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Exploring Fifth Grade Teachers' Perceptions of Math Instructional Practices

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This is to certify that the doctoral study by

Lastarra Bryant

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Abstract

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MED, Regent University 2014

MED, Regent University 2012

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Doctoral Study Submitted in Partial Fulfillment

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Abstract

Even though a school in Southern Virginia had been utilizing a variety of manipulatives, calculators, and computers to transition students through the concrete-representational-abstract (CRA) sequence; students did not meet the state proficiency requirement on the standardized math assessment. A qualitative descriptive case study design, grounded in Bruner's learning theory on the modes of representation, was utilized to explore fifth-grade teachers' perceptions of their math instructional practices. The central question was about 5th grade teachers' perceptions of utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts. Data were collected through observations, interviews, and archival data. The data were analyzed through thematic analysis and coded through the constant comparison approach. The data collection revealed that the 4 participants were utilizing a wide variety of manipulatives, calculators, and computers to transition students through the CRA sequence; however, the teachers were unable to teach students to a level of mastery due to various barriers. The study's findings suggest that the research site would benefit from a three-day professional development plan, created to address the lack of teaching to mastery. This study will contribute to positive social change because it addressed the math achievement gap that is widening in America. This study's findings could benefit local, district, and state stakeholders as the project addresses teaching students to the appropriate cognitive levels to prepare for lifelong learning in mathematics, as well as for standardized assessments.

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Dedication

To my mother, the most amazing woman I know. Your strength, grace, and unconditional love have been a constant inspiration. From a young child, you taught me to value education. You always said you would ensure that I did what you were unable to do, so this is a win for US! I now understand why a C was never acceptable. To my Gramma Sue, you were always telling people that your granddaughter is a Doctor. Now you can scream it to all your buddies resting in heaven!! To my father Frank, you say I get my brains from you…hmmm, maybe just a little. To my dad, Brian, thank you so much for always supporting me. You were foundational in making this dream reality. You are always my blessing!

To my children, I pray that my success inspires and encourages you to soar and reach for your dreams. If you see it, you can achieve it! Do not let anyone's perception of you become your reality! Nothing is impossible with faith, focus, and determination!

To my honey, my loving husband, you have always been everything that I needed throughout this journey. Your love, support, and most importantly, your prayers have gotten me through to the finish line. You put some of your aspirations to the side, so I could pursue my dream. The sacrifices that you have made to ensure our family was great throughout this process, reminds me of your greatness. This is a win for US

Lastly, to all the young women who feel stuck. Please know that your current circumstances do not define your destination. I hope my journey inspires you to "Be" the best you…Dr. StarrBe!

Acknowledgments

All praise, glory, and gratitude goes to the highest, my Lord and Savior, Jesus Christ. There have been millions of prayers sent up for strength, guidance, and motivation and here I am! It is only through your glory that I stand here today-accomplished!

Next, I must acknowledge my family. There were a lot of sacrifices made for me to complete this journey. My husband Theo, who has given me unconditional support on this journey. Your love, support, and prayers are what got me through. I love you boyfriend! Sun I'Shyne, thank you so much for always motivating your "Honey" even when you had no clue you were doing it. You have also become a great baby sitter ☺ . Navaj, my busy bee. You reminded me throughout this journey that there is still life to live. No matter how many times I told you not now, I am studying; you were going to make sure I saw that new handstand! Anavya Love, my princess, you are like a mirror. Everything I do, you do! Because of this, giving up was not an option.

Last and most certainly not least, I extend my thanks and appreciation to my chair and committee for their scholarly guidance. I am grateful for the continued encouragement. Dr. Jazzaar and Dr. Goodin, your timely responses have made this journey much easier. I appreciate you, more than you know. Dr. Williams, thank you for remembering what it was like to be in my seat, your understanding made the process a lot less stressful. I must also thank the local schools and teachers for their cooperation and participation.

To all my friends and family who have kept me in their prayers, whether near or from afar, thank you! This Power Kingdom girl made it…

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Section 1: The Problem

The Local Problem

The problem at an elementary school in Southern Virginia is that students did not meet math proficiency standards on the mathematics state assessment in fifth-grade (Profiles, 2018). Although schools in this district utilized a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts (Math Curriculum Leader, personal communication, May 4, 2018), students were still not meeting state proficiency standards. Utilizing manipulatives in math instruction is a critical component in helping students conceptually understand math topics (Liggett, 2017). According to the National Council of Teachers of Mathematics (NCTM, 2008) including various methods of technology into daily math instruction supports and increases mathematical reasoning, problem-solving, communication, and conceptual understanding.

Additionally, the process of transitioning students through the concrete-representational or pictorial-abstract method is a best practice known as the concrete-representational-abstract (CRA) model/method/sequence (Akinoso, 2015; Jones & Tiller, 2017). The CRA model is a three-step mathematics instructional approach. At the concrete stage, students get introduced to hands-on manipulatives that are used to solve math problems. The pictorial or representational stage is where students use pictorial representations to represent the concrete manipulatives from the previous stage. The abstract stage is where students begin to work with the numbers only, without the manipulatives or pictorial representations (Peltier & Vannest, 2018).

Bender (2009) argued that the CRA model has a profound influence on students' math performance on standardized assessments. Per Jones and Tiller (2017), the CRA model helps learners make meaningful connections and helps teachers teach conceptually, increasing the students' understanding by connecting concrete manipulatives to abstract math processes. It is vital that students are offered opportunities to learn math in various ways to conceptually understand the skills taught; this could include manipulatives, pictorial representations, or technology integration (Flores, Hinton, & Burton, 2016).

According to one of the district's math leaders, teachers within the district implement the CRA instructional model to help students attain the conceptual understanding of math concepts (Math Coach, personal communication, April 7, 2015). Having a conceptual understanding of topics taught is imperative, as this will increase students' performance on the standards of learning (SOL) tests (Math Teacher Specialist, personal communication, April 7, 2015). Despite this fact, the school's state report card indicates student performance on benchmark assessments/standardized test scores in fifth-grade have not been successful (Education, 2018). In an interview with stakeholders affiliated with the school, they believed a big part of the gap in mathematics at this school is some of the teachers' ability to provide sound tier-one instruction, and student's ability to make connections between previous and newly learned concepts. The administration recognized discipline concerns as impediments to student learning (Personal Communication, Administration, May 10, 2016).

The demographics of this school in Southern Virginia has a population of 80% African American and Latino students (Profiles, 2018). Per Venzant-Chambers and

Huggins (2014), African American and Latino students are consistently outperformed in math by their Caucasian and Asian peers. Researchers have suggested the gap persists because minority students enter high school mathematically unprepared (Schenke, Nguyen, Watts, Sarama, & Clements, 2017). Per the Virginia Department of Education's quality school report (Profiles, 2018) this school's math scores have declined significantly. Math scores in the fifth-grade have decreased from the 2016-2017 school year from an 83% to 61% in the 2017-2018 school year (Profiles, 2018).

The school's leadership seen their math status as a problem. They have indicated that math as a focus on their School Improvement Plan (SIP). The SIP for this school indicated that improving student's math scores continues to be a priority. Some of the action steps included to reach the goal were continuous and ongoing professional development on math best practices, intervention time built in the master schedule to address areas that students struggle with, and professional learning community (PLC) meetings are bi-weekly.

According to Cope (2015), there is a significant amount of research that supports the use of the CRA model in classrooms to help students gain conceptual understanding. Cope (2015) further discussed the importance of CRA implementation being presented to students in the correct manner, for it to have lasting effects on their development of mathematical concepts. They cautioned against moving through the different stages too quickly as this can impact student understanding. There is a gap between what the literature suggests about students learning through the CRA process and the results that teachers in this Southern Virginia school are having. This qualitative descriptive case study added to the body of knowledge needed to address the problem by exploring fifth-grade teachers' perceptions of their math instructional practices. Obtaining their perceptions provided insight into what methods need to be in place to help students gain a conceptual understanding of math concepts so that they can meet proficiency levels on their standardized assessments.

Rationale

Evidence of the Problem at the Local Level

Academic reviews are standard practice in schools in Virginia. The inspections are intended to help schools identify and examine factors relating to instruction and organization that affect student achievement. The focus of the investigation is on the methods, activities, and instructional practices that are applied at the local and division levels (Education, 2018). This problem is crucial because even though the district utilized best math practices such as using manipulatives, calculators, and computers to transition students through the CRA process, the transfer of knowledge was not profound enough to get students to a level of proficiency on annual standardized assessments.

Per the Virginia school's quality report (VDOE, 2018), math continued to be an area for improvement. Incorporating manipulatives, calculators, and computers to transition students through the CRA model were listed as instructional strategies for elementary math content for the district (Orange City Schools, 2018). Discovering the influences impeding student achievement was imperative, and the stakeholders in this school were concerned about their student's lack of progress on state assessments. Parent/community surveys revealed: (a) stakeholders felt as if the schools are not adequately preparing their children for what is ahead and they would like to know the plan moving forward on getting students to pass state assessments; (b) various community partners question whether their tax dollars are spent on programs and materials that will increase student achievement; (c) concerns about the teacher turnover rate and how this affected student achievement was prevalent; (d) concerns about teacher quality have also been raised (Stakeholder, personal communication, April 10, 2015). Gibbs, Hinton, and Flores (2017) discussed the importance of teacher's knowledge being a contributing factor to a student's success. Their emotional state, comfort level with the material, lack of adequate professional development, disconnection from the school's mission, and personal feelings are a few barriers that can influence a lack of student achievement (Gibbs et al., 2017).

The purpose of this qualitative descriptive case study was to explore fifth-grade teachers' perceptions as they related to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. It was necessary to understand fifth-grade teachers' perceptions because they could speak to the content knowledge that students brought to the fifth-grade. Understanding their perceptions gave insight on what areas needed to be a focus in the lower grade levels so that by the time students got to fifth-grade they had a solid foundation that fifth-grade teachers could build upon. According to Cheryan (2012), students are entering middle school without a solid math foundation, which is widening the math achievement gap. In Virginia, middle school starts at sixth grade and ends in eighth. Therefore, understanding fifth-grade teachers' perceptions will help bridge the gap between instructional practices in the lower grades and meeting the instructional needs of students to prepare them for middle school.

Evidence of the Problem from the Literature

Success in mathematics is dependent on a conceptual understanding of concepts for which students can link the mathematical language with their experiences (Cohen, 2018; Doabler et al., 2017; Doabler & Fien, 2013). These conceptual links can be made using manipulatives and pictorial representations with explicit math instruction (Jones & Tiller, 2017). Furthermore, students' mathematics achievement gains closely link to teachers' mathematics knowledge (Ladd & Sorensen, 2017). Bigham, Hively, and Toole (2014) supported the idea that the classroom teacher is the most effective tool for impacting student learning. Giving students information as fact without a true understanding of the concepts is often the result of teachers' lack of understanding of the concepts taught. This lack of understanding inhibits the teachers' ability to effectively deliver strong mathematical content (Shockey & Pindiprolu, 2015). Exploring fifth-grade teachers' perceptions as they related to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts helped to develop an understanding of this school's problem, to find a solution.

Definition of Terms

This descriptive case study contains terms related to the CRA model and the conceptual understanding of mathematics. The terms listed below are defined to give the reader a clear understanding of the terminology used throughout this project. The terms were derived from the literature.

Barriers: Obstacles or problems that teachers may face that negatively impact their ability to provide sound instruction (Jameson & Fusco, 2014).

Conceptual understanding: Is helping students make mathematical links to connect interrelated concepts (Peltier & Vannest, 2018).

Concrete-representational-abstract: This instructional sequence involves teaching students computation at the concrete level by first using manipulatives. Students then progress to using drawings that represent the manipulatives at the representational stage. The last stage, abstract, requires students to compute using only numbers. Mnemonic strategies are sometimes used at the abstract level (Flores et al., 2016).

Manipulatives: Concrete objects used to illustrate mathematical ideas (Osana, Adrien, & Duponsel, 2017).

Sequence: Refers to moving through math instruction utilizing manipulatives first, then pictorial representations of manipulatives, lastly, to numerals only (Akinoso, 2015).

Standards of learning (SOL): The SOLs are the standards that were set for Kindergarten through twelfth-grade students in Virginia. The standardized yearly assessments that are given are used to determine school accountability (Virginia Department of Education, 2017).

Significance of the Study

This project study addressed a local problem and contributed to filling the gap between increasing math achievement by using math best practice strategies, such as manipulatives, calculators, and computers. These strategies allowed students to transition from concrete understandings to pictorial representations before they embarked upon abstract concepts. Understanding how teachers implemented the best practices, highlighted areas in need of additional teacher training and helped to establish guidelines for improvement. This study's findings impact various stakeholders as it adds to the knowledge base required to ensure that teachers are adequately utilizing manipulatives, calculators, and computers to transition students through the CRA process during their instructional time. More specifically, it ensures that students as stakeholders receive explicit and sound math instruction to ensure they are workforce ready or prepared to be college bound. Lastly, building and district level stakeholders have the necessary information to provide their teachers with proper training/coaching, effective professional development, and the knowledge required to put effective math procedures and routines in place, so teachers are readily prepared to transition their students through the CRA process.

Ensuring that teachers have a strong knowledge of the required mathematical skills, standards, and methods to teach all students is imperative to student success (Palardy, 2015; Phillip, 2007). The influences that are affecting the lack of student math achievement in this school is attributed to the lack of one of the aforementioned factors. According to Rhoads, Radu, and Weber (2010), many American math teachers have established an attitude about how to effectively teach math. However, their views can inhibit the use of best practices in the classroom that increases students' understanding of math concepts (Nielsen, 2016). Obtaining fifth-grade teachers' perceptions on utilizing a wide variety of manipulatives, calculators, and computers to transition students through the CRA sequence established math practices to put in place. These practices will help this school increase student achievement in mathematics.

This study created positive social change by providing a greater understanding of what is taking place in the classroom and why the best practices (manipulatives, calculators, computers, and the CRA process) that have been put in place were not showing expected results in student's mathematics achievement. Based on the findings, policies need to be re-evaluated to meet teachers' needs, which may result in increased student achievement (Jones & Tiller, 2017). In addition, stakeholders may use this study's findings as an opportunity to have meaningful discussions about trends in the data at the local, district, state, or global level, to obtain best practices that can be used to develop new methods to help teachers locally and globally incorporate manipulatives, calculators, and computers to transition students through the CRA model.

Research Question

The problem at an elementary school in Southern Virginia is that fifth-grade students have not met math proficiency standards on the mathematics state assessment. The purpose of this qualitative descriptive case study was to explore fifth-grade teachers' perceptions as they related to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. The central question that framed this study was: What are fifth-grade teachers' perceptions of utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts? The following four subquestions helped to answer the central question:

1. What are fifth-grade teachers' perceptions of using math manipulatives during instruction?

2. What are fifth-grade teachers' perceptions of using pictorial representations during instruction?
3. What are fifth-grade teachers' perceptions of using technology in math during instruction (i.e., calculators & computers)?
4. In what ways do fifth-grade teachers' approach abstract concepts during instruction?

Conceptual Framework

Bruner's learning theory (1966) grounded this study. Bruner's learning theory is grounded in the constructivist ideology, which is the process of how humans gain new knowledge based on their past experiences. Bruner's learning theory indicates that students' conceptual understanding depends on their schemata. Through their experiences, they can formulate new ideas and make new connections. An active learning process provides students with the opportunity to connect concepts from their previous knowledge to new concepts introduced (Bruner, 1966).

Bruner (1966) proposed three modes of representation for how children learn best and retain information; Enactive representation (action-based), Iconic representation (image-based), and Symbolic representation (language-based). The concrete-representational-abstract model is grounded in Bruner's modes of representation. Concrete refers to the use of manipulatives (Bruner's enactive phase), representational is image-based (Bruner's iconic representation phase), and abstract refers to the use of symbols and numbers (Bruner's symbolic phase).

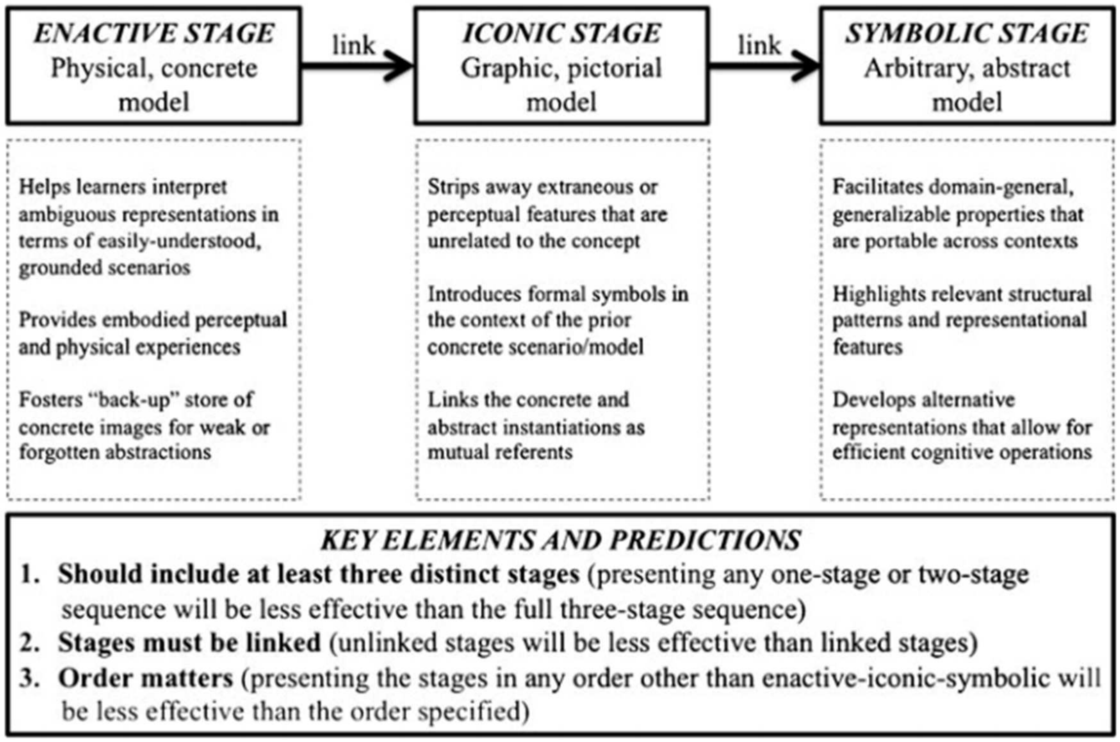

Figure 1. Bruner's modes of representation. Reprinted from Concreteness Fading in Mathematics and Science Instruction: a systematic review, by Fyfe, Mcneil, Son, and Goldstone (2014), Educational Psychology Review (2014) 26(1), 9-25. 2014 by Springer. Reprinted with permission.

Teachers at this Southern Virginia school are utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts. Bruner (1966) suggests following the modes of representation in a sequential format, to increase student's retention of knowledge and achievement. Bruner argued that when teachers assume students will already know the enactive phase, or if the student has a strong symbolic background, teachers are prone to skipping the enactive and iconic phases. He explains that when teachers do this, they are risking students not obtaining the imagery needed to fall back on when their symbolic understanding prohibits them from solving a problem. Being familiar with all the modes of representation will allow students the opportunity to rely on information learned from the previous phase, which will strengthen their overall conceptual understanding of the topic and interrelated topics (Leong, Ho, & Cheng, 2015).

Bruner's theory framed this study by posing guidance on how to effectively transition students through the CRA process. Constructivist learning environments support teachers guiding students learning through cooperative learning, hands-on experiences, and collaboration. Bruner believed students would begin to develop knowledge and make sense of their world when presented with different ways to construct the meaning of taught concepts. It is crucial that students are provided opportunities to move from the enactive (concrete) to the iconic (representational) and then the symbolic (abstract) levels sequentially, to understand mathematical concepts abstractly (Bruner, 1966). Moving to the symbolic, or abstract level too quickly, or skipping past the enactive or iconic stages can hinder students' understanding of the concept being taught (Driscoll, 2014). Utilizing Bruner's theory to frame this study provided a basis for understanding fifth-grade teachers' perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts.

Review of The Literature

Mathematics continues to be a content area where American students struggle (Guglielmi & Brekke, 2017). There are many contributing factors for the achievement gap that exists in mathematics. The CRA model is a widely supported instructional best practice that bridges concepts and procedures when solving various math concepts.

Studies show that when the CRA model is followed explicitly, students experience significantly higher gains in mathematics achievement (Agrawal & Morin, 2016).

Understanding the CRA model was a fundamental portion of the research problem, purpose, and research questions. Teachers at this Southern Virginia school are expected to utilize manipulatives, calculators, and computers to transition students through the CRA method. Therefore, a thorough understanding of these best practices was important for analyzing the gap between what research says about the use of manipulatives, calculators, computers, and the CRA model and what was happening in the classrooms at this school. Peer-reviewed articles, books, and research databases were utilized to find prospective literature to support this study.

The databases explored were Resources Information Center (ERIC), Education Research Complete, Education Source (EBSCO), and ProQuest. The following keywords were used with the Boolean operators to maximize the search results: *math achievement gap*, standardized testing, *concrete-representational-abstract (CRA), math manipulatives, math strategies, calculators, technology in math, student achievement in math, and pictorial representations in math.* Abstracts were reviewed to choose articles applicable to this study. Included in this section is a synthesis of my literature review.

Standardized Testing

The No Child Left Behind Act (NCLB, 2001), expected all students to score in the proficient range on standardized tests. The NCLB has been replaced by Every Student Succeeds Acts (ESSA). However, there are still some components of the former act that remain the same. ESSA continues to hold states liable for student achievement, but they have now given states the flexibility of setting their own goals for student achievement

(United States Department of Education (USDOE), 2015). The Virginia State Department of Education (VDOE) has set a math goal for Grades 3-12 at a 70% pass rate. Therefore, the scores for third-fifth grade combined must average 70% or higher for the school to receive accreditation in math (VDOE, 2017).

Unfortunately, the lack of math achievement is a challenge in the country. According to the USDOE (2017), America is not keeping up globally in mathematics. Our students are not prepared with 21st - century skills that they will need. In reviewing the 2015 National Assessment of Educational Progress (NAEP, 2015), the fourth, eighth, and 12th graders math scores have had minimum improvement throughout the United States. Forty-percent of fourth graders and 33% of eighth graders are working at proficient levels or above. There has been minimum growth in 12th-grade math scores since 1996 (NAEP, 2016). Twenty-five percent of 12th graders are performing at or above proficient levels. The least amount of growth since 1996 occurred at the lowest levels of achievement (NAEP, 2016). Improving students understanding of math is a major concern in the American educational system. If the United States wants to ensure they are preparing students to compete in a global society, then students must obtain a conceptual understanding of the math concepts that are taught (Dancis, 2014). According to Agrawal and Morin (2016), the CRA method bridges the gap across grade levels for struggling math students.

Math Achievement Gap

According to the National Center for Education Statistics (2015), an achievement gap exists when a group of students performs better than another group of students on a test, and the difference between the scores is statistically significant. Groups are categorized by race, ethnicity, gender, or other factors. There have been conscientious efforts to close the math achievement gap in the United States, but some believe that the gap is widening (Reardon, 2013; Sparks, 2015). Therefore, it is imperative that educational leaders put best instructional practices in place to help diminish the gap. A significant barrier to student achievement is teacher preparedness for the diversity that they encounter (Brown & Crippen, 2017). Students bring different experiences and learning styles with them to the classroom. Consequently, it is essential that educators are prepared to teach to different learning modalities, to make the lesson meaningful for all learners (Marzano, 2013).

Teachers must also be culturally sensitive. According to Hur, Buettner, and Jeon (2015), the interactions between teachers and students can greatly impact their academic achievement in mathematics. Culturally responsive teachers willingly accept students' languages, culture, and their community in their classes. They understand that these differences will contribute to their overall knowledge base, rather than viewing them as a liability (Wyatt, 2017).

Many causes contribute to the achievement gap in mathematics. For many years, the socioeconomic status of the family has linked to the achievement gap (Galindo & Sonnenschein, 2015). However, Gut, Reimann, and Grob (2013) associate the gap with behavioral issues. Reinke, Herman, and Stormont, (2013) support the idea of the gap being a result of behavioral issues, they discussed some of the behaviors as defiance, restlessness, hyperactivity, disruptive classroom behavior, and lack of self-control as contributing factors. Some other possible causes are a student's self-efficacy, teachers' and students' attitudes towards math, and student's overall educational expectations

(Ikoma & Broer, 2015; Kotok, 2017). Doabler et al. (2016) associated students' math achievement with the varied instructional interactions the teacher and students have during instructional time. Students are better set up for success when they have teachers who understand how they learn (Semerci & Batdi, 2015). According to Barton (2003) and Kotok (2017), African-American students face a significant number of barriers to academic achievement, in and outside of the classroom. One major point in Barton’s (2003) research highlights the expectations that educators place on African American students; they are significantly lower than their White peers. Also, they also experience a less rigorous curriculum, which leaves them unprepared for more advanced math courses, because they lack the necessary math skills needed to excel in more demanding courses. Palardy (2015) discussed similar findings. Palardy also noted that African American and Hispanic students tended to be in classes with more negative characteristics and less effective teachers.

Cultural sensitivity is significant in lessening the achievement gap. It is vital that teachers are culturally sensitive to the differences their students bring into the classroom (Kumar, Zusho, & Bondie, 2018). They must have high expectations for all learners, and they must implement best practices proven to increase student achievement; this will ensure that students are more prepared for rigorous content in the upper grades.

Throughout the literature, the CRA model is a useful math best practice for teaching students with and without math difficulties and disabilities (Agrawal & Morin, 2016; Cass, Cates, Smith, & Jackson, 2003; Doabler & Fien, 2013). The CRA sequence requires students to learn through manipulatives-pictorial representations-to the abstract, using explicit instruction. Therefore, it has been proven to increase computational and conceptual understanding, resulting in improved student achievement (Doabler & Fien, 2013; Agrawal & Morin, 2016). The CRA model can be a powerful best practice to help lessen the math achievement gap.

Explicit Instruction

An efficient approach to teaching mathematics to students with math difficulties is through explicit instruction (EI). EI ensures that teachers thoroughly interact with students around critical math concepts (Doabler & Fien, 2013). According to Doabler et al. (2017) EI design has specific principles that align with CRA that teachers can follow to improve mathematical understanding (Morgan, Farkas, & Maczuga, 2015). These principles include: (a) engage students with background information. Teachers must tap into students' schemata; (b) provide explicit modeling and explanations; (c) promote conceptual understanding through visual representations; (d) provide multiple opportunities for mastery; (e) provide immediate feedback to ensure student understanding.

Researchers have focused on the benefits of explicit instruction for students with disabilities and those who are low performing in math (Morgan et al., 2015). In previous studies, EI has been associated with increasing student achievement in mathematics for both students with and without disabilities (Doabler et al., 2015). However, recent studies are limited on the influence of EI on general education students (Doabler et al., 2015), but special education students have had increased academic achievement using EI (Cohen, 2018). Although Bruner's (a self-proclaimed constructivist) work anchors the

CRA framework, many empirical research studies have utilized an EI approach rather than a constructivist approach (Peltier & Vannest, 2018).

The first of the three major principles of EI is explicit teacher modeling. Explicit modeling is free from ambiguity, and it shows the students exactly what the expectations are. Students are more successful at acquiring new math content when they are explicitly taught the expectations, before any independent practice (Doabler & Fien, 2013). There are three strategies offered by Maccini and Hughes (2000) to improve the use of teacher modeling, they include: (a) when communicating the ideas and concepts to students, teachers need to be precise with their words; (b) students must be actively absorbed in the learning process; (c) teacher expectations must be demonstrated, so that students have a clear understanding of the learning intentions.

Guided practice is the second major principle of EI. During guided practice, the teacher guides students through the prerequisite skills. The intent is that students will begin to apply those skills independently. It may require teachers to take their time and sequentially introduce new skills or concepts. This stage should include lots of verbal prompts through questioning (Doabler & Fien, 2013). Questioning will allow the students the opportunity to justify their thought process and intermingle with their peers throughout the learning experience. The guided practice stage incorporates the first two components of the CRA model, the concrete and representational (Doabler & Fien, 2013). During the guided practice, teachers should be introducing students to manipulatives and pictorial representations (Jones & Tiller, 2017). Under the CRA model, teachers must be sure to follow the steps sequentially, moving students from the concrete manipulatives to the pictorial or representational, and finally to the abstract stage (Doabler & Fien, 2013). This stage should end with a cumulative review, which highlights previously learned skills.

The final significant principle of EI is academic feedback. Academic feedback is necessary to affirm student responses and correct student's misconceptions. Consistent and timely feedback helps to deepen and develop students conceptual understanding of learned topics (Doabler & Fien, 2013). Heckler and Mikula (2016) discuss the importance of ensuring that feedback is positive and addresses the mistake specifically. Positive feedback will help to foster the love of mathematics and discourage a lack of motivation.

Utilizing Manipulatives, Calculators, and Computers

This School's district cites Manipulatives, calculators, and computers as methods used to transition students through the CRA process. According to The National Council of Teachers of Mathematics (NCTM, 2008), technology inclusive of tools such as calculators and computers supports students' mathematics understanding. It is unknown how teachers are implementing the use of these materials in their daily instruction currently. Incorporating manipulatives and various forms of technology to transition students through the CRA process provides students with the opportunity to explore a plethora of math models that were incomprehensible in the past (Liggett, 2017).

Manipulatives

Demme (2017) describes a manipulative as a visible, hands-on, object used to illustrate abstract symbols. For example, to represent the number 7, seven blocks or tiles can be used to represent the numeral 7. Having concrete manipulatives accessible for students increases math understanding while making the learning process fun (Demme, 2017). Using manipulatives in a teacher or student-centered classroom is appropriate. In teacher-centered classrooms that use the CRA model, teachers model how to use manipulatives and then students follow (Satsangi, Bouck, Taber-Doughty, & Bofferding & Roberts, 2014). In student-centered classrooms, it is more of an explorative process. Given manipulatives, students explore the manipulatives and arrive at an answer (Polly, Margerison, & Piel, 2014).

Using manipulatives to show math notions earlier in life enables students to grasp abstract concepts better Demme, 2017). One research-supported best practice that incorporates teaching utilizing manipulatives is the CRA sequence. With the CRA math is taught in a transitional sequence of concrete objects used to represent abstract concepts, to pictorial representations that represent abstract concepts, to finally working with only the abstract numeral and symbols to problem-solve (Satsangi & Bouck, 2014). Manipulatives are referred to as "concrete" in the CRA model. The options for manipulative use are limitless. However, it is vital that teachers are adequately prepared to make the connections between the manipulative chosen and the abstract concept (Demme, 2017).

It is important to note that when using manipulatives, that the purpose is to construct knowledge. Teachers should ensure that they thoroughly explain what the manipulative is supposed to represent, so students can begin to build connections between the concrete and the abstract. Failure to bridge this connection could negatively impact student learning (Golafshani, 2013). Bjorklund (2014) provided evidence that the use of manipulatives increased student's conceptual understanding of abstract concepts, which increased student scores. Many researchers support the use of manipulatives in the classroom to improve student learning and some who do not. However, manipulatives have been found to decrease math anxiety, increase student achievement, and students report that math is more fun when using manipulatives (Boggan, Harper, & Whitmire, 2009). The fun nature that manipulatives bring to math instruction can be beneficial in fostering a student's love for mathematics.

Calculators

SUN district (pseudonym) references calculators as a tool they utilize to transition students through the CRA process. According to Koop (2016), there has been a significant increase in the amount of current research that directly relates to the use of calculators in the lower grade levels. While there are, many uses for calculators in the classroom such as problem-solving, concept development, teaching place value, repeated addition to teaching multiplication concepts, repeated subtraction to explain division concepts, math fluency practice, checking long-handed computation, and applying formulas and graphs, it is imperative that teachers establish a purpose for the use of the calculator prior to any instruction (Koop, 2016).

Ensuring that students know how to use the calculator is imperative. It is necessary for them to have explicit instruction on the way that the calculator should be used to address the learning intentions for the specific lesson to avoid misuse and overuse. Additionally, teaching estimation before including a calculator in the teaching is a best-practice; this pushes students to think critically about the answer they receive from the calculator, and it will help them evaluate whether their solution is sensible (Koop, 2016).

In a study conducted by Yakubova and Bouck (2014), a teacher had great success using the calculator after teaching her students to problem solve using a number line. She transitioned her students from the representational (number line) to the abstract (calculator), and her students had a deeper understanding of the concepts taught, as evidenced by pre/post assessments. According to Yakubova and Bouck (2014), teachers should spend more time allowing students to use calculators for computational operations and spend more time on building conceptual understanding of other math concepts.

As technology is continuously advancing, calculators now allow students to learn more than just basic computation. Kissane (2015) discussed the importance of ensuring that students see the calculator as more than just a device for calculating answers. The calculator can help students make connections between number processes (Kissane, 2015). For example, as part of the fifth-grade curriculum at SUN district, students learn patterns and function tables. Traditionally, after being given a number, students have to manually compute the outcome (in a table) after finding the number pattern to apply to create the table of missing values. Using an advanced calculator, students have the opportunity to plug in the values to create their formulas, patterns, and table sets.

According to Kissane (2015), today, calculators are used for learning mathematics not just how to calculate. As we focus on instilling our students with 21st-century skills, we must begin to look at the calculator as more than a limited tool for finding answers at the end of lessons and start to incorporate it into the beginning stages of the learning process (Kissane, 2015). Depending on how creative teachers get with their instructional practices, they can include calculators into any step of the CRA process.

Computers

With the push to ensure that teachers prepare students with 21st-century skills, incorporating computers into math instruction can be very profound for students understanding of concepts, content engagement, and retention (Farisi, 2016). Computers have a lot of tools that teachers can include during math instruction. Some of those tools include spreadsheets, interactive presentation devices, and a host of mathematical content aligned games. Therefore, there is an array of opportunities for teachers to enhance student's learning through computers (NCTM, 2008; Turel, 2014). However, there is evidence that teachers’ attitude and comfortability with both the math content and the computer technology will impact what type of programs they include in math instruction and how often they add it (Turel, 2014).

Approximately 97% of U.S. classrooms have computer technologies that include any variation of interactive whiteboards, laptops, and ipads/tablets (U.S. Department of Education, National Center for Education, 2014; Williams, Warner, Flowers, & Croom, 2014). Teachers who are not comfortable with math content may never include technology of any sort, as they are just trying to give students basic instruction. Whereas, teachers who understand the material, but are unfamiliar with the technology are more apt to learn the technology so that they can include it in their lessons (Agbo, 2015). Other factors that contribute to the lack of computer use in classrooms is the lack of time, especially if they have experienced technical difficulties with the technology in the past, challenges with scheduling and pacing, and a lack of professional development on available programs (Agbo, 2015; Project Tomorrow, 2014). Mundy and Kupczynski (2013), discussed the importance of ensuring that teachers receive adequate professional development and ongoing instructional support in best practices for incorporating computers into instruction.

According to Halverson and Smith (2009), the platform to provide instruction through computers is so varied. Therefore, there is no excuse not to include it. Teachers can use programs aligned with their textbooks that teach explicit lessons. For example, the SUN district uses Envisions math in elementary school. Envisions math has a computer component that will provide an explicit instruction video on each topic. It also incorporates the CRA process as it walks students through the learning process. Additionally, teachers can utilize You-Tube educational channels, programs such as IXL, Matific, and prodigy math to provide students with a fun math learning experience using computers. Because of all the options available through computers, teachers can differentiate and individualize lessons to address students’ specific learning needs (Halverson & Smith, 2009).

With the continued educational reform pushing for digital transformation, there is a push for constructivist types of learning environments, where the classrooms are student-centered, and the intent is for students to use their schemata to build new knowledge (Hao & Lee, 2015). Utilizing computer programs allows teachers to be more creative with how they address students' needs while using technology to increase student's academic performance (OECD, 2012). The SUN district utilizes computers to transition students through the CRA process. Therefore, this is in line with educational reforms. This use of technology can have a profound influence on teachers’ instructional practices and student's learning. It can aid in basic computation, as well as provide pictorial representations of abstract math concepts (Francom, 2016).

With all the benefits of incorporating computers into math instruction, there are a few barriers worthy of mentioning as well. An and Reigeluth (2011) discuss the importance of ensuring that lessons that include computers do not lack in rigor. Their point is valid, as computer use in many classrooms focuses on word processing, social media, and math drills/practice (Reigeluth, Beatty, & Myers, 2016; Ruggiero & Mong, 2015). Another barrier that impacts effective computer implementation relates to the unrelated and unstructured time on the computers that meaningless gaming consumes (Jones & Dexter, 2014).

Concrete-Representational-Abstract (CRA)

Concrete-Representational/Pictorial-Abstract (CRA) Origins

In Singapore, the representational phase of CRA is called pictorial. Therefore, it is called the concrete-pictorial-abstract (CPA) model in Singapore and CRA in the United States. The CRA/CPA model is a critical strategy that was developed and used throughout Singapore (Hoong, Kin, & Pien, 2015). It is an effective instructional method used with students who struggle with math (Hoong et al., 2015). Singaporeans believe that the CRA/CPA model helps students build a stronger math foundation because it allows them to experience the same concepts taught explicitly in different ways (Jaciw, Hegseth, Lin, Toby, Newman, Ma, & Zacamy, 2016).

Singapore continuously performs at the top percentile in international Math assessments. Singapore students ranked second in mean score on the Programme for International Student Assessment (PISA) in 2012, while the United States ranked 28th (OECD, 2012). On the most recent PISA assessment given in 2015, Singapore scored number one, while the United States dropped from 28th to 36th (OECD, 2015).

Jerrim and Vignoles (2016) discuss the disparity between the US and Singapore's approach to teaching mathematics. Hazelton and Brearley (2008) further examined the significant differences between the US and Singapore. In their discussions, they note the difference between the curriculum frameworks. Singapore's structure allows the students more time on task. Therefore, students can try a different approach to problem solve. Singapore also places focus on one concept until students have gained mastery. They go through the CRA/CPA model sequentially to help students gain conceptual understanding. According to Jaciw et al. (2016) a single lesson in Singapore may be covered over multiple days; therefore students are given a lot more time to master concepts. Most lessons in the U.S. are covered daily, giving students limited time to master concepts (Jaciw et al., 2016). The time on task is necessary to note, as this can be a significant factor influencing the lack of success in math at this Southern Virginia school.

Effective CRA implementation happens over a period. One lesson cannot thoroughly go through the three modes of the CRA/CPA; therefore, it is imperative that curriculum guidelines allow for more extended periods to cover the standards (Hoong et al., 2015). In Singapore CRA/CPA is embedded into their daily textbooks and teachers receive adequate training on CRA/CPA in their pre-service teacher courses (Hoong et al., 2015). Bouck, Satsangi, and Park (2017) discuss the importance of ensuring that pre-service classes in the United States are structured so that they familiarize teachers with all the stages of the CRA instructional framework.

Concrete-Representational-Abstract (CRA) Overview

The literature depicts a wide range of students who have developed conceptual understanding after being taught mathematics after explicit instruction, using the CRA model. It has been used to teach a multitude of mathematical concepts including word problems, place value (Doabler, & Fien, 2013), and computation (Maccini & Hughes, 2000), geometry (Cass et al., 2003), Fractions (Butler, Miller, Crehan, Babbitt, & Pierce, 2003), algebraic expressions (Witzel, Mercer, & Miller, 2003), fluency in arithmetic computations (Flores, 2010). Teaching students mathematics, using manipulatives, pictorial representations, and then abstract numerals and symbols are the CRA method (Jones & Tiller, 2017). For example, the number eight could be represented by eight actual balls at the concrete stage. At the representational stage, the number eight may be eight pictures of a ball or 8 circles representing balls. Lastly, at the abstract level, eight will be represented by the Arabic numeral 8. This three-level strategy of concrete, representational, and abstract practices increase conceptual understanding of abstract math concepts. Additionally, because of the multisensory instructional approach, students' procedural accuracy and fluency in math are also improved (Witzel, Riccomini, & Schneider, 2008). Fluency or declarative knowledge (Hinton, Stroizer, & Flores, 2014) in math is essential as it builds a solid foundation for achievement in math. When students become fluent in problem-solving whole numbers and fractions, they are better prepared for higher order thinking in mathematics (Hinton et al., 2014).

Conceptual knowledge is when there is an in-depth understanding of the concepts presented. The steps it takes to problem solve is procedural knowledge. Both conceptual and procedural knowledge is built upon when using the CRA model (Strickland &

Maccini, 2013). Additionally, the three-part stages of the CRA model are impactful, because they involve kinesthetic, visual, and auditory learning (Witzel, 2005). Adhering to the different learning modalities is imperative for student achievement. Mudaly and Naidoo (2015) report that some teachers feel that students come to their classrooms uncooperative and unprepared to learn because of their lack of exposure to the various ways of learning math that the CRA method affords them. Moving through the stages of the CRA model increases students' mathematical confidence and builds their overall understanding of math concepts (Mudaly & Naidoo, 2015). Furthermore, the CRA model helps ground information learned at the concrete and representational stages, which results in a smoother transfer of knowledge when students begin to approach the problem at the abstract level (Fyfe et al., 2014).

According to Flores et al. (2016), researchers have proven that students' computational skills and conceptual understanding improved with the use of the CRA sequence taught with explicit instruction. The CRA sequence involves the active participation of students in their learning process, and it provides a structurally sound foundation that ensures that lessons can be created to help students think abstractly about difficult concepts and content (Akinoso, 2015). Current research emphasizing the CRA framework highlights the importance of teaching the stages to mastery before moving onto the next stage (Flores, Hinton, Stroizer, & Terry, 2014; Strickland & Maccini, 2013). Therefore, students must have a profound understanding of the concrete before moving on to the representational and lastly, the abstract. Jones and Tiller (2017) report that if teachers follow this sequence of teaching appropriately, then it is very likely that their students will experience considerable advancements in their mathematical understanding and achievement in math.

Peltier and Vannest (2018) discuss the importance of understanding that although Bruner's (1966) theory requires students to master each stage before moving on to the next stage, the stages should not be taught in isolation once they have mastered the previous stage. It is essential that students understand how the concrete and pictorial representations represent the abstract concept. Teachers can do this by ensuring that when they demonstrate the concrete and representational that they include the abstract next to it, so students can continuously make connections (Peltier & Vannest, 2018). Strickland and Maccini, 2013 suggests using the two to three modes simultaneously to help improve students' conceptual understanding. Some CRA researchers report the benefits of incorporating supplemental lessons to bridge the connection between the modes of representation (Flores et al., 2014; Strickland & Maccini, 2013). For example, when moving from pictorial representations to abstract symbols, a bridge lesson may include a mnemonic that connects the representational to the abstract that they will begin to practice. Pneumonics help students understand the concepts more thoroughly, by making connections to previously learned material.

Implementing the Concrete Stage

The first stage of CRA is the concrete stage; this is the "doing" stage (Witzel, 2005). At this stage, students learn to manipulate tangible objects to practice mathematics concepts through teacher modeling (Stroizer, Hinton, Flores, & Terry, 2015). Concrete objects that are used to represent math ideas are manipulatives. Students can manipulate these items to better understand math concepts (Doabler & Fien, 2013). As the lesson begins at this stage, it is essential for teachers to utilize a graphic organizer while discussing the learning intentions for that day (Hinton et al., 2014). Graphic organizers help to set a purpose for learning for the students. They also help students make continuous connections throughout the learning process (Hinton et al., 2014).

The concrete stage incorporates visual, tactile, and kinesthetic learning modalities (Witzel et al., 2008). According to Witzel (2005) and Akinoso (2015), the use of three-dimensional manipulatives increases students' sensory inputs that they use when acquiring new content. It enhances their ability to recall procedural information needed to problem solve.

Once the teacher finishes showing students the procedures to solve the problems, (modeling) the next step is guided practice. Guided practice allows students to work closely together to practice the content from the teachers' modeling, demonstrations, and explanations with the teacher (Kaffer & Miller, 2011). The teacher can use this time to check for understanding and clarify any misunderstandings. Students then move on to independent practice. During independent practice students work independently and complete their assignment. The teacher will provide the students with individual feedback.

The last step of the concrete stage is to go back to the original graphic organizer (Flores, 2010; Kaffer & Miller, 2011; Miller, 2009). The post organizer serves as a closure piece; this allows the class to reflect on the concepts learned throughout the lesson. According to Stroizer et al. (2015), the representational stage should not begin until students have mastered 80% of the content on their independent practice assignment from the concrete stage.

Fyfe et al. (2014) discussed four probable benefits to using concrete materials. First, they can bridge links between the concepts to be learned and real-world experiences. Second, the increase of physical activity has a direct link to enhancing understanding and memory. Third, they provide learners an opportunity to make meaning of their learning and connect new concepts to their schemata. Fourth, they require use of sections of the brain that process visual information, so perceptual processing is more prevalent.

Despite these benefits, using concrete materials in isolation, without sequentially following the CRA model can be more of a distraction than a link to bridge the concrete and abstract. Belenky and Schalk (2014) discussed the importance of teaching the proper way to utilize the concrete manipulatives because their irrelevant perceptual details can be a distraction for the learner. Therefore, it is imperative that teachers model the appropriate use of manipulatives before allowing students to use them.

Implementing the Representational Stage

The representational (also called pictorial) stage involves using visual representations to solve problems, it is the “seeing” stage (Witzel, 2005). At this stage, students use two-dimensional drawings to represent the manipulatives that they used during the previous stage (Akinoso, 2015). For example, if students were learning about place value, in the concrete stage they could have actual base ten blocks to manipulate. In the representational stage, they would draw small squares to represent ones, long rectangular rods to represent tens, and a large square to represent hundreds to demonstrate their understanding of place value (Doabler, Nelson, & Clarke, 2016). One misconception is that the representational stage can only be drawings by the student

(Jones & Tiller, 2017). Mancl, Miller, Kennedy (2012) and Miller and Kaffar (2011) support using pictures of manipulatives at the representational stage. Virtual manipulatives used on digital devices are also appropriate in the representational stage of CRA (Satsangi & Bouck, 2014; Shaw, Giles, & Hibberts, 2013; Van de Walle, Karp, & Bay-Williams, 2013; & Yildirim, 2016).

The representational stage bridges the gap between solving problems using manipulatives and problem-solving with numbers only (Hinton et al., 2014). Flores, 2010; Flores et al., 2016; Kaffer & Miller, 2011; Miller, 2009; give an in-depth discussion on this phase of instruction. Both the concrete stage and representational stages require a graphic organizer, teacher modeling, guided practice, independent practice, and a post organizer. However, the organizer used in the representational stage is a little more advanced. It sets a purpose for learning, by telling the students what to expect.

The teacher will then move on to modeling the lesson for the students using drawings of his/her own while giving explicit instructions on the process of solving the problem through the given procedures (Flores, 2010; Flores et al., 2016; Kaffer & Miller, 2011; Miller, 2009). Once the demonstration has concluded, the students will work with partners or whole group on guided practice items together. At this time, the teacher will provide overall feedback and have conversations with students to deepen their understanding of the content (Flores, 2010; Flores et al., 2016; Kaffer & Miller, 2011; Miller, 2009).

Next, the students will move on to independent practice, where they practice problems on their own. As the teacher monitors students working independently, he/she will clarify any misunderstandings on a one to one basis. The teacher and students reconvene the whole group and close the lesson out with a reflective discussion. Lastly, students demonstrate what they have learned by completing their graphic organizer (Flores, 2010; Flores et al., 2016; Kaffer & Miller, 2011; Miller, 2009).

Implementing the Abstract Stage

The abstract stage is the final stage of CRA. It is the symbolic stage, as it only requires students to use numbers, notations, and symbols to solve problems (Akinoso, 2015). Therefore, objects and pictures are not used. However, they may be referenced during instruction. Students translate their previous drawings into conventional math notation to solve math problems (Jones & Tiller, 2017). According to What Works Clearinghouse (2008), many researchers prefer abstract materials, because they eliminate irrelevant perceptual details. On the contrary, some researchers argue that problem-solving with the abstract only, may result in a greater number of incorrect strategies being used (Koedinger, Alibali, & Nathan, 2008) and illogical errors (Thompson & Siegler, 2010).

The abstract phase incorporates an additional strategy called strategy instruction (SI). Strategy instruction focuses on strategic understanding (Fyfe et al., 2014). For the context of this paper, SI refers to teaching students a mnemonic to jog their memory on the procedures involved in solving the problem (Hinton et al., 2014). Strategy instruction is conducted before abstract instruction. According to Horowitz (n.d.) learning a mnemonic to help solve problems is useful when students will have to learn and apply new skills. One example of a common mnemonic used to assist students in solving word problems at the abstract stage of CRA is DRAW. According to Stroizer et al. (2015), the

DRAW strategy has four steps: (a) discover the sign; (b) read the problem; (c) answer with a conceptual representation; (d) write the answer and check. Over time, with frequent use of strategy instruction, students begin to develop a range of strategies to use as needed (Fyfe et al., 2014). Although they may build a repertoire of strategies, some researchers report that mnemonic strategies can mask the lack of authentic conceptual understanding. Students become fluid with the steps that the mnemonic represent, but fail to understand the mathematical procedures (Koban & Sisneros-Thiry, 2015).

Hinton et al. (2014) explained that once the abstract stage has been implemented (after reviewing the SI), following the same procedures from the concrete and representational phases will occur. There will be a graphic organizer discussion; the teacher should review the learning targets with the students. The teacher should then model and demonstrate what students should do with the numbers and procedures. Guided practice will occur; next, the students work together with the teacher solving problems. Independent practice follows. Independent practice requires students to work independently on questions. The teacher will monitor and check for understanding after a given time. Lastly, the teacher and students will work to complete a post graphic organizer. They will use this organizer for their reflection. The lesson will conclude with a class discussion on the concepts learned (Flores, 2010; Flores et al., 2016; Kaffer & Miller, 2011; Miller, 2009).

CRA Studies

CRA is empirically supported as an effective method for ensuring struggling math students obtain a conceptual understanding of mathematical topics (Agrawal & Morin, 2016). The CRA model has been proven successful across many different mathematical concepts and amongst many different learning groups (Peltier & Vannest, 2018). It has been used to help students who have math difficulty (Agrawal & Morin, 2016), emotional and behavior disorder, and students who are at-risk mathematically (Peltier & Vannest, 2018).

There are positive findings in the literature that discuss the outcomes of CRA with both students who have learning disabilities and those who do not; Bryant, Bryant, Gersten, Scammacca, and Chavez (2008) conducted research involving first and second graders. In this study, CRA was used to teach number relationships, place value, and addition and subtraction. Their findings report that second-grade students will benefit from incorporating CRA methods and explicit instruction. The data regarding the first-grade students is inconclusive.

Gibbs et al., (2017) conducted a case study that investigated the outcomes of the CRA method when being used to ensure students had flexibility with counting and using skip counting to increase multiplication fact fluency. Students showed a great deal of improvement. The authors discuss the importance of ensuring students obtain conceptual understanding so that they will have a strong sense of numeracy knowledge. Students in this study became proficient in their multiplication facts.

Miller and Kaffar (2011) have had success using the CRA model. Their study focuses on utilizing the CRA to teach addition and subtraction. They suggest using the CRA model alongside explicit instruction to build students' fluency with addition, subtraction, multiplication, and division. The findings from the study show that educating students through the CRA model will allow them to perform better than comparison students who receive tradition textbook instruction on computation and fluency tasks.

Flores, Hinton, and Schweck (2014) have found the CRA model to be a great way to increase students with specific learning disabilities (SLD) understanding in computational fluency. Their particular focus was on multiplication and division fluency. They found that by incorporating place value mats and base ten blocks as concrete objects, the students gained a better understanding of multiplication and division, as evidenced by pre/posttest data.

Butler et al. (2003) studied the use of the CRA while teaching junior high school students the concept of fraction equivalents. Their study compared the CRA model of instruction with the representational and abstract (RA) method. Their findings concluded that students taught using the CRA model had more gains than the students who were trained using only the RA model.

Witzel et al., (2003), Witzel (2005), Scheuermann, Deshler, and Schumaker (2009), and Strickland and Maccini (2013) all conducted studies that explore how useful the CRA model is when teaching algebra. Their findings report higher gains for the students who learned math by using the CRA model than those students who learned via traditional methods. Students also demonstrated less computational errors after being taught math, using the CRA model.

Witzel et al., (2008) focused on teaching students with emotional and behavior disorders (EBD) using the CRA model. They report that there is limited research that focuses on the CRA with EBD. However, their study focused on helping students with problem-solving skills. The findings in their study demonstrate the CRA model as an effective method to utilize when teaching EBD students mathematical concepts.

Bouck, Park, and Nickell (2017) used the CRA method on students who were intellectually disabled (ID) to investigate math problems that involved money and making change. The CRA method effectively taught 100% of the participants how to solve the questions correctly. Therefore, the CRA model was successfully used to support ID students.

The literature shows that CRA is successful across the different mathematics strands. It is a proven best practice for teaching students with and without disabilities. Following the CRA method sequentially, but not in isolation is imperative. Teachers should reference each mode of representation when moving on to the next stage. For example, when moving from the concrete to the representational stage, concrete manipulatives should still be visible and referenced.

Summary of CRA

The CRA model is an empirically researched best practice that has been used to help struggling learners in math conceptually understand math content (Agrawal & Morin, 2016). Agrawal and Morin (2016) discuss how the CRA has been beneficial in aiding in students understanding of many math concepts. Using the CRA model allows students to make concrete links between concrete and abstract referents, which will lessen the ambiguity of complex topics (Fyfe et al., 2014). Also, it is imperative that careful progress monitoring takes place at each phase so that teachers can ensure students have obtained a level of mastery at each stage before transitioning to the next step of the CRA (Akinoso, 2015). Skipping to the next phase in the CRA framework before students have mastered the previous stage will set students back and may prohibit conceptual understanding of the skills taught (Akinoso, 2015; Fyfe et al., 2014).

According to Hoong et al. (2015), it is common for teachers to jump to the abstract due to timing and curriculum pacing restraints. They discuss the importance of teachers understanding that when they skip to the abstract that they are doing students a disservice because it limits the opportunity for students to make conceptual connections in their learning. Because of the amount of time, it takes to go through each phase of the CRA it is a lot harder to obtain teacher buy-in. Hoong et al. (2015) suggest that if schools implement CRA, they should consider if teachers perceive the CRA as too time-consuming and are teachers having concerns about the direct impact that CRA has on test scores for the topic.

Hoong et al. (2015) recommend policymakers design instructional units that will show the benefits of the CRA model immediately. They argue that it is important to acknowledge that implementing CRA for an entire curriculum is not feasible, because it is a time-consuming process. Therefore, it would be more beneficial to create units of about 6 hours of lesson time (throughout the unit) to see what impact the CRA method has on students learning. Effective implementation of CRA happens over a period. One lesson cannot thoroughly go through all three phases of the CRA. Lastly, they discuss that perhaps teachers are not having success with CRA because the sequence cannot be used on all math topics. CRA is inappropriate for some math topics. However, studies have shown it to be useful with fluency in subtraction computation (Flores, 2010), understanding of fraction relationships (Butler et al., 2003), teaching of place value and geometry (Fuchs, Fuchs, & Hollenbeck, 2007) and word problem computation (Maccini & Hughes, 2000). The literature demonstrated the effectiveness of the CRA model on mathematical conceptual understanding across many subjects. CRA is recognized as a successful process for teaching students in the general education and special education setting (Watt, Watkins, & Abbitt, 2016).

Implications

The literature review for this study addressed the crisis that math education is in regarding standardized assessments, various math strategies used throughout the stages of the CRA process, the CRA math model, and the conceptual framework that grounds this project study. After a review of the literature that highlighted the effectiveness of the CRA model for helping students obtain a conceptual understanding of math concepts, my concern as to why students in this school are not meeting the proficiency level on state assessments have heightened. The purpose of this qualitative descriptive case study was to obtain teachers' perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts.

According to the literature, carrying out the CRA model explicitly and sequentially is vital (Agrawal & Morin, 2016; Stroizer et al., 2015). Understanding the fifth-grade teachers' perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts may provide direction for improving student achievement in mathematics. Furthermore, research has revealed that teachers' beliefs and overall comfortability with math determined how they conducted their math classes (Polly et al., 2014).

The results of this study impacted the development of the three-day professional development final project. Data findings revealed that teachers are comfortable with utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts, in fact, they see it as a non-negotiable. However, other barriers impeding student achievement emerged from the data collection. Additionally, this study has the potential to impact positive social change as the findings help to provide curriculum and PD leaders with the necessary information for improvements in the understanding of rigor and pacing in math, to help increase students' mathematics achievement. Students with strong math skills will have the essential 21st-century skills to compete in a global society (Yadav, Hong, & Stephenson, 2016).

Summary

Section one discussed a significant problem in that fifth-grade students had not met math proficiency standards on the mathematics state assessment at an elementary school in Southern Virginia. The literature proves that the CRA model is a valid sequence of teaching mathematics concepts that have been shown to increase students' achievement in math, yet that is not the case in this school in Southern Virginia. The literature provided highlights specific ways that the CRA sequence needs to be implemented to ensure students obtain conceptual understanding, resulting in increased student achievement. Obtaining teachers' perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts helped the researcher obtain a great understanding of math best practices to address the gap in practice.

The next section of this study will discuss the qualitative methodology and research design used. Also, I explained the process for participant selection, data collection, data analysis and the limitations of this study. Lastly, I discussed my role as the researcher and my plan for the protection of the participants.

Section 2: The Methodology

Introduction

Qualitative research will be applied to address the problem in this study. The purpose of this project study was to explore fifth-grade teachers' perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. The central question that framed this study was: What are fifth-grade teachers' perceptions of utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts? The following four subquestions helped to answer the central question:

1. What are fifth-grade teachers' perceptions of using math manipulatives during instruction?
2. What are fifth-grade teachers' perceptions of using pictorial representations during instruction?
3. What are fifth-grade teachers' perceptions of using technology in math during instruction (i.e., calculators & computers)?
4. In what ways do fifth-grade teachers' approach abstract concepts during instruction?

This section discusses the methodology used to find the answers to the research questions listed above, the process of selecting participants, data collection and analysis, and limitations. As a result of exploring fifth-grade teachers' perceptions as they relate to their math instructional practices, a three-day professional development plan for improvement was put in place to help students obtain conceptual understanding so they can achieve proficiency, which will ensure that this school meets accreditation demands

Research Design and Approach

A qualitative descriptive case study was used in this study. Yin (2009) argued that the research questions, the researcher's control on the behavioral events, and the degree of focus on contemporary versus historical events determine the type of case study conducted. Due to the purpose of this study, utilizing qualitative research was the best approach. When there is little known about a topic, and the basis for a relevant theory is inadequate qualitative research is more appropriate to conduct (Yin, 2009). Qualitative research is dependent upon narrative phrases, which are analyzed and categorized into themes (Merriam, 2009). Contrarily, quantitative analysis requires asking questions that lead to constricted answers, which require a numeric value to analyze. Therefore, it was not an appropriate method to address the purpose of this research.

Other qualitative methods such as ethnographies, phenomenological research, and grounded theories were not appropriate for exploring fifth-grade teachers' perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts. Ethnography research was inappropriate because this study does not focus on one specific cultural group (Creswell, 2012). Phenomenological studies focus on the life experiences of a group of people, based on shared experiences, so it was also inapt (Hatch, 2002). Grounded studies would not work for this study either, because the research is not seeking to find a new theory (Hatch, 2002). Additionally, a program evaluation would not be an applicable method of research for this study either, because the focus was not on a specific program or intervention that the school was following with fidelity (Creswell, 2012).

The descriptive case study was the best qualitative approach for this study. Descriptive case studies document the procedures of an event or events (Yin, 2009). When a researcher works towards improving the discourse of educators through developing an educational theory or by refining current knowledge, a descriptive case study is appropriate (Baxter & Jack, 2008). Case studies have the flexibility that the research methods mentioned above do not have. Therefore, they can be designed to address the research questions and can be diverse in the study design (Hyett, Kenny, & Dickson-Swift, 2014). Utilizing a descriptive case study design ensured that I obtained meaningful information on the current math instructional practices in this school, to help lead to a solution for securing accreditation in mathematics at this Southern Virginia school.

Participants

There was a population of 33 classrooms teachers in the building from grades K-5, and the sample size was four participants. The pool of potential participants was not large due to the limited number of fifth-grade teachers this school year. They currently have four fifth-grade math teachers, including the special education teacher, math interventionist, and the math coach. If I were unable to obtain a reasonable number of participants, I would have extended the invitation to all testing grades from third through fifth-grade. Should the need for expansion have occurred, my research design would have changed from a descriptive case study to a comparative case study.

Nonprobability convenience sampling was used to create the pool of teachers for participation. Convenience sampling requires the researcher to utilize participants who are willing and available to participate (Creswell, 2012). This method of sampling was appropriate because I sought data from a small group of people within one school, with no intentions on generalizing the results to a larger population (Serra, Psarra, & O'Brien, 2018). Because the sample size was not sizable, I was able to obtain more depth of inquiry per teacher (Malterud, Siersma, & Guassora, 2016). All educators within the school building who taught fifth-grade math, including special education, math coaches, and math interventionists, were invited to participate and selected if they agreed to participate.

I applied to the district's research and accountability office to obtain permission to access participants. I used personal time to conduct observations and interviews. I had no prior relationship with the participants. To build a rapport with the teachers, I discussed the purpose of the study with them before I conducted any research to let them know my position and intentions. I also included the information in the consent form. It was vital that they understood that my role was not supervisory and I was only there to collect data.

Protecting participants' rights as outlined by Walden and the Institutional Review Board (IRB) was a top priority. Initially, I thought that participants would be apprehensive about someone observing their classroom's instructional practices and set-up, or discussing their perspectives on the current math practices they were required to implement, so I discussed confidentiality with the participants multiple times. It was crucial that they understood that what I saw and heard from them would not be connected to them at all. To protect their identity, I used a number in place of their names. I referred to the school district and building as the “research site.” I provided the participants with clear documentation that explained their rights, expectations, and the intentions of the study in the consent form (Santiago-Delefosse, Gavin, Bruchez, Roux, & Stephen, 2016). I ensured that participants were aware that they could withdraw from the study at any point. Marshall and Rossman (2016), discussed the importance of assurring that participants are aware of potential dangers, how will their identity be protected, and how will the results be reported. Additionally, I obtained informed consent from each of the participants before conducting any research.

Data Collection

Data collection played a significant role in examining the results of the study. Therefore, I collected data in various ways. I used classroom observations, interviews, and physical artifacts for data collection. The timeline for data collection was four weeks. Below is an explanation of each method I utilized in this study.

Classroom observations

I conducted four, 60 minutes, nonparticipatory observations during math instruction. The observations were scheduled around the teachers’ availability. I observed to see if and how teachers were utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts (see Appendix C). I arrived at the participants’ classrooms about 15 minutes earlier than my scheduled observation time to organize my data collection tools. The participants allowed me to sit wherever I felt comfortable, and to feel free to walk around the classroom to observe the small group settings they had established. I utilized an observation protocol that was directly in line with my study because it showed if the teachers' delivery of instruction aligned with the expectations that the district's math department had in place (see Appendix C).

The conceptual framework used in this study, Bruner's learning theory states that the transition from the concrete to the abstract should be done sequentially and not done in isolation (Bruner, 1966). Therefore, I observed and wrote descriptive and reflective field notes on how explicit their instruction was. I was looking to see if teachers were modeling expectations for students, using manipulatives to introduce concepts, transitioning the students from the concrete manipulatives to some form of pictorial representation (Hoong et al., 2015). I understood that it would be difficult to observe every step of the CRA sequence in one sitting, but through my analysis of the lesson plans, I could see the extent to which the unit or lesson was taught. Additionally, if anything seemed to be lacking, I obtained feedback from the teacher during our interview.

I tracked how the components mentioned above were implemented through an observation protocol that I created (see Appendix C). The protocol allowed me to state my observations regarding the overall classroom environment and how teachers and students used manipulatives, calculators, and computers in the classroom. I included a section that allowed me to write descriptive and reflective notes on classroom practices and instruction as I observed. Merriam (2009) discussed the importance of keeping detailed reflective field notes to ensure there is an understanding of the phenomenon that is studied. Therefore, I wrote notes continuously as I observed.

Throughout the observations, I took a lot of notes on how explicit the teachers taught the standards and on the classroom environments and management styles of the participants. After observing the interactions between the students and their teachers and the students and their peers, it was evident that the school practiced a school-wide behavior plan. Students were respectful of the teachers and their classmates. I witnessed two students have a disagreement and their conflict resolution skills showed that the teacher had fostered an environment built upon respect and kindness. All four participants had strong classroom management skills, and their students were motivated to learn. The students were calm; they listened to their teacher's explicit instruction and engaged in the learning experiences provided. All the teachers had their classroom set up in groupings conducive for collaborative work. Two of the four classrooms had the desks set up in collaborative groups of four. Although two of the other learning spaces did not have desks set up in collaborative groups, it was obvious that small group stations took place regularly, by the areas that were set up in the room with tables and multiple chairs. There were also charts displayed that showed students what rotation they were to participate in daily. The classroom walls had general posters displayed of basic math algorithms, however, I did not observe anchor charts being displayed. The anchor charts would be evidence of continuous guided lessons with the teachers. They would also serve as reference points for the students as they progress through the math standards.

According to Creswell (2012), observations provide the researcher with the opportunity to watch the participant in the natural setting. Observations influenced some of the questions that I asked during the interview, so it was essential that I paid close attention and kept detailed field notes (Merriam, 2009). Although obtaining permission to observe participants was a tedious task (Creswell, 2012), the information gleaned from the observations was essential to the outcome of the study. I obtained a lot of pertinent information about the participant's instructional practices and overall classroom environment, which has a direct impact on student achievement (Marzano, 2013). After each observation, I rewrote the notes in a narrative format, so it would be easier for me to identify themes during the analysis and triangulation process.

Protecting participants' privacy throughout the study was imperative. Therefore, I used numeric pseudonyms as identifiers for my participants. I labeled all observation information with a numeric pseudonym that was randomly assigned. I did not assign the numbers in the order in which the participants participated to ensure I protected their privacy.

Interviews

Data collected through interviews provide valuable information that cannot be obtained through observations (Yin, 2014). Through the interview process, I gathered information on teacher practice at this school. The interviews helped me explore in what ways fifth-grade teachers are teaching math utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts (see Appendix D).

I obtained the interview questions from the dissertation of Angela Vizzi of Walden University, who has permitted me to use in this descriptive case study (See Appendix E). The questions were adjusted to fit all the components of the CRA model as opposed to just manipulatives. Eleven interview questions were asked to address the questions guiding this study. The interview questions were directly related to the conceptual framework, Bruner's learning theory, in that they provided a deep understanding of how teachers perceived a student's conceptual understanding and math achievement related to the math instruction that they received. According to Kotok (2017), a teacher's attitude and thoughts towards math could have a significant impact on a student's math achievement in his/her class.

The included interview questions (see Appendix E), generated data that described teachers' perceptions on district-wide math instructional mandates that required them to utilize a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. I conducted the interviews after observing the classrooms, so I could include questions that pertained to the instructional practices that I observed. Per Creswell (2012), it was vital that the questions were open-ended so that the researcher could get rich responses, rather than yes/no responses. I recorded the interviews and transcribed them within two days of the interview. Once I had transcribed them, I provided the participant with the transcription so that they could member-check them for accuracy. Yin (2014) suggests using an audio recording along with an interview protocol to minimize any ethical matters that can jeopardize the participant's confidentiality.

Although there was much valuable information gathered from the interviews, the validity of the interviews could be questionable. Because I was the one conducting the interview, it was possible for the participant to provide answers that were in line with what they thought I wanted to hear, rather than genuine information (Creswell, 2012). Therefore, I reminded my participants of my obligation to maintain their confidentiality throughout the interviewing process.

Archival Data

The use of interviews as a single source of data is not uncommon in qualitative descriptive case studies (Yin, 2014). However, I supplemented the interviews and observations with the use of archival documents. According to Yin (2014), archival documents provide stable data, and when coupled with interviews it can strengthen a case study research design. I reviewed archival documents such as lesson plans and professional development offering logs. Reviewing those documents did not give me any information on the participants' perceptions of their math instructional practices. However, it allowed me to see the instructional process that teachers normally utilize to implement math instruction. I also obtained insight into the amount of training provided and how the teachers transferred math professional development to their actual instructional practices. Collecting this information aligned with this study, because the outcome of the review provided additional possible reasons for student's lack of success in math at this Southern Virginia school.

Participants were asked to provide me with this year's lesson plans and a log of PD offerings that were offered that school year for math. My review of the lesson plans revealed that the teachers are collaborating and working on the plans together, as they were very similar. The resources that accompanied the lessons plans were aligned with the standards and appeared to be rigorous. Some of the activities were differentiated for students who did not work on grade level. The lesson plans clearly articulated the overall objectives and standards being addressed over time. However, I did not observe learning targets, or learning intentions being identified for daily instruction. Incorporating daily learning intentions will help to ensure the lessons are focused. Additionally, I did not observe pre-requisite skills that needed to be addressed prior to teaching current skills addressed in the lesson plans.

The PD logs appeared to be vague. Although the district has provided math PD throughout the year, the PD provided by the district to address the CRA model specifically, was not evident from the documentation I reviewed. Much of the professional development offered by the district was optional, so the teachers were not obligated to participate. Based on the documentation provided it was not clear if the teachers had attended the offered math PD, so I asked each participant during the interview if they attended the PD offered by the district. Two of the four stated that they did not attend the district's PD, because it was not aligned with their needs at that time. One of the participants said that she did attend both of the optional math PD sessions that were offered and they were informative. The last participant could not remember if she attended the math PD sessions or not. However, the documentation provided by one of the participants provided me insight on their in-house professional development. In which, the facilitator of the PD consistently included CRA practices to address forthcoming math standards. The lesson plans reflected the use of manipulatives and technology to address current standards that they received PD on, but there was no evidence of how prerequisite skills were addressed prior to starting a new standard.

The data collected corroborated the findings from the observations and interviews. Yin (2014) discussed archival data as a pathway to validate observational and interview data because it allowed for a rich source of data. I deidentified all archival data to ensure I maintained the participants' privacy. I triangulated the data obtained from observations, interviews, and archival data by cross verifying the information gathered to ensure credibility. To decrease any threats to the credibility, after triangulating the data I member checked the information obtained to guarantee it was accurate. Creswell (2012) suggested using member checks as a strategy to ensure credibility. Member checking is a process where the researcher takes the analyzed data, interpretations, assumptions, and conclusions back to the participants to check for accuracy of the information (Merriam, 2009).

Data Collection Summary

Dasgupta (2015) included interviews and observations as suitable information to collect when conducting a case study. Including semi-structured interviews gives participants the opportunity to respond and illustrate concepts, as well as allows the reader to obtain all information (Dasgupta, 2015). I reviewed archival data including lesson plans and professional development offering logs to see if teachers were receiving adequate professional development and if the professional development content was reflected in the lesson plans. In addition to completing an observation protocol, I wrote field notes during my observations so that I could remember and document the behaviors, activities, and events that I observed. Field notes yield meaning to the phenomenon being studied (Dasgupta, 2015). All data collected was triangulated and member checked to ensure validity and credibility. To further protect the identity of my participants and research site, I locked paper files in a file cabinet that only I have access to and digital records will continue to be protected on a password secured laptop for no more than five years, as required by Walden University.

Role of the Researcher

When I initially started my classes at Walden University, I was a teacher in the district. Since progressing into the capstone phase of my studies, I have obtained employment elsewhere. I previously taught elementary education, but for a two-year period, I taught only mathematics in fifth-grade. Therefore, I am familiar with the curriculum in fifth-grade and may hold some bias as to how it should be taught. To decrease the likelihood of my biases affecting my role as a researcher, I used a researcher personal journal, as suggested by Corbin and Strauss (2014). This journal was used before, during, and post any participant interactions. The purpose was for me to acknowledge my thoughts, actions, and potential biases before the data collection, so I could avoid insertions and influencing participants with my personal feelings.

Because my personality type tends to be physically expressive, I ensured that I kept my facial expressions, body language, and tone neutral to avoid bias. Maintaining these standards guaranteed that my facial expressions and responses did not indicate approval or disapproval of the participant's responses. Confirming that I was aware of my disposition diminished any bias that could have been the result of physical influences.

Data Analysis

Data analysis is essential in any research study (Yin, 2014). The analysis provides the researcher with a more detailed understanding of the data (Yin, 2014). I analyzed the data through thematic analysis. I applied the constant comparison approach for coding; this required me to categorize information, compare data from each category, and integrate the properties and their categories (Lincoln & Guba, 1985). I tracked the themes until I decided that saturation had occurred. Saturations is defined by Creswell

(2012) as the point where the researcher makes a subjective decision that any newly identified data will not provide any additional information to develop a new category.

To adequately explain the central phenomenon, Merriam (2009) discussed the importance of using an inductive process. When analyzing the data, it is possible to come across a theme that does not align with the rest of the data, or it is inconsistent, this is called a discrepant case (Gast & Ledford, 2014). Yin (2014) discussed discrepant cases, and they suggest making the data a part of the study, rather than excluding it because it is not consistent with the other data; including discrepancies in my data provided contrary evidence about the central phenomenon (Yin, 2014), which strengthened my study's findings. Triangulation and member checks were also used to ensure the credibility and validity of this descriptive case study.

Triangulation

Triangulation is a process of comparing multiple data sources in research to strengthen the researcher's findings (Renz, Carrington, & Badger, 2018). In addition to ensuring credibility and validity in a study, triangulation also diminishes researcher bias and ensures that information is constantly being checked throughout the study (Renz et al., 2018). Therefore, using the constant comparison approach, I triangulated all the data obtained from observations, interviews, and the archival documents review. Through this thorough analysis, I was looking for reoccurring themes, trends, and patterns (Lodico, Spaulding, & Voegtle, 2010). Because I constantly compared the data, triangulation was a continuous part of this descriptive case study. According to Thurmond (2001), some researchers believe that using triangulation to ensure validity is controversial. However, there are many proponents that believe that using triangulation provides a greater understanding of the research problem. These proponents feel that triangulation provide the opportunity for increased findings, because there are more data sources that offer various perspectives of the phenomenon studied (Thurmond, 2001). Fusch and Ness (2015) recommend triangulating the data until saturation is reached and no new themes emerge.

Member Checks

Member checking is a process where the researcher takes the analyzed data, interpretations, assumptions, and conclusions back to the participants to check for accuracy of the information after data collection (Merriam, 2009). The purpose of the member check is to ensure the validity of what the participant said and expressed is an accurate account of what is presented in the study (Koelsch, 2013). Including member checks will also ensure that any bias that I may have is not included in the data (Lodico et al., 2010).

Member checks can be uncomfortable for both the researcher and the participant, because the participant may not be able to accept the words or actions that they exhibited during the initial data collection (Forbat & Henderson, 2005). To be prepared for this type of outcome it was imperative that I established a relationship with the participant throughout data collection, so they were comfortable with being transparent. In ensuring that there is mutual respect between the researcher and participant, Bloor (1997) advises the researcher to be cautious during the member check process, because researchers and participants may have different end goals. While the researcher wants to conduct member checks to ensure all data collected is reported accurately, the participant may be more interested in conjuring sympathy or getting back at an organization (Bloor, 1997).

Knowing that there was a possibility that the participants may have different end goals from myself, I was sure to repeat the purpose of the study throughout the process. Keeping my participants comfortable was a top priority. I guaranteed that my human subjects were protected by obtaining informed consent, maintaining their confidentiality, and by following proper information-storing guidelines as suggested by The Institutional Review Board (IRB) and Walden University.

Limitations

Limitations of a study are inevitable and are considered a potential weakness of a study (Merriam, 2009). Being aware that limitations exist helped me to ensure I alleviated any biases that I may have had and critically evaluate my data collection and analysis. One potential limitation was the fact that I was once an employee in the district. Being a former employee in the district could have had an impact on what was observed as well as the amount of information the teacher was willing to divulge during the interview process, for fear that what they shared may be repeated. Another potential limitation is whether the teachers had adequate professional development with utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. Lastly, generalizing the data to a larger population was a limitation of this study, because of the small number of participants.

Summary

Qualitative research methods were applied to explore whether fifth-grade teachers were utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. I used a descriptive case study and collected data through interviews, observations, and archival data. The participants consisted of fifth-grade teachers (general education and special education) and math content specialists, such as the interventionist and math coach. Protecting participants' rights was a top priority. All records will continue to remain confidential. Paper documents are locked away in a file cabinet in my home. Electronic versions of the collected data will remain protected on my password secured laptop for five years. When I referenced the participants in this study, I used a number in place of their names. Participants received informed consent and were reminded that their participation was completely voluntary throughout the study. They were also reminded that they could have withdrawn from the study at any given point if they wanted to.

Data Analysis Results

The purpose of this qualitative descriptive case study was to explore fifth-grade teachers' perceptions as they related to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. After observing, interviewing, and looking through archival data the data was analyzed. I used the constant comparison approach for coding, so that common themes and patterns could be identified. Using this open coding approach to analyze the data allowed me to organize the data from the themes that arose. The interview protocol (see Appendix D) was set up to address the following central question: What are fifth-grade teachers' perceptions of utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts? The following four subquestions helped to answer the central question:

1. What are fifth-grade teachers' perceptions of using math manipulatives during instruction?
2. What are fifth-grade teachers' perceptions of using pictorial representations during instruction?
3. What are fifth-grade teachers' perceptions of using technology in math during instruction (i.e., calculators & computers)?
4. In what ways do fifth-grade teachers' approach abstract concepts during instruction?

Evidence of Quality

First, I created the interview protocol to address the research questions. I was sure to align the interview questions with the conceptual framework. I ensured that the questions I utilized would get me closer to finding a solution to the problem at the research site. After the data collection process, I transcribed the interviews and submitted a transcript of the interview to the teachers to ensure I have clearly and accurately understood their responses (Creswell, 2012). After the member checking process, I began analyzing the data looking to see what themes emerged. Once I identified the themes I continued to triangulate the research questions, observation data, interview data, and archival data to see if any new themes emerged, or to see if there were any discrepancies in the data (Hancock & Algozzine, 2006). I placed the research questions, interview questions, and participant responses into a matrix to organize the data to cross check, to see if any new themes emerged (see Appendix F). Appendix F was systematically organized by the central research and sub-questions, interview questions, the theoretical framework, and the participants' responses. It was important for me to organize the data in this way to ensure that all the information was aligned, before finding themes in the collected data. I printed the documents out after typing them and color coded the data to ensure it was all organized. As a third check, I created an analysis overview where I rewrote the participants' responses under each interview question in a Word document (see Appendix G). I continued to triangulate the data until I reached saturation and no new themes emerged.

Discrepant Cases

Gast and Ledford, (2014) described a discrepant case as a theme that does not align with the rest of the data, or it is inconsistent. The data did not reveal any discrepant cases. This could be because there were only four participants within the same research site. The participants' responses aligned for the most part, although there was a discrepancy noted during the interview process with the information shared about the special education teacher's attendance at the collaborative learning team meetings (CLT). Participant 1 mentioned that the special education teacher was not in attendance at the CLT meetings. Participant four stated, that all the teachers on the grade level attend the CLT meetings, so they can plan upcoming lessons and review data together. Through member checking this inconsistency was cleared up, and participant 1 clarified, that due to scheduling conflicts the special education teacher is unable to attend the full 90-minute planning session, but she holds an alternate planning session for the team after school monthly. Therefore, the special education teacher does get the same instructional supports and resources as the other members on the team.

Findings

The problem of this qualitative descriptive case study is even though a school in Southern Virginia has been utilizing a variety of manipulatives, calculators, and computers to transition students through the concrete-representational-abstract (CRA) sequence, they have not met the state requirement on the standardized math test. To get to the root of the problem the researcher explored fifth-grade teachers' perceptions on utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts. Overall, the participants had positive perceptions on the use of manipulatives, calculators, and computers to transition students through the CRA process. All four of the participants felt that manipulatives are an invaluable tool to help students understand math. They all agree that taking students through the CRA process is necessary for moving students towards conceptual understanding in math. Although they utilize technology and felt it is an asset in the classroom, they agree that if not strongly monitored students can lose focus and use the computer time as free time. Collectively, the participants felt that calculators are great for self-checking and error analysis. The participants shared that it is important to start students off with tangible manipulatives and then transition them to pictorial representations before working on abstract problems. The thought process of the participants was concurrent with the sequential process of Bruner's theory on the modes of learning.

While triangulating the observation, interview, and archival data I noticed that teachers were incorporating manipulatives, calculators, and computers while transitioning students through the CRA sequence. Several themes emerged as the data was analyzed.

Collaborative learning teams (CLT), teaching to mastery, students' lack of foundational prerequisite skills, and teaching test-taking strategies were amongst the most prevalent themes that emerged.

Theme 1: Collaborative Learning Teams (CLT)

Throughout the interview process teachers referenced their CLT meetings as an effective means for obtaining professional development. Collaborative Learning Teams is a method of professional development that involves teachers, specialists, and principals working together collaboratively to move students forward academically through a data-driven process (Gibbons, Lewis, & Batista, 2016). The CLT meetings at the research site are facilitated by the math specialist (coach). In their interviews, the participants described the CLT meeting as a time for all the teachers to get together and learn from each other. They explained that these meetings are bi-weekly and that at these meetings they plan for upcoming lessons, share resources, disaggregate data, and align their resources. Participant 1 (P1) discussed the importance of the CLT meeting, "this is the time when I can ensure I am speaking the right language and am in accordance with my team." Participant 2 (P2) described the CLT as "invaluable! I receive professional development and resources." Participant 3 (P3) stated, "This is the time for the lesson to be taught by the specialist to ensure that all teachers know what they are teaching in advance. This way all teachers are on one accord." Participant four (P4) said, "This is a time where we can plan who is going to teach what and go over test-taking strategies. Test-taking strategies I believe is a big part of the puzzle that is missing."

Gibbons et al. (2016) discussed four conditions that can lead to effective collaborative discussions during a CLT meeting: (a) the quality of school work. Teachers need to use work that shows them how students think, not just whether they got the answer right. Although standardized assessments often only test whether students know the answer or not (Lewis, Gibbons, Kazemi, & Lind, 2015). By incorporating formative assessments that allow the teacher to conference with the student can provide more in-depth data to be used to inform decisions (Gibbons et al., 2016); (b) examine student work collectively. This helps support the teachers in trying new instructional strategies; (c) school leaders' participation is essential. The principal should participate as a learner, so that they can provide adequate feedback to teachers; (d) effective coaching supports teacher learning. The coach should lead the meeting, provide teachers with learning opportunities, consider instructional implications, and get the teachers to agree to do something when they get back to their classrooms.

Theme 2: Teaching to Mastery

The participants discussed that although they are utilizing technology and the CRA process to teach math, they felt that one of the greatest factors leading to student failure is the fact that they are unable to teach the standards to mastery. Participant four stated, "It's unfortunate that no matter how much we put into a lesson, we still find ourselves trying to remediate a week later because we had to introduce another new skill." Participant two mentioned, "we will never get out of this hole that we are in if we don't start mastering basic math skills." Mastering basic mathematical skills is critical for the success of students in primary education because it is the foundation for future math applications (Codding, Burns, & Lukito, 2011). The participants explained that the district pacing does not allow them to stay on one skill for too long. Participant one discussed the district's pacing in relation to the state standards. The participant explained that there are so many skills to be covered in the state standards that the district is forced to cram the standards in a pacing guide, which sometimes only allows for five days to cover a full standard. Participant three noted students' lack of foundational skills as a reason that they don't get to a level of mastery. This participant discussed the amount of time spent spiraling and backtracking on skills to get students to understand the new content. This participant stated, "We are having to go back and teach simple basic math facts like counting backward from five to two without using fingers." This participant, posed the following question,

> How could I possibly get students to multiply fractions when they don't understand prime and composite numbers, so they don't know their factors. Seriously, they are having trouble with multiplication facts like two multiplied by seven. These are the factors that we are facing while trying to prepare our students mathematically.

According to the Hedginger Report (2014), American math classes are trying to cover too much material, leading to wasted instructional time. The quality of the lessons that should be preparing students for more complex concepts are diminished due to the number of standards that must be covered in a short period.

Theme 3: Students' Lack of Foundational Prerequisite Skills.

Prerequisite skills are the necessary skills that students should have before being introduced to new tasks. Rittle-Johnson, Fyfe, Hofer, & Farran, D. C. (2017) discussed how understanding how student's early mathematics understanding can be a good indicator of their math achievement in later years, therefore a strong foundation is imperative. All four participants expressed that student's lack of a solid foundation on basic skills such as adding, subtracting, multiplying, dividing, place value, and a basic understanding of fractions are hindering their success in fifth-grade. Participants two and four explained that the all the skills in fifth-grade build upon these basic math skills. All four participants discussed the importance of incorporating the CRA sequence when spiraling back to review missed skills. They described the CRA process as a necessary component to building students' math foundation. Research question one examines the strengths of using manipulatives. Participant three discussed the fact that manipulatives are tangible and therefore, students can manipulate the objects to problem solve. Participant four saw the manipulatives as necessary too. She added that she believes the lack of prerequisite skills that the students display in fifth-grade are a result of not being introduced to the CRA method earlier. She mentioned, it could also be that teachers are not teaching foundational skills to the level that they need to teach, so when the next grade tries to build from there, it's like a foreign language to the students. According to Participant four;

> Students must be given manipulatives from PK, and they must continually be using them across grade levels. If students are learning place value using the place value chart in first-grade it needs to be taught this way all the way up to fifth. This will ensure that students have a strong foundation of these basic and necessary skills.

A shared belief amongst all participants is that students need to be taught using manipulatives and pictorial representations. They all agree that technology can be used to build up some of the fluency facts that students are missing in the fifth-grade. The participants referenced the following programs as resources that students can work on to increase their math fact fluency (a) Reflex, (b) Prodigy, (c) Matific, (d) ABCya and (e) IXL. Once they begin getting students that have a solid math foundation, they believe their scores will soar. Collectively, they recognize the CRA sequence being introduced earlier would benefit the students' understanding of basic facts. Participant three also noted that there might be a need for more foundational math professional development in the district. This participant stated, "I don't really think people understand how hard elementary math is. It has changed and our kids are underprepared…in fact our teachers are underprepared. There really needs to be a reset and teachers have to realize what the students need to know."

Theme 4: Teaching Test-Taking Strategies

Test-taking strategies (TTS) were mentioned throughout the interviews amongst all four interviews. Teachers discussed the need for teaching test-taking strategies. Participant four described TTS as the missing part of the puzzle. According to Participants two and four, if students are not taught how to take the test and ways to be successful on the test it is a disservice to the students. Participant one, discussed the importance of the need to teach TTS for new standards and new testing formats. Participant one stated, "We must give the students a set of skills that they can use to get through these assessments." One of the interview questions asked about the benefits of teaching the abstract; all four participants noted that the abstract prepares students for what will be on the test. "This is what they will see on the test, so we have to prepare them by giving them an arsenal of strategies." Two of the four participants expressed the necessity of teaching students test-taking strategies to combat the lack of foundational skills. Per Peng, Hong, and Mason (2014), students equipped with test-taking strategies are better equipped to demonstrate conceptual understanding on a test. All of the participants believed that integrating test-taking strategies with the CRA sequence would be a move in the right direction towards seeing growth on standardized assessments.

Conclusion

The problem of this qualitative descriptive case study was even though a school in Southern Virginia has been utilizing a variety of manipulatives, calculators, and computers to transition students through the concrete-representational-abstract (CRA) sequence; they have not met the state requirement on the standardized math test. Therefore, the purpose of this study was to explore fifth-grade teachers' perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. The research questions were grounded in Bruner's learning theory (1966). The central question that framed this study was: What are fifth-grade teachers' perceptions of utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts? The following four subquestions helped to answer the central question:

1. What are fifth-grade teachers' perceptions of using math manipulatives during instruction?
2. What are fifth-grade teachers' perceptions of using pictorial representations during instruction?
3. What are fifth-grade teachers' perceptions of using technology in math during instruction (i.e., calculators & computers)?

4. In what ways do fifth-grade teachers' approach abstract concepts during instruction?

There were four participants in this study who allowed the researcher to observe a math lesson, conduct an interview, and review archival data. Once the data was collected, it was transcribed, and member checked. Information from the observations, interviews, and archival data were coded to see what themes emerged. The findings of this study revealed that teachers have positive perceptions of utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts. Overall, the participants felt that the CRA process and incorporating technology into their instruction is beneficial to students' understanding of math concepts. The major themes that emerged were collaborative learning teams (CLT), teaching to mastery, students' lack of foundational prerequisite skills, and teaching test-taking strategies. Based on these findings, I recommended a three-day professional development/training focused on teaching students to mastery.

Section 3: The Project

Introduction

In this qualitative descriptive case study project, I collected data to explore fifth-grade teachers' perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts. The data revealed that teachers had positive perceptions of all the above. They collectively felt that math could not be taught properly without utilizing manipulatives and pictorial representations. They also agree that technology and calculators are useful tools to utilize when teaching math. The major reoccurring themes were collaborative learning teams (CLT), teaching to mastery, students' lack of foundational prerequisite skills, and teaching test-taking strategies. Based on the outcome from the data collection, I decided that it would be beneficial to create a professional development training on teaching to mastery. I addressed the other themes that emerged, such as students' lack of prerequisite skills and teaching test-taking strategies in the workshops during the PD training. I prepared a three-day hands-on CLT-workshop style PD plan to help equip teachers to teach for mastery. The style of the PD will be similar to the format they currently use in their CLT meetings. I included activities throughout the PD that will help teachers implement the necessary components needed to teach the standards to mastery. Some of the activities include; unpacking standards, pacing out the curriculum guide while aligning it with the district pacing guide, creating daily learning targets, infusing test-taking strategies, and planning exciting activities to build vocabulary and formative assessments that will help teachers move their students to a level of mastery of math concepts (see Appendix A).

This section of the project study will include the description and goals, rationale, review of the literature, and a project description.

Description and Goals

Teachers at the research site are expected to be teaching students through the concrete, representational, and abstract (CRA) sequence, while incorporating technology and computers. Therefore, this qualitative descriptive case study explored fifth-grade teachers' perceptions as they related to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embarked upon abstract concepts. The basis of the research is grounded in Bruner's learning theory (1966), which discussed student's understanding conceptually rather than through rote memorization (Bruner, 1966). Based on data collected from observations, interviews, and archival data teachers perceive the use of manipulatives, calculators, and computers as effective processes for students to gain a conceptual understanding of math concepts. However, the problem still exists, why are students not meeting proficiency levels in mathematics at the research site?

The data analysis revealed the following themes that teachers perceive as factors that are contributing to the failing scores in their building: (a) teaching to mastery, (b) students' lack of foundational prerequisite skills, (c) teaching test-taking strategies. One theme that teachers perceive as a step in the right direction toward increasing students' scores is their collaborative learning teams (CLT). Therefore, the project I designed is a three-day "Teaching to Mastery" workshop. The workshop will follow a CLT style so that the recommendation to continue the activities in their current CLT meetings will be a smooth transition for the team(s).

The "Teaching to Mastery" workshop will include three full days of collaborative team planning. Day one will focus on understanding the standards. Teachers will work collaboratively to unpack the standards and determine to what level they should be teaching their students to. Day two will focus on instructional design. The focus will be on pacing, alignment, creating learning intentions and targets, a skeleton for unit exams, and starting a folder for shareable resources and activities. Day three will be all hands-on. The workshops will be designed for teachers to set up model activities for their students, to address vocabulary, number sense routines, and formative assessments. Throughout the three-day PD, teachers will work together to plan the curriculum and pacing by nine-week quarters. Teachers will prepare for the first quarter of school throughout the three -day workshop. Teachers will plan subsequent quarters at their bi-weekly math CLT meetings.

The overarching goal of the project is to get teachers to work collaboratively on teaching to mastery. Additional goals include: (a) helping teachers understand the level at which they should be teaching; (b) helping teachers learn how to move their students towards mastery; (c) help generate creative and fun activities for promoting interactive notebooks and interactive number sense routines in the classroom; (d) formatively assessing throughout the process, so teachers can monitor their students understanding continuously. This three-day training will directly address the themes that emerged from the data collection, which will help get the research site and possibly other schools in similar situations on the right path to getting students to understand conceptually and obtain success on their standardized math assessment.

Rationale

The findings of this study indicated an immediate need for professional development on working with teachers to instruct students to a level of mastery. Collectively, the participants felt that their students lack prerequisite skills, so they have a hard time filling the gaps and teaching the new concepts. Participant four expressed that teaching test-taking strategies is a missing component of their current instruction, and it is indispensable.

Observations indicated that teachers are implementing computers and calculators while transitioning their students through the CRA process. They are teaching the CRA sequentially, as Bruner (1966) suggested. However, observations revealed that their lessons appear to be rushed, as they have a lot of material to cover. Therefore, unpacking the standards and pacing through daily objectives is necessary. The PD modules will allow teachers to dig deeper into the new math standards. As a result of this training, teachers can ensure they are teaching to the level of rigor for students to obtain mastery. Teachers have the opportunity to collaborate with their team members to develop strategies for remediating the lack of prerequisite skills. Teachers will develop engaging model activities for vocabulary, number sense, and formative assessments to prepare students for standardized assessments and life in general. Lastly, teachers will discuss test-taking strategies and how they can be incorporated into teachers' daily instruction to help prepare their students with strategies when taking tests.

Based on the analysis of the findings, there is a need for teaching students to a level of mastery. Therefore, I created a three-day professional training entitled Teaching Students to Mastery. The three-day training was designed to take place over the summer before teaching the first quarter of math (but they can be started at any point) and should be continuous throughout the year to prepare for the upcoming unit, semester, or quarter. Ayvaz-Tuncel and Çobanoglu (2018) discussed the importance of ensuring that PD is ongoing and not limited to a few in-service trainings. Therefore, Teachers will use their CLT time for math to discuss, unpack, and pace upcoming standards to ensure they are teaching to the appropriate level and to ensure they have adequate activities, test-taking strategies, and review items for prerequisite skills prepared for the next unit, quarter, or semester.

Review of the Literature

Based on the findings from the data collection I conducted a literature review on professional development, with a focus on the best way to approach teacher-learners. Professional development (PD) was chosen as the genre for the deliverable project because it was obvious that the teachers at the research site were adamant about being able to work collaboratively to ensure their scholars obtain conceptual understanding. The teachers felt that they are not currently teaching students to mastery, so I determined a PD training with ongoing training within a professional learning community (PLC) would be the best fit. The literature review includes:

1. A discussion of the andragogy theory so there is a clear understanding of the components that my PD plan will include.
2. An overview of PD, to give a clear understanding of the selected genre.
3. PLCs, to provide the reader with information on the primary method for sustaining PD.
4. Collaboration, because this is the driving force within a PLC.

5. Mastering and unpacking the standards.

Using the education databases; ProQuest, Eric, EBSCO, Education Research Complete, and Sage I conducted an extensive review of PD articles published between 2014-2019. I also utilized textbooks to gather information. The search terms I used were: *Professional development, Andragogy, Types of Professional Development, Effective professional development-elementary math, professional learning communities, collaborative professional development, Virginia state standards, unpacking standards, and teaching math to mastery*. These searches produced a lot of information, so I narrowed them down to focus on collaborative professional development and unpacking standards.

Andragogy

Andragogy or the adult learning theory is a conceptual framework that focuses on the art and science of how adults learn (Knowles, Holton, & Swanson, 2012). Because people have different ways of understanding, it was imperative that I considered learning styles when planning the professional project (see Appendix A). It is crucial to apply the adult learning theory to PD offerings to heighten professional practice and ensure that it has a bearing on professional growth, (Knowles et al., 2012).

According to Knowles et al., (2012) the theory of adult learning encompasses the following assumptions that motivate adults to learn: (a) need to know. Adult learners need to know the goals and expectations of PD upfront; (b) self-concept. Self-concept refers to the maturing of a person's self-concept. Adults go from being dependent on receiving information to being self-directed when obtaining new information; (c) prior experience. Adults acquire information as they age, this increases their knowledge base and strengthens their ability to share information; (d) readiness to learn. Adults are more apt to learning, based on the role they will play in the process; (e) orientation to learning. As an adult matures, they are more likely to apply the newly acquired knowledge; (f) motivation to learn. As a person develops, the learning process becomes intrinsic. The six principles discussed, aid in helping PD developers design valuable professional learning experiences for adults (Knowles et al., 2012). Although there are other adult learning theories, Merriam and Bierema (2014) suggest using the andragogy learning theory because of the six principles within it.

Knowles (1987) has created four essential questions for structuring any adult learning experience, they include: (a) the content covered, (b) how the content is organized, (c) the sequence followed when content is presented, (d) the most effective method for transmitting the content. Under an andragogic approach, the role of the facilitator is to design a learning process where the learner is engaged in an active role within the learning process. Including the learners in the process of the PD will ensure that the PD is meaningful to all learners involved (Knowles, 1987).

The PD that I designed for the teachers at the research site follows an andragogic approach. I addressed the 6 principles within the PD plan that I designed. Principle one addresses the participants need to know. The findings of the study revealed that teachers perceive their students are not taught to mastery. Therefore, the goals of the PD match the needs of the teachers. The PD plan addressed the necessary components for teaching students to mastery. Principle two is related to teachers' self-concept. To ensure the teachers are not relying on information being given to them by a presenter, they will be active participants in the sharing of knowledge. Principle three relates to prior experience.

This principle is incorporated when teachers share their insight on best-practices that have worked for them. The intent is that through dialogue, the team of teachers begin to expand their current practices to include ideas from their colleagues. Principle four is adults' readiness to learn. To ensure that the participants were ready to learn, I was sure to design a project that addressed their current needs based on the findings from the data analysis. Teachers felt that their students were not being taught to a level of mastery, students had a lack of foundational prerequisite skills, and there was a need to teach test-taking strategies. Therefore, the PD that I developed addressed ways to address these three major themes from the data analysis. Principle five addresses teachers' orientation to learning. To ensure that teachers were applying the knowledge gained from the PD plan, I recommended an evaluation tool that will require teachers to do peer observations and walkthroughs to evaluate the extent to which teachers are teaching through the year. The peer reviews will hold the teachers accountable for implementing ideas, strategies, and interventions discussed in the PD sessions. To ensure that I aligned the PD goals and initiatives to the research findings. Principle six addressed teachers' motivation to learn. All four participants were motivated to learn. Therefore, addressing their needs was at the forefront in the development of the project.

Professional Development

According to the Gates Foundation (2016) over $18 billion is spent on teacher PD programs a year. Despite the large amount of money spent on PD, a large-scale survey of over one thousand teachers expressed that they did not feel that the PD offerings that they had received were beneficial (Gates Foundation, 2015). Amongst the types of offerings are, workshops, conferences, PLC's instructional coaching and mentoring (Gates

Foundation, 2015). According to research conducted by Wells and Feun (2013), sending teachers out of the school to receive PD is ineffective. Often, the offsite PD does not meet teachers' immediate instructional needs. Therefore, the information is not retained or utilized. The expectation is that when teachers receive off-site PD, they will then bring those teaching experiences that they learned about back to the school and share with their colleagues. However, if the school does not have a structure that is time-permitting and organized for feedback the information won't be effectively relayed (Wells & Feun, 2013). While all four participants expressed that PD is available through various means, two of the four participants felt that the PD given by the district did not always meet their immediate needs. However, all four participants value job-embedded PD. They felt that this was a time when they could plan together collaboratively. Three participants shared that the PD that they receive from their math coach is invaluable. They feel immediately prepared to go in and teach the strategy or lesson discussed at the PD.

Carpenter and Linton (2016) stated that quality PD is necessary for improving instruction. However, it can be difficult to obtain in every district. Holm and Kajander (2015) would agree, as they stated Effective PD provides teachers with the support and resources needed to increase their professional growth while developing or building upon their content knowledge (Carpenter & Linton, 2016). Effective PD depends on the value and depth of support provided to teachers throughout the PD. To effectively restructure education, PD must be detailed and structured (Gökmenoğlu & Clark, 2015). Several studies have reported on the effectiveness of PD. Bannister (2015) asserted that effective PD training is imperative for preparing teachers and students to meet local, district, and state goals. Gökmenoğlu and Clark (2015) discussed the connection between effective

PD and teacher productivity. Their discussion suggested that PD that expands the depth of knowledge that the teacher has will directly impact the instruction he/she gives to their students. The participants collectively felt that the PD that they receive in their building in their collaborative learning team meetings (CLT) directly affects their instruction. They stated that the facilitator, usually the math coach ensures PD aligns with what they are currently working on, or what is coming soon and they receive resources and best practices on how to teach it.

PD is often considered a significant factor in teacher training. However, traditional methods are criticized for being unproductive and inadequate (Yolcu & Kartal, 2017; Safi, 2015; Koc, 2016; Popova, Evan, & Arancibia, 2016). According to Vernon-Feagans, Bratsch-Hines, Varghese, Bean, and Hedrick (2015), nontraditional methods of PD such as webinars, online forums, blogs, and video feedback are becoming more popular than the traditional face-to-face formats. Participant two shared that the district often provides PD opportunities via the web. However, it is not a personal preference. This participant shared that it is nice to have the opportunity, but it may be more effective if it were tailored to their upcoming skills. This way they could have a best-practice to go along with the skill all the time. Meyers, Molefe, Dhillon, and Zhu (2015) argued that PD offerings are a lot more effective when they regularly include school or district support whether they are traditional or not, as opposed to just involving teachers. Conventional methods of external PD are not adequately preparing teachers with professional growth (Wells & Feun, 2013). Recent studies show the benefits of providing ongoing professional development and the impact that it has on teachers' content knowledge and increasing student achievement (Cherkowski & Schnellert, 2018).

To lessen potential problems with PD and add to its effectiveness Bando and Li (2014) discussed four conditions that any PD should have: (a) professional development should be intensive enough to cause changes in teachers' behaviors, to include being over 50 hours; (b) it should connect to the teacher's practice; (c) it should be ongoing; (d) it must be in alignment with the teacher's incentives. When teachers are happy in their positions, they are more likely to apply the newly acquired knowledge from the PD (Hur et al., 2015). The needs of the teachers and the PD's ability to meet those needs will determine how effective a PD session is (Gökmenoğlu & Clark, 2015). Educators must have input in the preparation of the PD activities to be vested in the actual session; ensuring that teachers are a part of the process increases their engagement (Callahan & Sadeghi, 2015). When educators can see the relevance of the PD in relation to their actual classrooms, they are more inspired to participate and apply the new knowledge (Carpenter & Linton, 2016). PD should be tailored to the needs of the teachers and based on student data. Therefore, a standard PD is not effective at all (Holm & Kajander, 2015).

Professional Learning Communities

When a body of teachers come together to collaborate and improve student achievement by discussing data, developing strategies, problem-solving, exploring best-practices, and to create and enhance curriculum, instruction, and assessment they have formed a professional learning committee, or PLC (Hord & Hall, 2014; Olivier, Hipp, & Huffman, 2013; & Thessin, 2015). In recent research, there has been some confusing terminology for structures that are in line with PLC's. These structures share a purpose and focus on the teacher's learning to improve student achievement through dialogue and a review of student work (Vescio & Adams, 2015). The research site in this study refers to their learning community as a "Collaborative Learning Team," or CLT. The CLT was a theme that emerged from the data. The participants spoke highly of their CLT meetings. They expressed that this is the time where they get together with their team to plan for upcoming lessons. Participant two communicated that this is the time where the teachers can be the student and learn from the specialists in the building. The theory of PLC is grounded in the constructivist theory because learning takes place through active collaboration in social environments (Hord & Hall, 2014). Therefore, teachers are continuously learning from each other. The CLT was a theme that emerged throughout the data analysis. The participants frequently referenced it as the time when they receive job-embedded professional development. They all felt that it is beneficial and has a significant impact on their instructional practices. Because of the positive feedback regarding the CLT meetings, I chose to develop the PD plan for this project in the same manner. The initial three -day PD for this project will take place over the summer as a summer CLT workshop, which will put the team ahead for the upcoming school year. They will then align their monthly math CLT to the format of the one presented within this study. Teachers should continuously collaborate and look to the curriculum to unpack standards; this ensures they teach students to the depth of the standards. Discussing test-taking strategies to prepare their students for new math standards and standardized computer adaptive tests is imperative to student's success. Teachers should consider ways to remediate students on prerequisite skills that they often lack to lessen the barriers that students are facing when they get to the next grade. Lastly, teachers should challenge students with mathematical vocabulary, and check their understanding through formative assessments daily.

Many school systems are abandoning traditional methods of PD (Popova et al., 2016). They are transforming their professional development into PLC's. (Olivier & Huffman, 2016). Schools where the staff engage in inquiry and are reflective foster highly functional PLC's (Olivier & Huffman, 2016). PD that starts with teacher's questions disregards traditional notions of PD (Cherkowski & Schnellert, 2018). This practice promotes teachers' professional growth, with the support of their colleagues. PLC's also provide students with an opportunity to learn from a multitude of expertise (Killion & Roy, 2009). Hord and Hall (2014) further discussed the positive effects that continuous review of data, reflection, and action research in PLC's has on student achievement. At the research site, participant two stated that every decision they make within the school is grounded in the data. This participant explained that all instructional decisions and the alignment of resources are contingent upon student performance on school, district, and state assessments. Participants one and three mentioned that they could improve as a team by discussing student progress on assignments. However, while there is a lot of research on the benefits of PLC's, there is limited research on how to implement, structure, and sustain PLC's (Kelly, 2013).

Effective professional development must be a collaborative effort amongst administration and staff (Jacob, Hill, & Corey, 2017). Teachers must collaborate to plan, share best-practices, analyze and evaluate data to measure students' progress and achievement. For teachers to be vested in inquiry, they need to have a clear objective in sight and feel empowered to learn through collaboration with their colleagues (Schnellert & Butler, 2014). When teachers participate in effective PD their content knowledge increases, improving their instructional practices, which results in increased student achievement (Hirsh & Killion, 2009). All four participants discussed the positive impact that their CLT meetings have on their professional growth. Participant one expressed that she loves the opportunity to work with her colleagues and see their perspectives on various concepts. Participant two said, "It is nice to know that you are not the only one who struggles with a concept, but even better that there is always someone in the CLT who can help you see the concept in a clearer way." Participant three said, "The CLT is necessary for professional growth" and Participant four said, "After teaching many years, CLT's are by far one of the best initiatives that were put in place in education."

Delivering effective PD is essential. Although the learning process within a PLC is a joint learning experience, it is vital that whoever the lead facilitator is, is comfortable with andragogy (Hord & Hall, 2014). Often, PD is presented from a pedagogical standpoint, which can be ineffective with adults (Knowles et al., 2012). Therefore, it is imperative that PD experiences meet the needs of adult learners. Addressing how teachers learn is necessary, as this provides opportunities for active learning; allowing teachers a chance to practice and reflect on new strategies before implementation (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009).

Hord and Hall (2014) discussed six aspects that need to be in place for an effective PLC, they include: (a) shared and supportive leadership, this is defined by Hord and Hall (2014) as power, authority, and decision making shared amongst all stakeholders; (b) shared values and vision. Is everyone within the building on the same page? It is necessary for the PLC to have common goals and the same purpose for the PLC to function (Olivier & Huffman, 2016); (c) collective learning and application, which refers to a continuous collaborative sharing of ideas and practices amongst the staff; (d) shared personal practice, this is defined by Hord and Hall (2014) as a learning environment conducive to teachers learning from each other; (e) supportive conditions and relationships. The favorable conditions refer to trust among the teachers and whether they have fostered trusting relationships; (f) supportive structures that ensure that schedules and time allotted for PLC's to meet are adequate

Collaboration

For teachers to develop their skills, collaboration can be a very effective means for doing so. Collaboration allows teachers to work together within their learning community to enhance their professional growth on instructional practices and strategies. According to DuFour (2016), it is imperative that teachers are reflective and make it a point to ensure that all members are accountable for student achievement. Ensuring that a consistent commitment to growth and improvement of teaching and learning is imperative for effective collaboration. One of the participants at the research site stated that reflection is necessary. It is a time for her to think about how she presented the lesson, think about students' misconceptions, and then come back prepared the next day to address those misconceptions.

As discussed above, collaborating to improve teacher understanding and student achievement is the primary focus of PLCs (DuFour, 2016; Hord & Hall, 2014; Olivier & Huffman, 2016; Owen, 2014). Through collaborative inquiry, PLCs foster a socially bound learning environment for educators (Dufour, 2016; Hord & Hall, 2014; Olivier & Huffman, 2016). When members of PLC's collaborate to discuss student work and share instructional strategies they can develop a deeper understanding of the concepts to better align their instructional practices (DuFour, 2016; Hord & Hall, 2014; Olivier & Huffman, 2016). It is important that school and district administrators are a part of the PLC process. PLC's foster a sharing of best practices, which allows educators the opportunity to enhance their instructional strategies (Hord & Hall, 2014). In a study conducted by Olivier and Huffman (2016) they found that student achievement increased with the addition of central office staff supporting the PLC's to foster collaboration.

By allowing teachers, the opportunity to respectfully challenge each other and discuss areas of success or areas needing improvement improves teacher's pedagogy (Owen, 2014). Teachers look at student data so that they can compare the instructional practices and outcomes across the grade level (DuFour, 2016). This collaborative time nurtures professional growth as the teachers are consistently learning various ways to approach different topics and they can view different ways that the students may be approaching subject matter (Killion, 2016). Teacher training, teacher's understanding of content and collaboration directly affect student achievement (Ronfeldt, Farmer, McQueen, & Grissom, 2015) therefore, teachers should develop student growth indicators based on their previous outcomes during their PLC meetings (ACT, 2015). The collaborative process should include teachers, administrators, and specialists (ACT, 2015). At the research site, administrators, teachers, specialists and sometimes para-professionals are all present. The facilitator is usually the math coach but may vary depending on the topic and focus of the meeting.

Gökmenoğlu & Clark, 2015 discussed collaboration as the most effective form of PD, because teachers can meet with their grade and subject area regularly to discuss curriculum, instruction, and assessment. Collaborating increases dialogue amongst the team (Ronfeldt et al., 2015), which is important for building trusting relationships amongst the group. Many teachers value PLC's. However, researchers indicate that collaboration can be impeded if there is not a trusting relationship amongst the team (Gray, Mitchell, & Tarter, 2014). Participant one mentioned that her team worked well together because they have grown to trust one another and they know that all input is meant to help and not tear down.

Mastery of Standards

The development of Standards of Learning (SOL) for all content areas in Virginia came in 1995 for Grades K-12. The SOL's provide educators with a framework for increasing students' academic achievement in Virginia to prepare them for college and careers (Education, 2018). In 2000, the Board of Education established a seven-year cycle for review. Therefore, the 1995 standards went under review in 2001, 2009, and 2016 (VDOE, 2016). In 2016, the Virginia Department of Education (VDOE) issued a new set of standards. Before implementation, various stakeholders including parents, teachers, administrators, representatives from higher education, and the business community gave input. Standards were revised based on their feedback. According to the VDOE (2016), the expectations for the standards are clear, concise, and measurable.

Virginia's state standards are set up so that students are taught the fundamentals of number sense, computation, measurement, geometry, probability, data analysis and statistics, and algebra and functions. Additionally, they must develop proficiency in math skills (VDOE, 2016). For students in grades K-8, the content strands include number and number sense, computation and estimation, measurement and geometry, probability and statistics, and patterns, functions, and algebra. As the students advance by grade level, the complexity of the strands increase. The VDOE organizes the math SOL's for numerically by strand. However, the school district determines the instructional sequence of the standards (VDOE, 2016).

In addition to the standards for learning, the VDOE also has a SOL curriculum framework that includes the knowledge, skills, and levels of understanding necessary for students to be successful on the end of the year standardized assessments. School divisions are responsible for incorporating the VDOE SOL's into their curriculum. Teachers should follow the VDOE curriculum framework to know the content that they should be teaching and what their students should be learning (VDOE, 2016).

The VDOE (2016) has identified five goals that the standards are designed to address to help students process math: (a) becoming mathematical problem solvers, which may involve students creating problems from real situations and applying various strategies to determine a solution. Problem-solving may or may not relate to math. The goal is to get students to think for themselves; (b) communicating mathematically. Students will use math terminology, including specific vocabulary to communicate math ideas with fidelity. Teachers can encourage this by having students justifying their answers, reading and writing about math, and discussing math with their peers; (c) reasoning mathematically; this will allow students to analyze situations to check the validity of conclusions; (d) making mathematical connections; this will enable the student to see how all of the math works together, rather than in isolation. Students will have the opportunity to recognize how the things that they learned in third-grade may now be more relevant in fifth-grade when working on a new skill. Additionally, cross-curricular connections are profound. The VDOE (2016) suggests that teachers try to incorporate Science that applies and supports math topics as often as possible; (e) using mathematical representations to model and interpret practical situations, including real-world problems that mirror real-world situations. The VDOE (2016) suggests that students have the opportunity to use different representations such as physical, visual, contextual, verbal, and symbolic.

Computational Fluency

Computational fluency means having efficient ways to compute. Students can demonstrate CF when they can determine a strategy for solving a problem, solve it, and discuss their means for attaining the solution. Through continuous practice in solving simple problems that lead to memorizing basic number facts and rules, CF is achieved (Vasilyeva, Laski, & Shen, 2015). Fluency can also be attained by transitioning students from manipulatives to mental strategies during the problem-solving process (Vasilyeva et al., 2015).

Through thorough math instruction, problem-solving skills, conceptual understanding, and computational fluency (CF) is developed. According to the VDOE (2016) conceptual understanding, conceptual fluency, and problem-solving should be intertwined and happening simultaneously. One influences and reinforces the other. For example, during problem-solving, having computational fluency can improve a student's performance because they will not have to exhaust themselves on the primary arithmetic portion of the problem (Vasilyeva et al., 2015). It is imperative that students understand the base-ten number system, number relationships, and the meaning of operations and properties (VDOE, 2016). CF with whole numbers is an essential skill for elementary students. Fifth-grade students should already be fluent with addition, subtraction, multiplication, and division. Unfortunately, at the research site, all four participants stated that the students get to fifth-grade without knowing these basic math skills.

CF is an important aspect of math proficiency (Burns, Ysseldyke, Nelson, & Kanive, 2015). Students who master basic math facts and commit them to memory are more likely to develop problem-solving skills to solve more complex problems and interpret abstract math concepts more easily than those who have not mastered basic math facts (Burns et al., 2015). CF is an essential component of quality instruction. According to Burns et al. (2015), CF is a missing link in many American classrooms; this is the case for two reasons. The first being teacher assumptions. Teachers assume that students will come to them with a set of skills as stated in the curriculum, therefore in the upper grades, there is less time practicing CF. The second reason is the curriculum and pacing demands. Teachers have so much to cover, and if CF is not in the curriculum to be taught, they do not teach it (Burns et al., 2015). At the research site, all four participants stated that students do not have a fluent understanding of basic math facts. This was one of the themes that emerged; students lack prerequisite skills. Participants three and four also discussed the fact that the pacing does not allow them to double back and teach missed skills. Collectively, one of the factors that they attributed the failing math scores to was the lack of student's ability to work on grade level, because they are missing many prerequisite skills.

Unpacking Standards

The VDOE provides the teachers with the curriculum framework as stated above. Although the essential skills and knowledge are stated in the framework teachers are still responsible for ensuring that they are narrowing those broad statements into learning targets for their students (Konrad et al., 2014) Therefore, it is necessary for teachers to go through the standards of learning and unpack them.

Chappuis, Stiggins, Chappuis, and Arter (2012) described the process of unpacking standards as a great learning opportunity for teachers. Unpacking the standards allows teachers to dig deeper into the content to ensure they clearly understand what their students must know. According to Chappuis et al., unpacking the standards is generally done collaboratively, therefore teachers can bounce ideas off each other, gain a different perspective, and share instructional strategies and resources to ensure they collectively meet the needs of their students.

There are many ways to unpack the standards. One method described by Konrad et al. (2014) is by analyzing what the students need to know and be able to do to master the standard. What students need to know can be determined by looking at the nouns within the standard. Secondly, classifying standards into lower-level and higher-level thinking skills by using Blooms Taxonomy. The verbs help determine the level of reasoning expected as well as what the students need to do to demonstrate mastery. Once a standard has been unpacked teachers should then prepare learning targets, or "I can" statements. According to Marzano (2007) establishing clear learning targets, is essential for effective instruction. Communicating those learning targets with the students is crucial.

Chappuis et al. (2012) discussed the benefits of having clear learning targets for the teacher and students. Teachers are more knowledgeable about what their students need to know. This will help them ensure that they have differentiated lessons planned, they will know how to assess their students, and they can better communicate with their colleagues and parents to get students all the support they may require to be successful. Students need to be aware of the learning targets, so they can be held accountable for their own success.

Based on the expectations within the standards teachers will be required to develop learning targets to address the level of the standards (Chappuis et al., 2012). According to Marzano (2013), it is necessary for teachers to determine if the knowledge students are required to attain is declarative or procedural. Declarative knowledge is informational and procedural knowledge is related to processing and reasoning. Declarative knowledge is what the students need to know and procedural knowledge would be what the students must do. Understanding the difference between these two will make it easier to meet the established learning targets.

Pearson and Battelle for Kids (2012) broke learning targets down further than either declarative or procedural. They included knowledge, reasoning, skill, and product targets. Knowledge targets refer to the conceptual understanding. These targets should be based on the concept around the standard that students need to know. Reasoning targets refer to how the students must think about the standard to be successful. Advocating for problem-solving, will address reasoning targets. Skill targets show proficiency. These targets focus on the "doing" to show understanding. Lastly, product targets focus on the students creating something.

Determining the learning targets will require teachers to differentiate between the levels of understanding. After an archival data review at the research site, they currently use Bloom's taxonomy to determine their levels of knowledge on their lesson plans. The 6 levels of Blooms' knowledge or questioning are broken into tiers of lower-order skills and higher-order skills. The lower-order skills include those that require students to remember and understand. The higher-order skills require students to analyze, evaluate, and create. Ultimately, it is imperative that teachers break down the standards to move their students towards mastery (Konrad et al., 2014).

Project Description

The PD plan is designed to cover three full days of PD. Classroom teachers/staff for the grade level (general education & special education), math specialist, math interventionist and an administrator should be present. Having the three -day planning session over the summer provides adequate time to prepare for the first quarter of school. The work will be continued bi-weekly at their monthly CLT math meetings. They will continue to work to ensure that they are digging deep into the curriculum standards and pacing them out, looking at student data, and making instructional decisions and adjustments as necessary. The entire three-day PD was designed to address the immediate needs of the participants. Therefore, each day will be used to have the team collaborating and creating plans so that they can be proactive as opposed to reactive when dealing with the problem at hand.

Day one of the PD/CLT will be titled "Digging Deeper" this will require the team to work collaboratively to dig into their curriculum guide. Often, teachers work in isolation, and they don't fully understand the level to which they should be teaching at, so the lessons do not provide any depth. To combat that, day one of the project will have the teachers working in a collaborative team to make sense of the state standards by "unpacking" them. Once they have a better understanding of the standard, they will begin to create a pacing calendar and learning targets for mastery.

Day two will continue work from day one. Day two will have two working sessions. The am session will focus on the pacing calendar (started on Day one) and "I can" statements. The pm session will focus on lesson plan outlines. For the am session, teachers will map out tentative dates they will teach each standard and specific learning objective, using the "unpacked" standards along with the district's pacing guide. The pacing calendar will be done electronically, in an Outlook or Google calendar (whichever the team prefers). Having it electronically will provide easier access for school/central office members to access what standards teachers are teaching daily. The pacing template will include the objectives they will teach daily and the "I can" statements for that day. I will provide a blank calendar template that teachers can sketch on, but the final product must be completed in their Google calendars. The pm session will allow the team to use the pacing template they created from the am session to outline their lesson plans for the first nine weeks of school (they can do more if time permits). Lesson planning will also be done online via Google Drive so that all participants can actively engage in the document at one time. The district is a "Google" school. Therefore, teachers are comfortable with collaborating through Google.

Day three will combine all the things done from day one and day two. The team will go back to the lesson plan outlines and see where they can incorporate interactive vocabulary activities, number sense routines, formative assessments, and test-taking strategies. Once they have identified these areas, they will create interactive activities aligned to the curriculum and pacing (from day one & day two) to engage their scholars. During this time, the team will also incorporate test-taking strategies into their activities so that they can make the strategies a part of their daily practice.

Needed Resources, Supports, and Barriers

The needed resources for this workshop PD are not extraneous. Most of the materials teachers already have access to. Teachers will need a space to collaborate. I plan to use the schools' library because there is a smartboard in that area. The smartboard will enable the presenter to use a screen for projection. Teachers will need to have access to their curriculum guide for math (hard copies will be provided), district pacing guides, laptops with Google Drive access, scissors, construction paper, notebooks, markers, and large chart paper.

Human supports would include assistance from the math coach and the administrator over math. Both individuals need to be available to provide support with the actual instructional plan and to meet the needs of the teachers. Things will run more smoothly if there is an administrator there who can make immediate decisions if necessary.

The most prominent potential barrier has the initial workshop/PD over the summer. Teachers may not want to come in early to work over their break. A potential solution to this would be to hold the workshop during the pre-service week. This way teachers are required to be at the school anyway, so they will not view the PD as a burden. However, this poses another potential barrier. Holding the PD during the pre-service week will limit the amount of time the specialist and administrators will be able to attend the sessions because they will have other duties, obligations, and grade-levels to assist. A potential solution would be early strategic planning and scheduling of pre-service week activities and professional development. It may be necessary to try and book central office math support to attend, especially if multiple-grade levels will be planning on the same days.

The last barrier to having the workshop held over the summer is finances. If we are unable to hold the workshops during the pre-service week, the school will incur additional charges, because they would have to pay the teachers for their attendance. A possible solution to the funding would be to share the plan for the workshops as early as possible, so the principal can see if there is money in the safety-budget to pay teachers to attend professional development.

Proposal for Implementation

Once the final project is approved, I would schedule a meeting with the school's administrative team, including the math coach. After going through my recommendations for the project, we would plan the three-day summer workshops to be held in August. Depending on the schools' preservice schedule, the three-day PD will be during the pre-service week or earlier in August.

The timetable for the project consists of three full days of collaborative team planning workshops. Day one teachers will participate in "unpacking" the standards for the first quarter. Day two the teachers will participate in pacing and lesson planning. Day three will require teachers to be creative while creating interactive activities and strategies. Following the workshops, the team will meet bi-weekly at their math CLT to continue the work started over the summer. Because they will have two math CLT meetings per month, the expectation is that one of these monthly meetings mimic the planning process that happened over the summer for upcoming weeks and the other planning day would be used to discuss data, RTI tiering, and remediation. In June, there will be a final meeting for the year, in which teachers will work collaboratively to discuss the results of the standardized assessments to see the impact of the "Teaching to Mastery" PD.

Roles and Responsibilities

My role as the researcher is to sit down with the administrators over math and discuss the plan for professional development that I came up with to best help their team. Additionally, I will provide all the handouts (unless they would like to add some additional items) and evaluations for the teachers to complete after every session. I will also provide the end of the year reflection tool for teachers to see if the practices that they put in place has helped their instructional practices and students understanding of standards.

The math coach will have the role of lead facilitator at the three summer workshop meetings as well as the bi-weekly meetings throughout the year. According to Duncan, Magnuson, and Murnane (2016), instructional coaches can provide PD in a meeting setting or within the classrooms through modeling. Therefore, the math coach will be expected to demonstrate lessons and best practices for addressing the standards as teachers collaboratively unpack the standards. The math coach will also be responsible for observing and providing teachers with feedback as they implement the lessons and activities covered in the collaborative workshops and CLT meetings. Lastly, the instructional coach will keep an eye on the data. The participants stated that they have quarterly benchmark assessments that generally determine how they will group their children. Therefore, the instructional coach will monitor the data by standard and use that data during CLT to inform instructional decision making. For the first two-three meetings, the instructional coach will be the primary facilitator. As the teachers grow stronger in their practice, they can begin to rotate the facilitator position.

The administrator over math will need to have a presence in all three days of the summer as well as the bi-weekly math CLT. Having an administrator consistently present will ensure that all participants are actively engaged and are equal contributors. It also shows that there is a collaborative team effort from the top down. Teachers need to hear from their principals as instructional leaders rather than always from an administrative standpoint (Onsrud, 2016).

Lastly, the teachers have an essential role as active contributors to the CLT. All teachers need to be on one accord. Therefore, they must work together to make decisions that are in the best interest of their children. The teachers will eventually rotate the role of facilitator. Also, there will be other roles that they will be assigned (on a rotation schedule) such as scribe, time-keeper, and process observer. The facilitator will be the one to start the discussions and lead the conversations. The scribe will take the notes throughout the meeting and keep track of any next steps. The time-keeper will ensure that each component on the agenda has an answered in the allotted amount of time as notated on the agenda. The process observer's role is to assure that all decisions made are in the best interest of the students, so this person will continuously ask, "How does this affect students?”

Project Evaluation Plan

This professional development plan will utilize both formative and summative assessments. The formative assessments will be done throughout the three-day workshops to ensure teachers understand the process of "unpacking" and then using those things they learned to create high leveled lesson plans with interactive, engaging, and necessary activities to increase students understanding of math concepts. Some of the activities for formatively assessing the teachers will be turn & talks and then share out to the group, quick checks, and an end of session questionnaire (daily). The summative assessment will be two fold. Monthly there will be math walkthroughs that the team will participate in to see how the CLT meetings are carrying over into the classroom environment and instructional practices. The walkthrough committee will consist of the administrator over math, the math coach, a member of the instructional leadership team (someone not on the grade level) and one member from the grade level (the grade level members will rotate). The second type of summative assessments will take place during the last CLT meeting in June. At this time, the team will look at data and answer a few reflective questions.

I chose to use formative assessments because they provide the facilitator/presenter with immediate feedback. The presenter will be able to determine if participants understand the content presented, or if it is necessary to scale back and re-teach. Summative assessments will let you know how effective the professional development was overall. According to Guskey (2000), effective PD consists of the following five elements: (a) participants reactions. Did they like the PD? Questionnaires are helpful for collecting this type of information; (b) participants' learning. Have the learning intentions been met? Turn, and talks, presentations, demonstrations, or paper and pencil assessments are great for collecting this information; (c) organization, support, and change; ensuring that procedures are followed, there is flexibility, and the teachers have the necessary resources is imperative. Gathering this information through interviews and questionnaires will provide adequate and immediate feedback; (d) participants use new knowledge and skill. Are the participants applying the new information gathered? Direct observations could be a great way to determine if participants are applying those newly acquired skills; (e) student learning outcomes. How did the PD receive impact students' learning and understanding? Assessment records and interviews with various stakeholders (i.e., Students and parents) will provide this information.

The overall goal of the project is to get teachers to work collaboratively on teaching to mastery. Additional goals include: (a) helping teachers understand the level at which they should be teaching, (b) helping teachers learn how to move their students towards mastery, (c) help generate creative and fun activities for promoting interactive notebooks and interactive number sense routines in the classroom.

By incorporating Guskey's (2000) five levels of PD evaluation to my PD evaluation plan I will have evidence of the contribution that this PD plan has had on the teacher's ability to teach students to a level of mastery, which is my primary evaluation goal. Additional evaluation goals include ensuring that the evaluation tools capture teachers' perceptions on the PD that they are receiving on working towards improving their delivery of instruction, improving their understanding of to what level they should be teaching students to meet a level of mastery, and informing future instructional planning and implementation.

The key stakeholders are the students, teachers, administrators, central office representatives, the community, and anyone vested in the overall mission of ensuring the students are receiving an adequate education. According to Crum, Sherman, Whitney, and Myran (2010) stakeholders are affected when children do not perform well in school.

Therefore, it is imperative that stakeholders have input in instructional decisions as well as be informed as students make progress towards learning targets (Houser, 2015). The research site currently shares information with stakeholders via several means including, but not limited to emails/telephone, principal chew and chat sessions, newsletters, social media, school's website, and robo-calls.

Project Implications

Possible social change implications include reevaluating the way math pacing and instruction is currently done to improve teachers' instructional practices and students' math achievement. Having teachers plan and reflect on the level to where they are teaching students is powerful and necessary (Nielsen, 2016). The math achievement gap is continuously widening in the United States; therefore, math reform is imperative. This study could highlight a necessary step that other schools may want to incorporate to aid in increasing students' math understanding and performance.

The purpose of this project is to provide teachers with the necessary tools to ensure they are teaching students to mastery in mathematics. Local stakeholders are vested in the success of their students; therefore, teachers must be adequately prepared and have a depth of content knowledge to effectively teach students to mastery. Understanding the standards is a prerequisite to delivering solid tier 1 instruction, which reaches 80% of the students the first time (Mellard, McKnight, & Jordan, 2010). So, in the broader context, this professional development is timely and necessary for ensuring that teachers are collaboratively developing instructional practices and plans to move students towards mastery of fifth-grade math concepts.

Conclusion

After collecting data to explore fifth-grade teachers' perceptions of their math instructional practices, the data revealed that they had very positive perceptions of technology, calculators, and the CRA process, and they were utilizing them in their daily math instruction. However, a reoccurring theme pointed to the lack of mastery of math standards by fifth-grade students. Therefore, I developed a three-day collaborative workshop PD plan to address teaching to mastery (see Appendix A). In Section three of this project study I discussed the rationale, review of the literature, project description, and the project evaluation plan. Section four will address the project's strengths and limitations, recommendations for alternative approaches, scholarship, PD and leadership change, reflection on the importance of the work, implications, applications, and directions.

Section 4: Reflections and Conclusions

Introduction

The purpose of this qualitative descriptive case study was to explore fifth-grade teachers’ perceptions as they relate to utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts. After completing the data collection, I found that there was a need for professional development on teaching students to a level of mastery. Therefore, I created a three-day professional training entitled *Teaching Students to Mastery.* In this final section of the study I will reflect on this project study as well as the project deliverable. I will discuss the project’s strengths and limitations, recommendations for alternative approaches, my scholarship and growth.

Finally, I will reflect on the importance of the work, implications, and recommendations for further research.

Project Strengths and Limitations

Strengths

One strength of this professional development plan is the hands-on collaborative nature of the PD that is designed to take place at the school with the school's staff as opposed to the traditional, off-site, unrelated, single-day workshops that are often mandated (Stewart, 2014). The way I designed the PD plan, teachers will begin their work over the summer, to prepare for the first quarter of school. The plan is ongoing throughout the year and does not adversely affect their current schedule, as it ties into their CLT meetings for math. Teachers often complain about not having enough time to plan collaboratively with their team, with the new components being infused into their CLT (unpacking standards, planning and assessing around those learning targets, and incorporating test-taking strategies) they can continue to plan for upcoming standards in advance.

Another strength of the project is that it is cost effective. The PD will be coming from the team, and it does not require any special resources. Aside from materials needed for creating activities and anchor charts the only other materials that administrators may need to purchase are manipulatives. Adding the cost of the manipulatives to the Title 1 budget will save on costs to the school. The central office math department may also cover the expenses. Because the PD will be held during the summer and the monthly meetings will be held during teachers CLT time, this PD requires a minimum interruption to the master schedule. Additionally, the school will be saving on the costs for substitutes, because the PD will be job-embedded during their CLT.

Limitations

The main limitation of this project is delivering the PD over the summer. If the administration does not decide to incorporate the PD into the pre-service agenda, there may be some resistance from the teachers. Teachers are not obligated to work over the summer break, so getting them to participate in a three-day workshop could be an issue. If teachers do not agree that the project would be beneficial for them, they may also be resistant. Some teachers may feel they are doing a great job, and the problem is the kids, or some other factor, but not their instructional practices. Therefore, they can be resistant to making changes (LeFevre, 2014).

Another limitation of the project is the collaborative nature of the project. Some teachers have not converted their ways of thinking of teaching and learning as a collaborative endeavor. They would much rather close their doors and teach in isolation (Dana & Yendol-Hoppey, 2009). Therefore, this project can be very uncomfortable for them because it requires 100% collaboration. Throughout the year as the PD continues at their bi-weekly math CLT's teachers will have to have open conversations surrounding data and their teaching practices.

Recommendations for Alternative Approaches

The major theme that emerged from the data collection in this project is that teachers felt they were unable to teach students to a level of mastery. Therefore, I created a three-day PD workshop where teachers will unpack the standards, so they can ensure they are teaching students to the appropriate level. An additional recommendation that can be used as an alternative approach to address the problem at this Southern Virginia school would be to hold a vertical team planning meeting at the end of the school year to prepare for the upcoming school year. In this meeting, teachers will sit and plan with the grade level teachers who are 1 grade above them and 1 grade below them. For example, third grade teachers would be at tables with second and fourth grade teachers. During this session, teachers will cross reference the standards amongst the grade levels they are sitting beside. They will compare instructional strategies, interventions, and instructional practices. Their focus should be on how they will ensure their students are prepared to deal with upcoming content, and how should they spiral back to ensure students understand the previous content. Allowing teachers to plan vertically, would promote collaborative team building across grade levels. This type of planning would be a significant factor in ensuring that students are taught to mastery. It also guarantees a solid math foundation as students' progress from grade to grade (Ciampa & Gallagher, 2016).

Scholarship, Project Development, and Leadership and Change

The process of developing a scholarly project study has been challenging, yet rewarding. I have learned a lot about the process of conducting a qualitative descriptive case study, and look forward to one day completing some work utilizing a quantitative study, as the two have very different protocols. The qualitative method gave me the opportunity to spend time with my participants talking to them and gaining an understanding of the way they see things. In education, I feel that understanding the teachers' perceptions on topics is detrimental to ensuring that teachers provide students with their very best.

The process of data collection was an exciting experience, probably the best part of the study, in my opinion. Having the opportunity to talk with fellow educators in a different area, and hearing their perceptions on something I often think about was an exuberant experience. Transcribing and coding the data by hand required me to dig deep into the information that I collected, I feel that this has given me a deeper understanding of the problem. It also made the development of the project easier. Having the time to member-check with the participants allowed me the opportunity to check for clarity and ensure I captured what they expressed accurately.

When designing the project, I have learned that it is imperative that research inform the decisions that are made within a school. Often, decisions come from the top down, and the teachers comply. However, after working in this field for some time, it is apparent that these types of top-down systems don't work. Teachers must have an active role in the decision-making process at the school level (Dufour, 2016). Essentially, they are the ones left to carry out the plans. Therefore, we must ensure they are vested in the plan. Developing the project was a great experience because I tailored it to exactly what the participants see as the problem in their grade level. By tailoring the PD to the needs identified by the teachers, the PD will gain immediate buy-in from the teachers (Blackley & Sheffield, 2015).

As a scholar, practitioner, and project developer I have grown tremendously. I am now more aware of how important it is to make informed decisions based on data and not just personal preference. Ensuring that teachers have a voice in the decision-making process is crucial to the success of reform, instructional implications, and overall culture of the school (Dufour, 2016). As a project developer, I learned a lot about the principles of delivering effective PD. A lot of the time, presenters present to adults in the same manner that they do their students and therefore the information is not retained or applied (Knowles et al., 2012). It is imperative that I continue my growth on andragogy and best practices for presenting to adults, as I continue to improve as a project developer and scholar-practitioner.

Reflection on the Importance of the Work

With the math achievement gap continuously growing in Virginia and the United States collectively, it is necessary for teachers to act in determining the means of getting students to a level of conceptual understanding of elementary mathematics. Promoting students to the next grade-level without an understanding of the math standards for that current grade level is a disservice; this results in students getting to the fifth-grade without an understanding of basic arithmetic facts that are needed to progress to more complex understanding. Utilizing different memorization strategies may help students commit things to memory. However, this does not get students to understand conceptually. Therefore, it is imperative that teachers understand the level of understanding that they should be teaching, and apply that to real-world situations, to make the math meaningful for students (VDOE, 2016).

This project study meets the teachers where they are in their efforts to provide sound instruction for their students. Developing a PD plan that is self-directed, collaborative, and based on the needs that the participants identified will aid in preparing our teachers to teach their students to a level of mastery. As I continue to grow in my role of designing professional development, I will reflect on my experience as a scholar-practitioner and carry the importance of including teachers in the process of PD development and ensuring that the work is collaborative.

Implications, Applications, and Directions for Future Research

Due to the widening achievement gap in America, the implications of this project could potentially impact social change. Many schools are not meeting state standards leaving a lot of schools unaccredited in mathematics. Students need to master basic foundational skills to matriculate to higher levels of math and to be able to compete in career fields that involve using math (Burns et al., 2015). Therefore, applying the PD plan in Appendix A will ensure that teachers work collaboratively and understand how to teach for mastery in mathematics. This project will address these gaps in practice to increase student achievement in math. Schools in similar situations may benefit from following the PD plan that I designed (see Appendix A).

A recommendation for future practice would be a study that looks at the impact that vertical team planning has on students' achievement in elementary school. Students getting to the fifth-grade without having mastered basic math facts is unacceptable, yet it has become the norm in many schools. Ciampa and Gallagher (2016) discussed the importance of vertical team planning and the positive impacts it can have for attaining mastery of math skills. Vertical planning combined with teaching for mastery as laid out in Appendix A could have a profound effect on student achievement and conceptual understanding of math concepts.

Conclusion

As this project concludes, it is crucial that educators begin to look at the level to which they are teaching students. Through the data collection process, I have concluded that teachers need to ensure that their students are mastering the content being taught at their grade level so that they are not sending unprepared students to the next grade level. Unfortunately, when teachers get students who are so far below their current grade level, the teacher spends a lot of time trying to reach back and address the gaps that the students may have, resulting in teachers' inability to master the content for their grade level. Thus, the cycle continues. Due to pacing mandates by the district, teachers continue to push their students further, without them ever understanding the concepts. The participants in this study have explained that this is a continuous cycle. Unfortunately, this problem is not confined to this one school, but many schools are suffering from this issue. The project designed to address this problem at the research site can be adapted to fit the needs of any school/grade level struggling with math. Teachers must begin to work collaboratively and develop an in-depth understanding of the standards they are responsible for teaching the students. This practice must start from Kindergarten because the math skills build on one another from year to year. By the time students get to fifth grade, if the problems are not addressed, it becomes almost impossible for fifth-grade teachers to make up for those deficits and master their grade level content too while maintaining the district's pacing mandates.

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Appendix A: The Project

Professional Development: Teaching to Mastery

Purpose

The purpose of this three-day workshop is to get the teachers to add some elements to their current CLT meetings that will require them to consistently refer to the standards to ensure students are getting exactly what the curriculum says they should be receiving. A lot of teachers look to the pacing (created by the district) and build their lesson plans from there. However, to prepare students for their end of the year standardized assessments and equip them with life-long skills it is imperative that teachers know to which level they should be teaching the standards. Therefore, I created a three-day workshop/CLT style professional development plan that can be put in place during pre-service week. Although the plan was made specifically to address the themes that emerged for the data pertaining to fifth-grade, the practices can be adapted to any grade level that is struggling with math. Additionally, I would recommend that the earlier grades begin the process laid out in the PD as soon as possible, because there is a significant gap in foundational skills, that is very prevalent once those students get to the fifth-grade.

Goals and Learning Outcomes

The overall goal of this PD plan is to get teachers to a point where they are teaching students to the level necessary for mastering the standards in the curriculum. Additionally, to meet this long-term goal there are a few short-term goals established for each day of the PD. Below I will address the goal and learning outcome for each day of the three-day PD plan.

Day one: The goal for the am session of day one is to get teachers to collaboratively unpack the fifth-grade standards for the first nine weeks of school. The goal for the pm session of day one is for teachers to use those unpacked standards and the district's pacing guide to design a daily pacing calendar to address the standards of learning: Learning outcome: By the end of day one, teachers will have a thorough understanding of what they have to teach and when they will teach it for the first quarter in math.

Day two: Day two will continue work from day one. Day two will also have two working sessions. The goal for the am session will focus on the pacing calendar (started on Day one). On day two they will include I can statements, or learning targets to their electronic pacing calendar. The pm session will focus on lesson plan outlines. The goal for the pm session is for the team to use the pacing template they created from the am session to outline their lesson plans for the first nine weeks of school (they can do more if time permits). This will also be done online via Google Drive, so that all participants can actively engage in the document at one time. Learning outcome: After day two, teachers will have a completed calendar with their daily standards planned for the first nine weeks of school including students learning targets. Additionally, teachers will have outlines for their lesson plans completed.

Day three: The goal for day three is for teachers to use all the items created from day one and day two to create exciting vocabulary, number sense, and formative assessment activities to include in their lesson plans. They will also discuss test-taking strategies that they can include in their lesson plans. Learning outcome: At the end of day three, teachers will leave the workshop with unpacked standards, a daily pacing guide, lesson plan outlines, activities to build vocabulary and number sense, and formative assessments that check for understanding and present students with strategies for test-taking.

Target Audience:

The target audience for the PD plan is fifth-grade teachers, the math coach, math interventionist, and the administrator over math. However, the PD plan can be extended to be used with any grade level that is struggling with math. In fact, it is recommended that all grade levels adopt the practices laid out in this PD plan. Additionally, the pacing calendars can be shared with all stakeholders. This will allow everyone to know what students are learning daily. Parents can use this information to help remediate at home. Community partners can use this information to volunteer, or provide resources.

Daily Schedule of Activities and Timeline

Day one: Digging Deeper

8:00-8:30	Welcome & Breakfast
8:30-9:00	Unpacking Standards Overview
9:00-12:00	Unpacking First Quarter Standards (collaborative activity)
12:00-1:00	Lunch on your own
1:00-3:00	Pacing Calendar (collaborative activity)
3:00-3:30	Wrap-Up-Closure

Day two: I can!

8:00-8:30	Welcome & Breakfast
8:30-9:00	Overview of the importance of having a daily goal established: Discussion
9:00-12:00	I can statements placed on electronic pacing calendar for each day of learning
12:00-1:00	Lunch on your own
1:00-3:15	Lesson plan outlines
3:15-3:30	Wrap-Up-Closure

Day three: Bringing it all Together

8:00-8:30	Welcome & Breakfast
8:30-12:00	Create exciting vocabulary, number sense, and formative assessment activities
12:00-1:00	Lunch on your own
1:00-3:00	Incorporating Test-Taking Strategies Discussion/Web-Surf for applicable strategies
3:00-3:30	Review completed material for the upcoming 9weeks. Closure

Days 1-3 Handout (Work mat)

Standard:			
How many days will we spend teaching this standard?			
Concepts (List the Nouns here)		Skills (List the Verbs here)	
What is the big Idea?			
Put the big idea in student friendly language:			
Essential Questions?			
I can Statements	Key Vocabulary (use this w/activities)	Formative Assessment	Test-Taking Strategy

Day 1 Testing Blueprint &Standards (curriculum guides are linked in the email)

Grade 5 Mathematics
Test Blueprint Summary Table

Reporting Category	**Grade 5 SOL**	**Number of Items Computer Adaptive Test (CAT) Format**	**Number of Items Traditional Format**
Number and Number Sense	**5.1 5.2a*, b* 5.3a-b**	**5**	**7**
Computation and Estimation	**5.4 5.5a*, b 5.6a, b* 5.7***	**9**	**13**
Measurement and Geometry	**5.8a-b 5.9a-b 5.10 5.11 5.12 5.13a-b 5.14a-b**	**9**	**13**
Probability, Statistics, Patterns, Functions, and Algebra	**5.15 5.16a-c 5.17a-d 5.18 5.19a-d**	**12**	**17**
Number of Operational Items		**35**	**50**
Number of Field-Test Items**		**5**	**None**
Total Number of Items on Test		**40**	**50**

*Items measuring these SOL will be completed <u>without</u> the use of a calculator.
**Field-test items are being tried out with students for potential use on subsequent tests and will not be used to compute students' scores on the test.

Grade 5 Mathematics
Expanded Test Blueprint

(a) Reporting Category: Number and Number Sense
Number of Items: 5 (CAT) 7 (Traditional)
Standards of Learning:

5.1 The student, given a decimal through thousandths, will round to the nearest whole number, tenth, or hundredth.

5.2 The student will
a) represent and identify equivalencies among fractions and decimals, with and without models; and
b) compare and order fractions, mixed numbers, and/or decimals in a given set, from least to greatest and greatest to least.

5.3 The student will
a) identify and describe the characteristics of prime and composite numbers; and
b) identify and describe the characteristics of even and odd numbers.

(b) Reporting Category: Computation and Estimation
Number of Items: 9 (CAT) 13 (Traditional)
Standards of Learning:

5.4 The student will create and solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of whole numbers.

5.5 The student will
a) estimate and determine the product and quotient of two numbers involving decimals; and
b) create and solve single-step and multistep practical problems involving addition, subtraction, and multiplication of decimals, and create and solve single-step practical problems involving division of decimals.

5.6 The student will
a) solve single-step and multistep practical problems involving addition and subtraction with fractions and mixed numbers; and
b) solve single-step practical problems involving multiplication of a whole number, limited to 12 or less, and a proper fraction, with models.

5.7 The student will simplify whole number numerical expressions using the order of operations.

(c) Reporting Category: Measurement and Geometry
Number of Items: 9 (CAT) 13 (Traditional)
Standards of Learning:

5.8 The student will
- a) solve practical problems that involve perimeter, area, and volume in standard units of measure; and
- b) differentiate among perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation.

5.9 The student will
- a) given the equivalent measure of one unit, identify equivalent measurements within the metric system; and
- b) solve practical problems involving length, mass, and liquid volume using metric units.

5.10 The student will identify and describe the diameter, radius, chord, and circumference of a circle.

5. 11 The student will solve practical problems related to elapsed time in hours and minutes within a 24-hour period.

5. 12 The student will classify and measure right, acute, obtuse, and straight angles.

5. 13 The student will
- a) classify triangles as right, acute, or obtuse and equilateral, scalene, or isosceles; and
- b) investigate the sum of the interior angles in a triangle and determine an unknown angle measure.

5.14 The student will
- a) recognize and apply transformations, such as translation, reflection, and rotation; and
- b) investigate and describe the results of combining and subdividing polygons.

(d) Reporting Category: Probability, Statistics, Patterns, Functions, and Algebra

Number of Items: 12 (CAT) 17 (Traditional)

Standards of Learning:

5.15 The student will determine the probability of an outcome by constructing a sample space or using the Fundamental (Basic) Counting Principle.

5. 16 The student, given a practical problem, will
- a) represent data in line plots and stem-and-leaf plots;
- b) interpret data represented in line plots and stem-and-leaf plots; and
- c) compare data represented in a line plot with the same data represented in a stem-and-leaf plot.

5.17 The student, given a practical context, will
a) describe mean, median, and mode as measures of center;
b) describe mean as fair share;
c) describe the range of a set of data as a measure of spread; and
d) determine the mean, median, mode, and range of a set of data.

5.18 The student will identify, describe, create, express, and extend number patterns found in objects, pictures, numbers and tables.

5.19 The student will
a) investigate and describe the concept of variable;
b) write an equation to represent a given mathematical relationship, using a variable;
c) use an expression with a variable to represent a given verbal expression involving one operation; and
d) create a problem situation based on a given equation, using a single variable and one operation.

Day 2: Pacing Template

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Pacing Calendar Template

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2 Labor Day	3 Students Return	4	5	6	7
8	9	10	11	12	13	14

15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					
(1) Compare the district's pacing guide to the state's curriculum framework. Use these two documents to pace out how much time you will spend working on each standard. (2) Place the standard on the calendar along with the I can statement for that day. (3) Please note this is a draft. Information may change. All info must be transferred to the online pacing calendar in Google Drive.						

Day 2: Lesson Plan Template (Skeleton being completed only)

Standard	
Essential Knowledge (Paste from Curriculum Framework)	
Bloom's Level of Cognition	
Big Idea or Question(s)	
I can statement:	
Key Vocabulary	

Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Activities:	**Activities:**	**Activities:**	**Activities:**	**Activities:**
Formative Assessments:	**Formative Assessments:**	**Formative Assessments:**	**Formative Assessments:**	**Formative Assessments:**

TTS:	**TTS:**	**TTS:**	**TTS:**	**TTS:**

Evaluations
Days 1-3

Directions: Please complete the following information, so we can ensure that the PD days are meaningful for your team.

Professional Development Workshop: "Teaching to Mastery"

Session Day: (Circle One)   Day 1   Day 2   Day 3

1. How effective do you feel the goals/objectives for this workshop were? (circle the appropriate number)

   NOT AT ALL < 1   2   3   4   5   6   7 > COMPLETELY
   Comments:

2. How would you rate the overall effectiveness of the style of workshop? (circle the appropriate number)

   INEFFECTIVE < 1   2   3   4   5   6   7 > VERY EFFECTIVE

   Comments:

3. To what extent do you think the activities will prepare you for delivering instruction in Q1 (circle appropriate number)

NO USEFUL IDEAS < 1 2 3 4 5 6 7 >
SEVERAL USEFUL IDEAS

Comments:

4. Would you recommend changes to today's workshop?

5. In retrospect, do you feel this PD should have happened earlier? (circle one response)

YES NO MAYBE

6. Please share any other comments or concerns:

Link for End of the Year Survey

(Summative Assessment)

Directions:

1. Teachers should complete the final survey.
2. Administration should hold a final CLT meeting to discuss the SOL math scores
3. Teachers should speak freely about the data and the impact (if any) that the planning sessions had on student growth.
4. The team should use the information gleaned to make necessary changes (if necessary) to the planning sessions for the upcoming year.

Link: Please complete the end of the year survey by clicking the link below:

https://docs.google.com/forms/d/e/1FAIpQLSe3lPEBs5YAzwdd72veuNjVPZh2Rwu0Q5TaCZvzmJlpwtP2EA/viewform?usp=sf_link

3 Day PD Power Point Presentation with Presenter Notes

Teaching to Mastery

By: Lastarra Bryant

Day 1: Digging Deeper

- Introductions for anyone new to the team
- Review the purpose of the PD
- Review the agenda for the day

Day 1: Agenda

Day 1: Digging Deeper	
8:00-8:30	Welcome & Breakfast
8:30-9:00	Unpacking Standards Overview
9:00-12:00	Unpack Quarter 1 Standards
12:00-1:00	Lunch on your own
1:00-3:00	Pacing Calendar
3:00-3:30	Wrap-Up-Closure

Unpacking Standards
What does this mean & Why should we do it?

- Write your answer on the given index card.
  - Have a discussion at the table and write down the commonalities amongst the group and any differing perspectives.
  - Brief Group Discussion (Whole Group)

Unpacking a Standard

- Understanding how to use a taxonomy to unpack a standard:
  - Review the overarching standard in order to determine the CONTEXT.
  - Determine the CONTENT (what students must know)
  - Determine the COGNITIVE LEVEL. (Bloom's Taxonomy, Revised): What students must be able to *do* with what they know.

Unpacking a standard involves three steps. First, we must review the overarching standard to determine the *context* in which students are learning the essential knowledge and skills. Second, we will determine the content students must learn. Lastly, we will determine the cognitive level using Bloom's Revised Taxonomy.

Example: Unpacking a Standard (Apply)

For the learning objective, underline the content, circle the word(s) that provide information regarding cognitive level, and finally, classify the word into one of Bloom's six cognitive levels.

Apply

Apply

4.4 The student will

a) estimate sums, differences, products, and quotients of whole numbers;

d) solve single-step and multistep addition, subtraction, and multiplication problems with whole numbers.

- Verify the reasonableness of sums, differences, products, and quotients of whole numbers using estimation.

In the standard, itself, students must know how to find sums, differences, products, and quotients of whole numbers in both single-step and multistep problems (though the multistep does not include division). The verbs in this standard are estimate and solve, which are generally considered the Apply level.
But now let's look at the Essential Knowledge and Skill from the Curriculum Framework…What do you notice? Turn to your shoulder partner and discuss what you notice. In 5 minutes, we will discuss whole group.

Materials for Unpacking

- *Standards of Learning*: Outline essential components and content
- *Curriculum Framework*: Amplifies *Standards of Learning* and defines the essential content knowledge, skills, and understandings that are measured by the Standards of Learning tests
- *Test Blueprints*: Detail the specific standards covered by a test, reporting categories of test items, number of test items, and general information about how test questions are constructed
- *Blooms Taxonomy Lists*
- *Laptops*

Discussion:
Here are the three documents that every teacher should have readily available when planning an upcoming unit. The first thing needed is the Standards of Learning themselves. These will outline the essential components and content of the curriculum. The Standards of Learning are just that, however—an outline. To understand the scope of what students must know and can do to successfully master the standards, the Virginia Department of Education provides a Curriculum Framework for each subject and grade level. The difference between the Standards themselves and the Curriculum Framework are the depth and the way in which they are used. The Curriculum Framework amplifies those Standards of Learning by defining the essential content knowledge, skills, and understandings that are measured by the Standards of Learning tests. Then, to understand HOW those essential knowledge and skills will be assessed, we must look at the Test Blueprints themselves. These give us specific details regarding the standards that are covered on the end-of-year or course assessment (not all standards are testable, and some are subsumed under other standards), the reporting categories of the test items and the number of items in each reporting category, and other general information about how test questions are constructed.

The link to these documents are in your email, because of the number of pages.

Lets Unpack…

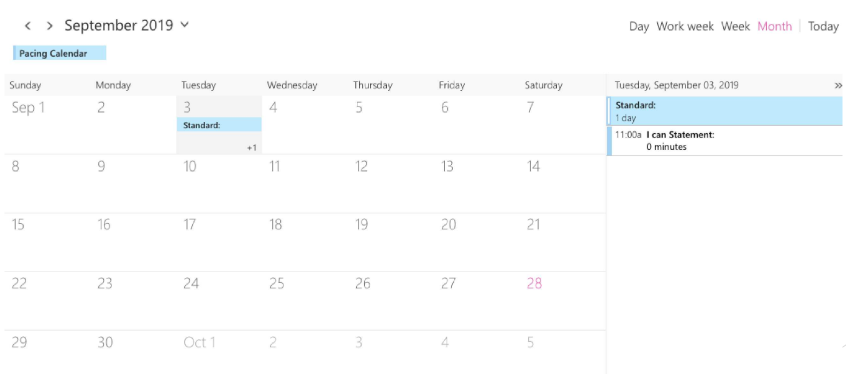
- As a group please begin to unpack the standards for the first 9 weeks of school.

Teachers will work collaboratively to unpack the standards. The presenter will observe and interject as necessary.

Lunch Time

- You may leave the building for lunch. Please be back by 12:45 so we can begin our pm session at approximately 1pm.

Day 1: PM session Pacing Calendar



Please check your emails and go to the calendar invite that says “pacing calendar”. We will begin to pace out the daily objectives for quarter 1 on the calendar. This will ensure that the standards are being taught in an adequate amount of time.
Please feel free to use the blank calendar printout templates and add to the electronic calendar after.

Day 1 Closure:

- Please complete the evaluation form and place it in the center of the table.

Evaluation forms will be reviewed and addressed the next day if necessary.

Day 2: I can!

- Welcome
- Recap from day 1
- Go over any questions from the evaluation from day 1
- Review the agenda
- Go over learning Targets for the day
- Get started!

Day 2: Agenda

Day 2: I can!	
8:00-8:30	Welcome & Breakfast
8:30-9:00	Overview of the importance of having a daily goal established: Video/Discussion
9:00-12:00	I can statements placed on electronic pacing calendar for each day of learning
12:00-1:00	Lunch on your own
1:00-3:15	Lesson plan outlines
3:15-3:30	Wrap-Up-Closure

Day 2: Materials

- *Enhanced Scope and Sequence:* Provides sample lesson plans and instructive resources to help teachers align their classroom instruction to the standards
- *Laptops*
- *Blank Calendar Template*
- *Blank Lesson Plan Template*

Opening Discussion

- What is the importance of having daily goals as opposed to week long goals? Do you think it makes a difference?
- Write your answers on the index card that was given.
- Have a table discussion
- Share perspectives (whole group)

Pacing Calendar: "I can" statements

- Using the unpacked standards and the enhanced scope and sequence provided by the VDOE, what are some learning targets or "I can' statements that can be developed to keep students engaged in the math lessons daily?
  - Use student friendly language.
    - Keep them simplistic

These are the learning targets that should be shared on the board with students daily, so they know the expectations and intended learning outcomes. This calendar can also be shared with parents, so they know what they can be reviewing at home.

Lunch Time

- You may leave the building for lunch. Please be back by 12:45 so we can begin our pm session at approximately 1pm.

Lesson Planning

- Using the unpacked standards, pacing calendar, *enhanced scope and sequence you all will be creating a skeleton for your lesson plans.*

Lesson Plan Outline, or Skeleton

Lesson Plan Template #1

Standard	4.4 The student will a) **estimate** sums, differences, products, and quotients of whole numbers; d) **solve** single-step and multistep addition, subtraction, and multiplication problems with whole numbers.
Essential Knowledge or Skill (from Curriculum Framework)	**Verify** the reasonableness of sums, differences, products, and quotients of whole numbers using estimation.
Cognitive Level(s)	• **Apply:** Solving multistep problem • **Analyze:** Comparing and contrasting solutions and solution strategies with other students • **Evaluate:** Verifying reasonableness of solutions
Big Ideas (Essential Questions, Enduring Understandings, how this lesson relates to theme, etc.)	• **Essential Question:** How do we know if our solution is correct? • **Enduring Understanding:** We can use estimation to determine the reasonableness of solutions.
Objective(s) (behavior, conditions, criteria)	• Given multistep problems involving addition and subtraction, students will first solve the problem independently, then work together in small cooperative groups to compare and contrast solutions and solution strategies, evaluating the reasonableness of their answers, and providing a group verbal justification for their answer. • Given one multistep problem involving addition and subtraction, students will solve the problem independently, evaluate the reasonable of their answers, and independently provide a written justification for their answer which will score Effective for the Computation, Strategies, and Reasoning Rubric.

Directions

- Lesson Plan skeletons should be completely filled out for the first 9 weeks of school.

Day 2: Closure:

- Please complete the evaluation form and place it in the center of the table.

Day 3: Bringing it all Together !

- Welcome
- Recap from day 1 & 2
- Go over any questions from the evaluation from day 2
- Review the agenda
- Go over learning Targets for the day
- Get started!

Day 3: Agenda

Day 3: Bringing it all Together	
8:00-8:30	Welcome & Breakfast
8:30-12:00	Create exciting vocabulary, number sense, and formative assessment activities
12:00-1:00	Lunch on your own
1:00-3:00	Incorporating Test-Taking Strategies Discussion/Web-Surf for applicable strategies
3:00-3:30	Closure: Review completed material for the upcoming 9weeks.

Day 3: Materials needed…

- *Released tests and test items:* Assessment items that are representative of the content and skills included in the SOL assessment and present the format of the tests and questions.
  - *To access go to the following website:* *http://www.doe.virginia.gov/testing/sol/released_tests/index.shtml*

Day 3: Directions

1. You will work collaboratively to brainstorm and create activities for vocabulary, number sense routines, and formative assessments for the am session.
2. The pm session will require you to think of various test-strategies you can apply to the activities created earlier.
3. All activities and strategies will be placed in a Google Drive folder and linked in the lesson plan outline.

Evaluation of 3 day PD

- Teachers will complete a Google Survey. The results will go directly to the math administrators (administrator over math and the math specialist), so they can align the necessary resources to meet the needs of the teachers at their bi-weekly CLT meetings.

Appendix B: Permission to use CRA Visual

5/2/2018 Mail - lbryant1@nps.k12.va.us

Re: Fw: Concreteness Fading in Mathematics and Science Instruction: A Systemic Review article

From: Emily Fyfe <efyfe@indiana.edu> **Sent:** Thursday, March 8, 2018 8:46:16 PM
To: Lastarra Bryant **Cc:** Fyfe, Emily Ruth **Subject:** Re: Fw: Concreteness Fading in Mathematics and Science Instruction: A Systemic Review article

Hi Lastarra,

You are correct - my co-authors and I created Figure 1 in the paper. Of course, I'm happy to grant permission to use the visual - you are certainly welcome to it!

I also have a continued interest in concreteness fading and the CRA model. I'd love to hear/read any work you have done on it!

Emily

-- Emily R. Fyfe, Ph.D. Assistant Professor Department of Psychological and Brain Sciences Indiana University https://lead.lab.indiana.edu

Appendix C: Observation Protocol

Project: Exploring Fifth Grade Teachers' Perceptions on Their Math Instructional Practices.

Teacher: ______________________________

Date of Observation: ____________________

Length of Observation: ______________ Start Time: _____ End Time: _____________

Brief Description of the classroom layout and environment:

____

____

____

Brief Description of the Observed Lesson:

____

____

____

____

What manipulatives are being used to transition students through the CRA sequence?

If they are being used, what kind of manipulatives and how were they introduced (explicit lesson or just given out)?

____

____

____

How are calculators being used to transition students through the CRA sequence?

If they are used, how are they being used (to teach number sense or to check work)?

____

____

____

How are computers being used to transition students through the CRA sequence?

If they are being used, who is using the computers (teacher or students)? What are they doing on the computers?

____
____
____
____

Description of instruction/activities/events	**Reflective notes**

Appendix D: Interview Protocol

Opening Introduction: Thank you for allowing me to interview you today! As a part of my research study, I am collecting data from participants through individual interviews. I am going to ask you a series of questions and audio record your responses. Upon transcribing the interviews, I will send the data back to you so that you can review for accuracy. All responses will be kept confidential and will only be used for this research. Additionally, your identity will not be revealed in my findings. I will be using pseudonyms to ensure I maintain confidentiality. If additional questions arise after I have analyzed the data, I will arrange a time to conduct an additional interview via telephone. Let's get started.

1. How do you feel a student's conceptual understanding and math achievement relates to the math instruction that they receive? (This question is linked to the conceptual framework-Bruner's learning theory)
2. During my observation, I noticed that you (did/did not) use manipulatives.
    - Which types of math activities or lessons would you plan using

manipulatives?
- What experiences have influenced (formal and informal) your decisions to use or not to use manipulatives?

3. During my observation, I noticed that you (did/did not) use pictorial representations.
    - Which types of math activities or lessons would you plan using pictorial representations?
    - What experiences have influenced (formal and informal) your decisions to use or not to use manipulatives?
4. In what ways, do you prepare your students to solve abstract math problems?
5. In what sequence, do you typically teach a new math concept when using manipulatives and pictorial representations?
6. In my observation, I noticed that you (did/did not use) technology. To what extent do you include technology in your classroom?
    - What forms of technology do you utilize?
    - In what ways are you prepared to incorporate technology into your math instruction?
7. During my observation, I noticed that you (did/did not) use calculators.
    - How do you typically use calculators in your classroom?
    - In what ways, have you been prepared to use calculators in your instruction?
8. How does teacher collaboration influence your instructional practices, specifically when manipulatives, pictorial representations, and technology are used?
9. How does professional development affect your instructional practices, specifically when **utilizing the CRA** method?
10. Other than teacher collaboration and professional development, what other instructional supports influence your instructional practices?

11. In your opinion, what are some strengths of using the following to teach math:

- manipulatives
- pictorial representations
- abstract concepts
- technology
- calculators

12. What are some barriers of using the following to teach math?

- manipulatives
- pictorial representations
- abstract concepts
- technology?
- calculators

*These questions have been adapted from another student's study. I have obtained permission from her to utilize them (Please see Appendix F).

Appendix E: Interview Protocol Permission Email

7/3/2018 Mail - lastarra.bryant@waldenu.edu

Re: Interview Protocol

angela.vizzi@yahoo.com

Tue 7/3/2018 6:06 PM

To:Lastarra Bryant <lastarra.bryant@waldenu.edu>; angela.vizzi@yahoo.com <angela.vizzi@yahoo.com>; Cc:Michael Jazzar <michael.jazzar@mail.waldenu.edu>;

Lastarra,

This sounds like a great study! Yes, I am more than happy to give you permission to use my interview protocol. Feel free to revise as needed to fit your study. I wish you good luck and continued success on the remaining portions of your journey toward completing your doctoral degree.

Sincerely, Dr. Angela Vizzi, EdD

Appendix F: Data Analysis Matrix

Central Research Question: What are fifth grade teachers' perceptions of utilizing a wide variety of manipulatives, calculators, and computers to transition students from concrete understandings to pictorial representations before they embark upon abstract concepts?

Interview Questions:
How do you feel a student's conceptual understanding and math achievement relates to the math instruction that they receive? How does teacher collaboration influence your instructional practices, specifically when manipulatives, pictorial representations, and technology are used? All 4 participants discussed the importance of their bi-weekly collaborative team planning.

- P1discussed the importance of the CLT meeting. "This is the time when I can ensure I am speaking the right language and am in accordance with my team".
- P2 described the CLT as "invaluable-I receive professional development and resources".
- P3 This is time for the lesson to be taught by the specialist to ensure that all teachers know what they are teaching in advance. All teachers are on one accord.
- P4 This is a time where we can plan who is going to teach what and go over test taking strategies. Test taking strategies I believe is a big part of the puzzle that is missing.

How does professional development affect your instructional practices, specifically when **utilizing the CRA** method? 4/4 participants discussed the importance of PD.

They all feel that it is necessary for their growth as professionals.

- 3/4 of the participants discussed that most of the PD they receive is from their math specialists in the building.
- 3/4 of the participants find the PD offered outside of the building helpful for working on upcoming skills.
- 3/4 of the participants feel that there needs to be more work on preparing students for "these new standards and tests"

Other than teacher collaboration and professional development, what other instructional supports influence your instructional practices?

- P1-meeting the student's needs.
- P2 & P3 data and assessments
- P4 district and state mandates; "There are things that we must follow within the curriculum, therefore that will certainly affect what you do and don't do".

In your opinion, what are some strengths of using the following to teach math:

- Manipulatives- 4/4: They can see it and it is tangible.
- pictorial representations-
    a. P1-Helps students to see what is going on
    b. P2 & P3 They can relate their understanding to the tangible manipulatives they just worked with. They can see the process.
    c. P4 it bridges the gap between the manipulatives and solving abstractly. "This is how they will see it on an assessment"
- Abstract concepts- 4/4 participants stated "This is how students will see it presented on a test".
- technology –
    a. 3/4 of the participants feel this is where this generation is. "They are into technology, games, and competition" the technology draws them into the lesson.
    b. 1/4 of the participants feels that it could be good, but also it can be overused.

- Calculators- 4/4 of the participants agree that it is a great tool for self-checking and error analysis for students.

What are some barriers of using the following to teach math?

- Manipulatives- 4/4 of the participants stated that students like to play with manipulatives. 1/4 participants expressed that there are times when teachers don't have the manipulatives that they need to teach a skill.
- Pictorial representations- 4/4 agree that the pictorial representations can be time consuming and students just don't want to put that much effort into it. 1/4 of the participants also expressed that "it MUST be done after the concrete, this will aide in their understanding of the pictorial representation".
- Abstract concepts- 4/4 of the participants expressed the lack of foundational skills is an issue. Therefore, they cannot understand the abstract often. 2/4 of the participants expressed the necessity of teaching students test taking strategies to combat the lack of foundational skills.
- Technology? 2/4 of the participants stated that students may sometimes play instead of working. 1/4 of the participants stated that if it is not in a controlled environment it can be a major distraction. 1/4 of the participants did not see any barriers to technology.
- Calculators-
  a. P1 & P2 students are sometimes embarrassed to use the calculator
  b. P3 students can become dependent on the calculator
  c. P4 there are no barriers to calculators, because there are established rules for use of the calculators.

Research Sub-Questions	**Interview Questions**	**Major Findings**
What are fifth grade teachers' perceptions of	During my observation, I noticed that you (did/did	2/4 participants were using manipulatives at the time of

using math manipulatives during instruction?	not) use manipulatives.	their observations. The 2 who were not, stated that they were at the abstract level of teaching those skills. P4 utilized all three of the sequence. This participant started with the concrete, then moved students to the pictorial, but kept the concrete accessible, to the abstract. It was clear that they have been practicing with this skill for some time.
	Which types of math activities or lessons would you plan using manipulatives?	4/4 participants stated that any math lesson in fifth grade could use manipulatives. 2/4 emphasized the importance of using the manipulatives when working on word problems and fractions.
	What experiences have influenced (formal and informal) your decisions to use or not to use manipulatives?	4/4 participants stated that they can see the benefits of their students going through the math process of using manipulatives. They see their students "getting it". P3 & P2 discussed that the

		hands-on factor increased student engagement.

What are fifth grade teachers' perceptions of using pictorial representations during instruction?	During my observation, I noticed that you (did/did not) use pictorial representations.	I observed 2/4 teachers using pictorial representations to model during their lesson. In 4/4 of the small groups that I observed by each teacher students were using pictorial representations on their own. It was obvious that this is a common practice amongst the grade level.
	Which types of math activities or lessons would you plan using pictorial representations?	4/4 participants felt that pictorial models could be used for all skills in math. They all stated that they focus on incorporating them the most for word problems and fractions.
	What experiences have influenced (formal and informal) your decisions to use or not to use pictorial representations?	4/4 of the participants are influenced by their students understanding of the content when they use the pictorial representations.

What are fifth grade teachers' perceptions of using technology in math during instruction (i.e., calculators & computers)?	In my observation, I noticed that you (did/did not use) technology. To What extent do you include technology in your classroom?	2/4 participants used technology during my observations. All students have equal access to computers, as they are a 1:1 school. However, during my interviews, all 4 participants expressed that they utilize technology often.
	What forms of technology do you utilize?	4/4 utilize computer programs. 1/4 expressed that they would prefer not to use computers during their instructional time as it can often be a distraction. This participant feels that students need more independent think time to problem solve.
	In what ways are you prepared to incorporate technology into your math instruction?	All 4 participants stated that the district does provide PD on any new computer programs being implemented. 2/4 of the participants were observed using calculators.
	During my observation, I noticed that you (did/did	4/4 of the participants

	not) use calculators.	reported that calculators are used for students to self-check in class and at home for their HW.
	How do you typically use calculators in your classroom?	1/4 of the participants reported that they do not use calculators all the time, because the state is moving away from these. Unless students have an IEP, they don't typically use the hand-held calculator. 1/4 of the participants stated that calculators are sometimes frowned upon by parents and students are discouraged to use them, because it is viewed as cheating.
	In what ways, have you been prepared to use calculators in your instruction?	4/4 participants report that there has not been any formal training on teaching students to use a calculator during instruction. 1/4 participants reported that there will be upcoming professional development by the district on desmos, the new form of the calculator that will be used on the state tests.

In what ways do fifth grade teachers' approach abstract concepts during instruction?	In what ways, do you prepare your students to solve abstract math problems?	Each participant explained this differently, however, they all incorporated some aspect of incorporating the manipulatives and pictorial representations prior to trying any abstract problem solving. P1 discussed the importance of working 1:1 with students who are struggling. "Struggling learners need a set of strategies to get them through these assessments" P2 discussed drawing pictures and tying the lesson to real world experiences. P3 discussed the importance of having the hands-on part at the start of the lesson and readily available throughout. P4 discussed providing rubrics as a way for students to understand the learning process.
	In what sequence, do you typically teach a new math concept when using manipulatives and pictorial representations?	3/4 of the participants discussed teaching the lessons using the C→R→A sequence in that order. 1/4 of the participants discussed first starting with reviewing the vocabulary prior to the CRA sequence.

Themes that emerged **1.** Collaborative Learning Teams (CLT) **2.** Teaching to Mastery **3.** Student's Lack of Foundational Prerequisite Skills **4.** Teaching Test-Taking Strategies		

Appendix G: Data Analysis List

1. How do you feel a student's conceptual understanding and math achievement relates to the math instruction that they receive?

    a. All 4 participants felt that to get students to a point of understanding conceptually, taking the students through the CRA sequence is beneficial and necessary. One participant (P2) felt that it was especially necessary to use the CRA model because a lot of students have a weak foundation of prerequisite skills, so taking them through the CRA sequence will help them build upon the weakened skills to strengthen their foundation.

2. During my observation, I noticed that you (did/did not) use manipulatives.

a. 2/4 participants were using manipulatives at the time of their observations. The 2 who were not, stated that they were at the abstract level of teaching those skills. P4 utilized all three of the sequence. This participant started with the concrete, then moved students to the pictorial, but kept the concrete accessible, to the abstract. It was clear that they have been practicing with this skill for some time.

- Which types of math activities or lessons would you plan using manipulatives? 4/4 participants stated that any math lesson in fifth grade could use manipulatives. 2/4 emphasized the importance of using the manipulatives when working on word problems and fractions.
- What experiences have influenced (formal and informal) your decisions to use or not to use manipulatives? 4/4 participants stated that they can see the benefits of their students going through the math process of using manipulatives. They see their students "getting it". P3 & P2 discussed that the hands-on factor increased student engagement.

3. During my observation, I noticed that you (did/did not) use pictorial representations.

a. I observed 2/4 teachers using pictorial representations to model during their lesson. In 4/4 of the small groups that I observed by each teacher students were using pictorial representations on their own. It was obvious that this is a common practice amongst the grade level.

- Which types of math activities or lessons would you plan using pictorial representations? 4/4 participants felt that pictorial models could be used for all skills in math. They all stated that they focus on incorporating them the most for word problems and fractions.
- What experiences have influenced (formal and informal) your decisions to use or not to use pictorial representations? 4/4 of the participants are influenced by their students understanding of the content when they use the pictorial representations.

4. In what ways, do you prepare your students to solve abstract math problems? Each participant explained this differently, however, they all incorporated some

aspect of incorporating the manipulatives and pictorial representations prior to trying any abstract problem solving.

a. P1 discussed the importance of working 1:1 with students who are struggling. “Struggling learners need a set of strategies to get them through these assessments”
b. P2 discussed drawing pictures and tying the lesson to real world experiences.
c. P3 discussed the importance of having the hands-on part at the start of the lesson and readily available throughout.
d. P4 discussed providing rubrics as a way for students to understand the learning process.

5. In what sequence, do you typically teach a new math concept when using manipulatives and pictorial representations? 3/4 of the participants discussed teaching the lessons using the C→R→A sequence in that order. 1/4 of the participants discussed first starting with reviewing the vocabulary prior to the CRA sequence.

6. In my observation, I noticed that you (did/did not use) technology. To what extent do you include technology in your classroom? 2/4 participants used technology during my observations. All students have equal access to computers, as they are a 1:1 school. However, during my interviews, all 4 participants expressed that they utilize technology often.
   - What forms of technology do you utilize? 4/4 utilize computer programs. 1/4 expressed that they would prefer not to use computers during their instructional time as it can often be a distraction. This participant feels that students need more independent think time to problem solve.
   - In what ways are you prepared to incorporate technology into your math instruction? All 4 participants stated that he district does provide PD on any new computer programs being implemented.

7. During my observation, I noticed that you (did/did not) use calculators.

   a. 2/4 of the participants were observed using calculators.

- How do you typically use calculators in your classroom? 4/4 of the participants reported that calculators are used for students to self-check in class and at home for their HW.

  1/4 of the participants reported that they do not use calculators all the time, because the state is moving away from these. Unless students have an IEP, they don't typically use the hand-held calculator.

  1/4 of the participants stated that calculators are sometimes frowned upon by parents and students are discouraged to use them, because it is viewed as cheating.
- In what ways, have you been prepared to use calculators in your instruction? 4/4 participants report that there has not been any formal training on teaching students to use a calculator during instruction. 1/4 participants reported that there will be upcoming professional development by the district on desmos, the new form of the calculator that will be used on the state tests.

8. How does teacher collaboration influence your instructional practices, specifically when manipulatives, pictorial representations, and technology are used? All 4 participants discussed the importance of their bi-weekly collaborative team planning.
   a. P1discussed the importance of the CLT meeting. "This is the time when I can ensure I am speaking the right language and am in accordance with my team".
   b. P2 described the CLT as "invaluable-I receive professional development and resources".
   c. P3 this is time for the lesson to be taught by the specialist to ensure that all teachers know what they are teaching in advance. All teachers are on one accord.
   d. P4 this is a time where we can plan who is going to teach what and go over test taking strategies. Test-taking strategies I believe is a big part of the puzzle that is missing.
9. How does professional development affect your instructional practices, specifically when utilizing the CRA method? 4/4 participants discussed the importance of PD. They all feel that it is necessary for their growth as

professionals.

a. 3/4 of the participants discussed that most of the PD they receive is from their math specialists in the building.
b. 3/4 of the participants find the PD offered outside of the building helpful for working on upcoming skills.
c. 3/4 of the participants feel that there needs to be more work on preparing students for “these new standards and tests”

10. Other than teacher collaboration and professional development, what other instructional supports influence your instructional practices?
    a. P1-meeting the student’s needs.
    b. P2 & P3 data and assessments
    c. P4 district and state mandates; “There are things that we must follow within the curriculum, therefore that will certainly affect what you do and don’t do”.
11. In your opinion, what are some strengths of using the following to teach math:

- Manipulatives- 4/4: They can see it and it is tangible.
- pictorial representations-

a. P1-Helps students to see what is going on
b. P2 & P3 They can relate their understanding to the tangible manipulatives they just worked with. They can see the process.
c. P4 it bridges the gap between the manipulatives and solving abstractly. “This is how they will see it on an assessment”

- Abstract concepts- 4/4 participants stated “This is how students will see it presented on a test”.
- technology –

a. 3/4 of the participants feel this is where this generation is. “They are into technology, games, and competition” the technology draws them into the lesson.
b. 1/4 of the participants feels that it could be good, but also it can be overused.

- Calculators- 4/4 of the participants agree that it is a great tool for self-checking and error analysis for students.

What are some barriers of using the following to teach math?

- Manipulatives- 4/4 of the participants stated that students like to play with manipulatives. 1/4 participants expressed that there are times when teachers don't have the manipulatives that they need to teach a skill.
- Pictorial representations- 4/4 agree that the pictorial representations can be time consuming and students just don't want to put that much effort into it. 1/4 of the participants also expressed that "it MUST be done after the concrete, this will aide in their understanding of the pictorial representation".
- Abstract concepts- 4/4 of the participants expressed the lack of foundational skills is an issue. Therefore, they cannot understand the abstract often times. 2/4 of the participants expressed the necessity of teaching students test-taking strategies to combat the lack of foundational skills.
- Technology? 2/4 of the participants stated that students may sometimes play instead of working. 1/4 of the participants stated that if it is not in a controlled environment it can be a major distraction. 1/4 of the participants did not see any barriers to technology.
- Calculators-

a. P1 & P2 students are sometimes embarrassed to use the calculator
b. P3 students can become dependent on the calculator
c. P4 there are no barriers to calculators, because there are established rules for use of the calculators.

Themes that emerged

1. Collaborative Learning Teams (CLT)
2. Teaching to Mastery
3. Student's Lack of Foundational Prerequisite Skills
4. Teaching Test-Taking Strategies

Overall, the participants are utilizing the CRA sequence appropriately. They also receive an adequate amount of PD on incorporating the CRA sequence. Incorporating technology is infused within the PD. Calculator PD has not been done according to PD logs. Lesson plans do reflect the presence of CRA in teacher's lesson plans. Collectively, they each have mentioned at some point throughout their interviews that students are coming to fifth grade unprepared. They have a week foundation of basic skills, so they are spending most the time trying to teach them basic math facts. 4/4 participants expressed that the district is against skill and drill methods, so it is important that they begin to teach them test taking strategies. Teachers attribute the consistent failing scores to the students' lack of foundational skills and the students' inability to apply test taking strategies. Especially with new standards and a new computer adaptive style test.