Two). "Getting with a partner and having them share their ideas has helped them with confidence, just small steps help them with confidence … Cooperative learning also helps build kind of a community in Math Lab. 'We're all in this together; we're all trying to get everyone to understand and we're all trying to do better in a regular math class'" (Interviewee Four).
	Connections between topics	"I don't care about correct or incorrect answers. You can shout the answer all you want but I need you to explain the steps and the patterns used to get there. Once they understand that you can really help them understand a problem and how topics in math connect" (Interviewee Four).
	Fewer worksheets	"I saw them working out problems more when they had a whiteboard versus the same exact thing on paper… they could do it on dry erase and put their answer in the computer versus do it on paper and give it to me to grade" (Interviewee Two). "Worksheets can be useful; I just have to monitor how I use them and put them in at the right time" (Interviewee Four).
	Instant feedback	"Instant feedback worked the best with them. Anything that they could do where they could get the answer right or wrong and know right away that it was right or wrong, that worked with them. They didn't want to know why it was right or wrong but whether it was right or wrong right away and to be done with the problems" (Interviewee Two).
	Knowledge gap	"When they come into Math Lab they have a big knowledge gap from what they're supposed to know, both things at their grade level and skills they've missed when they were in elementary school" (Interviewee Four).
Remedial Instructional Methods (RIM)	Reteaching	"I had success with going back and working on skills that they needed to help them be successful in the classroom without actually working on grade level stuff. I think that actually builds their confidence to go back and build off than to just stick them with the grade level concepts they may not know" (Interviewee Three). "Hearing a second voice and a second lesson or a second approach on a topic helps them, especially kind of going slower than the regular math class so we can make sure they pick up on it and giving extra time on that topic… Building up their confidence with reteaching of a topic and showing

		them that they can do it and them seeing that 'Yes, I can do this' so they have more confidence" (Interviewee Four).
	Technology	"They really liked playing the games related to the topics, using the technology…They didn't enjoy activities that are more written down type activities like worksheets and things they have to do independently that are not technology-related. I think the technology gives them extra motivation. When they're expected to do a worksheet on their own after we've gone over a concept I didn't get as good of results" (Interviewee One).
	Level competition	"In Math Lab they get to be the rock stars because they don't have those higher-level students competing against them. They all worked together because they were all on the same level" (Interviewee One). "It's more like a group effort to get to the finish line instead of being carried by the smartest kid" (Interviewee Four).
	Instructional level	"You're always teaching every topic to who happens to be at the lowest level of that topic" (Interviewee Four).
	Individualized instruction	"The computer games would give them that individualized instruction so that they could learn exactly what they needed and not be on the same thing as everyone else in the class" (Interviewee One).
	Pre-teaching	"Math Lab definitely helps the students gain confidence, especially when you're teaching concepts before the teacher taught the concept" (Interviewee One).
	Rigor	"Sometimes you have to take baby steps before you get to the rigor parts…If you overwhelm them with rigor they'll just shut down" (Interviewee Four).
	Structure	"Have a little more structure to it where there are some students that when they came in they were so used to playing [math games] that when we were doing things they just wanted to get on other websites. At a certain point...they expected things like that every day" (Interviewee Three).
Student Attitude (SA)	Self-confidence	"You've got to find what's going to make them feel better about themselves. For some kids it might be as simple as passing an SOL or it could be getting an A and it could be just passing the math class. That's something that's going to be different for every student. They're going to have their own idea of what a goal would be but you're got to have conversations with them and figure it out because they probably never have thought about it" (Interviewee Two). "When they would start seeing connections from Math Lab

		in a regular class they start believing that they can actually do the math and improve their grade and once they start seeing success they open up…You know their confidence and comfort level is improving when they actually start asking questions about the math and that's one big thing in Math Lab is trying to get them to open up. That's what I always take a look at, when they're willing to ask a question when they don't understand something. It's a key sign that their comfort level is higher and they're trying to engage with a topic…that's one sign that their confidence or at least comfort level in school has improved since they're more willing to show up" (Interviewee Four).
	Motivation	"They need their first win" (Interviewee Two). "I should have done a better job in building relationships with students. Building relationships with students is so important and keeping it positive and keeping it light instead of coming down on them. I wish I would have done more of that instead of coming down on them after we had covered something ten times and they were still getting it wrong. I wish I would have focused more on the relationship side of it and keeping it lighter and motivating them that way instead of coming down hard on them" (Interviewee Three). "They know that you honestly care about them and they care about you. They want to do more work because they know you care. It goes back to the old saying that 'they don't care how much you know until they know how much you care'" (Interviewee Four).
	Low comfort	"Their comfort level in doing math is very low and that's the first thing you have to solve if you're going to make Math Lab work…They felt like they were there because they were outcasts and they wanted to show off" (Interviewee Four). "They're almost scared of math" (Interviewee One).
	Comfortable	"Math Lab gives them a place where they're more comfortable to ask questions" (Interviewee Four). "It's a smaller environment and they get to share more and they get excited more when they get a question right…It's just that small group setting that makes them feel more comfortable. They learn to trust you and you're not really going to judge them in Math Lab because they're there for a reason" (Interviewee One).
	Worthwhile	"If you can relate math and help them see how important it is

		to that dream they have, it helps them a lot and it helps them to see that it's worthwhile" (Interviewee Three). "They see Math Lab as worthwhile when they start seeing their math grade go up" (Interviewee Four).
	Lose confidence	"When they would miss an answer and try to look at the explanation that was presented to them and still didn't understand it and that made them feel even worse and needed help" (Interviewee Five). "Students lose confidence when they're getting answers wrong multiple times in a row, especially when it's the same topic. You combat that kind of thing with doing something that they are good at" (Interviewee two). "Not just struggling on the grade level material but they were struggling on stuff from a couple years behind and that can really hurt their confidence if we're taking them back a couple years behind and they're still struggling" (Interviewee Three).
	Patience	"If you're going to be a Math Lab teacher the first thing that you have to have is extreme patience. You can't get frustrated and you have to keep in mind that there's an end goal but you shouldn't expect them to get there at a normal time as other students. You have to set little goals along the way and do it in a way that they see that they've accomplished little goals to keep them going and it helps you keep going too. You can't just say that 'I'm screwing this up because they can't get it.' You have to set little intermediate goals to keep them going and to keep you going" (Interviewee Four).
	Reward	"When they've been struggling sometimes I'll give them candy or the Most Improved award as a little pick me up reward" (Interviewee Four).

APPENDIX K

Themes, Codes, and Examples of Participants' Words

Themes	Codes	Examples of Participants' Words
Math Instructional Methods	Fewer worksheets	"Worksheets can be valuable but only after the student has grasped the topic. Simple worksheets from the beginning would have the least impact" (Participant 7). "Worksheets without the foundation are useless" (Participant 12). "Handouts that break down the concepts further and are used as a reference are helpful" (Participant 3).
	Knowledge gap	"Focusing on MAP Skills to help close the gaps where information was missing" (Participant 15).
	Gamified learning	"The Math Lab teacher found and incorporated really interesting activities and games that excited the students" (Participant 14).
	Instant feedback	"Having a small class size so that each student could get some individual help and feedback more easily" (Participant 8).
Remedial Instructional Methods	Reteaching	"Another person saying the same things you did in class, maybe in a slightly different way, just cannot be beat" (Participant 12). "The biggest experience would be when Math Lab became consistent in reteaching the topics the student was currently working on in their regular class" (Participant 7).
	Individualized instruction	"By receiving individualized help, the students were more successful in the lab, and that helped them feel more confident in class" (Participant 14). "The individualized help makes all the difference" (Participant 8). "The individualized instruction absolutely helped my students the most" (Participant 8).
	Pre-teaching	"This helped them learn in class better when we covered those topics" (Participant 8).

	Technology	"They need direct instruction to support the online activities" (Participant 4).
	Instructional level	"Finding a students' present level of performance and then continuing to work past their comfort zone will eventually give them confidence. When they see they are actually doing more than they thought they could, their confidence will improve" (Participant 12).
	Rigor	"When students grasp a concept in class but have difficulty executing the skill as rigor increases" (Participant 4). "Giving them problems on their current level then building their success up to the harder problems" (Participant 8).
	Communication between teachers	"I found success touching base at least weekly, if not daily, to make sure we would be working on the same skills" (Participant 4).
	Structure	"The least helpful is the time on computers that is not specified for work" (Participant 14).
Student Attitude	Self-confidence	"With understanding comes confidence" (Participant 12). "Some students became very confident, maybe thinking they understood better than they actually did" (Participant 14). "It was hard to tell with some of the students because they never asked for help in class and rarely passed the assessments given. They did not communicate at all with me and I saw no change in their confidence level" (Participant 15). "A lot of kids shut down in math class because of lack of confidence in doing math, and numbers can be intimidating! Math lab has given my kids confidence coming into my room that I cannot do alone!" (Participant 13).
	Lose confidence	"They would lose confidence when others in Math Lab picked up a topic before they could" (Participant 7). "They lose confidence when failing the assessments despite being able to do it in Math Lab" (Participant 15).

		"The key lies in the teachers' ability to re-direct and boost their self-esteem to keep them focused on the journey and not the bump in the road" (Participant 12). "Experiencing a level of success in math lab studying basic skills and not immediately being successful in math class with higher level applications. Sometimes this will reinforce their low self-image of being 'a dummy in math'" (Participant 3).
	Small successes	"A system of setting up attainable goals that would bring opportunity for small victories and positive returns. The math lab teacher and math classroom teacher acknowledging the effort and improvement" (Participant 7).
	Comfortable	"A smaller classroom environment gave them more freedom to ask questions they may not ask in a larger classroom which allows them to understand and build confidence on topic" (Participant 7).
	Low comfort	"Just being assigned to math lab is like being assigned to Fusion Reading or Support, and the kids know they are in some type of remediation. That can trigger their sense of failure or at least, a lack of success" (Participant 14). "Some viewed their assignment to Math Lab as validating their poor self-image as 'a dumb student in the dummies' class'" (Participant 3).
	Motivation	"One student stands out in particular, she always claimed to hate math and was often unmotivated. With the support of Math Lab, she grew more confident and would get so excited she'd often shout out answers in class" (Participant 4).
	Patience	"Having a Math Lab teacher that refuses to give up and is willing to go the extra mile to help students build that confidence has fostered the change I've seen" (Participant 4).
	Reward	"Celebrate the successes and the confidence goes up" (Participant 13).

APPENDIX L

Timeline

June-July 2021 – Develop Math Lab curriculum

August 2021 – Train Math Lab teacher on teaching remedial students

August 2021 – Explain to general math classroom teachers about required communication

September 2021 – Begin required communication between Math Lab teachers and general classroom teachers

October 2021 – Second professional development day for Math Lab teacher

January 2022 – Third professional development day for Math Lab teacher

May 2022 – Math Lab students take SOLs

June 2022 – Review Math Lab pass rates

July 2022 – Make necessary revisions to Math Lab curriculum

August 2022 – First professional development day for second year

January 2023 – Second professional development day for second year

May 2023 – Math Lab students take SOLs

June 2023 – Review Math Lab pass rates

July 2023 – Make necessary revisions to Math Lab curriculum

Beyond – Roll out program to entire district