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Developing A Deep Understanding Of Multiplication And A Growth Mindset In 5th Grade Students From Marginalized Groups

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DEVELOPING A DEEP UNDERSTANDING OF MULTIPLICATION AND A GROWTH MINDSET IN 5TH GRADE STUDENTS FROM MARGINALIZED GROUPS

By

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CHAPTER 1

The way mathematics is taught seems to be always evolving. I have had many conversations with the parents of my students who claim they were taught math differently and therefore are unable to help their children with math at home. The majority of the parents of my students were taught math when rote memorization of facts were expected and speed as well as fluency were the goal. This is not only how I was taught math, but how I first taught math. As educators learned more about how the brain works, the way mathematics was taught has evolved. Rather than a goal of memorization and speed, mathematics is now often taught with the goal of students developing a deep understanding of concepts, relationship between numbers and patterns. Although speed is not the top priority, fluency will be developed as students are exploring bigger mathematical concepts. "Research tells us that the best mathematics classrooms are those in which students learn number facts and number sense through engaging activities that focus on mathematical understanding rather than rote memorization" (Boaler et al., 2019). My research question is: *How can the use of number talks support and develop a growth mindset and create a deep understanding of multiplication in 5th grade students from marginalized groups?*

My Experience Learning Mathematics

As a young learner in the primary grades, mathematics came easily to me. I had great speed and accuracy with all the basic facts. I remember in third grade my parents bought a set of multiplication flashcards for my brother and I. I would practice my facts each night as part of my homework. Every so often, my mom would take the flashcards out and we would play a game to see who was the best at their multiplication facts. My

mom would show a card to us and whoever got the answer correct the quickest won the card. We kept a running record each time we played. It was my goal to be better than my brother so I practiced each and every night until I had those facts memorized and could give the answers quickly with ease. I remember my teacher commenting on how quick I was with my facts and I remember how proud I was of this recognition.

Interestingly enough, it was about this time when I began to really struggle with math. The focus in class had shifted from the basic facts to higher level concepts such as division of larger numbers, fractions and algebra. I remember coming to the realization that I was no longer good at math and I could not understand why. I would spend a lot of time at home each night working on my math homework with my parents. I very clearly remember them teaching me ways to get answers, often shortcuts that were completely different from what I was taught in school. Sometimes, what I was taught at home would get me the correct answer, but I honestly had no idea why it worked or really had any clue as to what I was doing. Often, as is expected with mathematics, we would build on the skills taught. When this was the case, the tricks I had learned no longer worked and I would be in the same position if not worse off, than I was to start.

As I entered High School, I arrived at the conclusion that I was just destined to not be good at math. I began to be okay with that thought and accepted the fact that I was not a math person. The only math class I did well in during high school was in 10th grade when my teacher taught us all sorts of songs to help us remember the formulas. I was finally able to memorize something, plug in the numbers and get a correct answer. Again, I had no understanding of what I was doing and the next semester when we moved to expand on the formulas learned, I was lost because I had no understanding of the material

taught but was able to memorize enough to pass. The only math I can recall learning from high school was the quadratic formula. I had no idea what this formula actually is or when I would use it, but thanks to a catchy song my higher algebra teacher taught us, I can recite this formula.

In college, I had to take a mathematics course as part of my licensure and due to my struggles with math, I was dreading this class. However, my professor was amazing. For the first time in my life, I felt as though I had a teacher who truly taught us mathematics. In order to build a deep understanding of mathematical concepts, she re-taught us the basics of math, but instead of using the base 10 system we typically use, she had us use a base 7 system. She taught in a way that had us explore the numbers, work together and develop a deep understanding rather than teaching us tricks to memorize basic facts. From this point forward, I developed a love for math and made it my goal to help others learn to love mathematics as well.

My Experience Teaching Mathematics

When I first began teaching, I would push multiplication fluency with my students. I would put aside ten minutes each day where students would complete a timed multiplication test that consisted of 100 multiplication problems. Students had 5 minutes to answer all 100 facts correctly. When time ran out, students would correct their tests and graph their data. My hope in doing this was so students could see their growth. I assumed all students would see growth and feel pride in their work since we spent so much time on these facts. At first students did make growth, but this quickly plateaued. Even after all this practice, my 5th grade students were not yet fluent in their basic multiplication facts. Not only did students stop making progress but I also began hearing

many comments from students stating that they are just not good at math. I was taught that practice makes perfect, so I printed off flashcards for students and sent them home with parents with the directions to practice them each night.

Students in my class often come to me with holes in their math learning and are often lacking a true understanding of number sense and multiplication. Not only does this make teaching the 5th grade standards extremely difficult as many of our standards revolve around multiplication, division and fractions but many of my students feel as though they are not good at math before I even teach my first lesson to them. My first few years of teaching, whenever I would notice students struggling, I would often teach them tricks and shortcuts to getting the correct answer. I have since learned that this is a problem. Yes, they are able to get a correct answer, but they have no idea how they arrived at a solution or why what they did worked.

In the Summer of 2019, I took a class called Mathematical Mindsets. In this course, we read the book Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching (Boaler, 2015). As I read this book, so much of what Boaler said made sense to me. I became energized to change the way I taught math. To help my students develop a growth mindset for math, to facilitate their exploration of numbers, patterns and relationships between numbers. I vowed never again to have my students practice facts over and over again in hopes of memorization. I would never again teach students tricks to getting a right answer quickly. I decided I would teach in a way that students would work together, share their thinking and develop a deep understanding of the relationships between numbers. I knew this

would not be easy and that students would have to struggle and work hard, but I knew that the hard work would pay off.

In the fall of 2020, my school began implementing Cognitively Guided Instruction (CGI) for math. These ideas coupled with the ideas Boaler shared about the importance of developing a mathematical mindset has led me to a place where I not only feel confident in my own mathematical abilities, but am confident that I can also lead my students down this same path.

Rationale

I have taught at my current school for 7 years. 6 of these years were spent in 5th grade, the other year was spent in 4th grade. My school's PLC focus has been on math. We collect lots of data on students and spend a lot of time talking about the data collected. No matter the changes we have made, the data always looks the same. Students are not learning the concepts we are teaching them. Year after year, the majority of my 5th grade students are missing many of the key concepts they should have learned in previous years. The truth is, without a solid mathematical foundation, I am not able to teach my students 5th grade standards. It is obvious something drastically needs to change and for years we have been stumped. When the ideas of a mathematical mindset as well as teaching with CGI best practices came around, we finally had a new approach to guide our teaching.

Number Talks were introduced to teachers at my school and I first began using them during distance learning in 2020. This was a difficult task to be done via Zoom. Even though this was difficult, I could see my students begin to grow not only in how they viewed themselves as mathematicians, but also in their strategies that they carry with

them in their math tool boxes. As I continue to learn more about the number talks strategy as well as CGI best practices, I am optimistic that data will begin to look different for my 5th grade students

Summary

As brain researchers learn more and more about how our brains work, teaching best practices continue to evolve and change. The way mathematics is taught is one area that has seen many changes throughout the years. We once focused on rote memorization to build speed and fluency. This is no longer the focus for many educators. Researchers have learned that speed should not be the goal of math instruction. Rather, students should develop a deep and concrete understanding of concepts. Through the development of these conceptual understandings, students will be able to learn their basic facts.

One of the best ways to help students not only develop a deep understanding of mathematical concepts such as number sense and multiplication fluency but also to support a mathematical mindset is through the use of number talks. This has led me to my research question: *How can the use of number talks support and develop a growth mindset and create a deep understanding of multiplication in 5th grade students from marginalized groups?*

Chapter 2 will be my literature review where I will explore and review literature around best practices for teaching mathematics including Number Talks and Cognitively Guided Instruction. I will review literature around the importance of growth mindsets to mathematics and explore how these techniques can support the learning of marginalized groups specifically when it comes to developing a deep understanding of multiplication.

CHAPTER 2

Literature Review

Introduction

In chapter 1, I discussed how there has been a shift in how mathematics has been taught. I shared my learning experiences in a school that pushed for rote memorization of facts and formulas and how this impacted me as a math learner.. Next, I discussed how the way I teach mathematics had evolved after I noticed more and more students not displaying the growth I had expected in math class and justifying this because they, like many of their parents, were just not good at math and that was that. This justification was not okay with me and I began looking for ways to deeply engage my students in mathematics. This led me to learning about the concepts of Number Talks, Cognitively Guided Instruction (CGI), and a growth mindset. This new learning led me to my research question: *How can the use of number talks support and develop a growth mindset and create a deep understanding of multiplication in 5th grade students from marginalized groups?*

In chapter 2, I will discuss the themes within my research question. The first theme is the shift in best practices of math instruction. This section will explore how mathematics instruction has shifted over the years from a focus on rote memorization to teachers being facilitators who help students think critically about math concepts, make sense of problems and reason. This section will also look specifically at multiplication development. The next section will discuss best practices for Cognitively Guided Instruction (CGI). The third section discusses Mathematical Mindsets and the importance of a growth mindset to the learning of mathematics as well as explores ways teachers can

promote growth mindsets in their math classes. The next theme is learners from marginalized groups and mathematics. This section will focus on how to best engage minority learners in challenging mathematics so that students can obtain a deep understanding of concepts explored. The final section will discuss Number Talks as a possible solution to the research question.

Best Practices of Math Instruction

Until the 1990s, the focus of many mathematics classrooms was on basic facts and rote memorization (Delvin, 2020). Math teachers often focus on memorizing formulas and procedures, which can leave students without the conceptual understanding behind these procedures. This can prevent students from making the connections necessary to transfer their knowledge to other situations (Mills, 2019; Steven et al., 2015). This focus on memorization of facts, formulas and procedures and then practicing these skills over and over again can still be seen across classrooms today (Sam & Ernest, 2000). Current research shows that this traditional way of teaching often leaves students without the deeper understanding of the procedures taught which are essential to the application of mathematical concepts. As a result, many students, especially those from marginalized groups, are left unable to attain high levels of math education (Ladson-Billings, 1997; Oakes et al, 1990; Steven et al., 2015).

Mathematics teachers tend to be in agreement that students should master basic math facts as well as have computational fluency, which is the ability to quickly and efficiently apply these basic facts. There has been, however much disagreement as to how to best help students achieve this (Baroody, 2006).

Recent research states the importance of moving beyond rote memorization of basic facts and formulas and drills as a form of practice. Rather, the research supports math instruction in which students are given opportunities to explore numbers, patterns and relationships and make connections between mathematical concepts in order to make sense of mathematics (Allsopp et al., 2018).

The National Council of Teachers of Mathematics (NCTM) supports the idea that math learning is an active process. Students must be given opportunities to create their own mathematical knowledge from both their personal experiences as well as through discourse with both teachers and peers. Further research has been able to pinpoint several pillars of learning necessary to provide a foundation for effective math instruction. It is imperative that learners are given opportunities and experiences that enable them to engage in challenging tasks in order to find meaning and connect new learning to past learning, engage in informal reasoning including addressing preconceptions as well as gaining both conceptual and procedural understanding in order to meaningfully organize, acquire and transfer knowledge to new situations. Researchers also state the importance of providing students with rich opportunities to construct knowledge through discourse and interactions related to meaningful math problems as well as the importance of receiving feedback in order to reflect and revise thinking and understanding so that students may see themselves as learners, thinkers and problem solvers who have the ability to monitor their own learning and progress (Steven et al., 2015).

in *Principles to Actions: Ensuring Mathematical Success for All* (2014), The NCTM has pinpointed a framework of effective mathematical teaching practices that mathematics teachers should use in order to provide effective math instruction. These

teaching practices include: establishing mathematics goals to focus learning, implementing tasks that promote reasoning and problem solving, using and connecting mathematical representations, facilitating meaningful mathematical discourse, posing purposeful questions, building procedural fluency from conceptual understanding, supporting productive struggle in learning mathematics, and eliciting and using evidence of student thinking. See Figure 1.

Figure 1

Effective Mathematics Teaching Practices

Mathematics Teaching Practices
Establish mathematics goals to focus learning. Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.
Implement tasks that promote reasoning and problem solving. Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.
Use and connect mathematical representations. Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.
Facilitate meaningful mathematical discourse. Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.
Pose purposeful questions. Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.
Build procedural fluency from conceptual understanding. Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.
Support productive struggle in learning mathematics. Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.
Elicit and use evidence of student thinking. Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

(Leinwand, et al., 2014)

Best Practices for Multiplication Development

Those who have a good foundation in number sense are able to think about and use numbers flexibly (Boaler et al., 2015). Number sense includes:

- understanding quantities such as *more, less, larger,* and *smaller*
- understanding the order of numbers such as *first, second, third*, etc.
- understanding symbols can represent quantities such as 7 means *seven*
- having the ability to make comparisons between numbers such as 5 is greater than 2
- recognizing relationships between single items and groups of items such as *three* is the same as *one group of three items* (Cunningham, 2021).

The truth is, number sense is the key to higher level mathematics (Boaler, 2009).

Multiplication falls under the realm of number sense and is an important concept to have a deep understanding of in order to be successful in higher level mathematics. The traditional way of teaching multiplication is through the memorization of facts through drills, repetition, practice and timed tests. However, this method of teaching multiplication can be harmful to students as it gives the wrong idea of what math is really about. It gives the impression that math is about speed and quickly getting correct answers. This idea can turn students away from math and leave those who take their time believing they are not good at math (Boaler, 2009). Although it is helpful to hold some math facts in memory, focusing on the memorization of such facts is not helpful. Math facts are best learned through interacting with numbers in other meaningful activities

such as those that engage students in problem solving and exploration of numbers, patterns and relationships (Boaler, 2009).

The use of manipulatives in a mathematics classroom can also help students to develop a conceptual understanding of procedures when coupled with in depth discussion to ensure students are making meaningful connections between what they have created with the manipulatives to the concept they are modeling (Mills, 2019).

Many teachers of mathematics have begun to change their teaching in order to better incorporate these new research findings. The next section will explore Cognitively Guided Instruction, a teaching practice that supports the eight effective mathematics teaching practices.

Cognitively Guided Instruction

Cognitively Guided Instruction (CGI) is a way of teaching math by focusing on students' mathematical thinking. Through CGI, teachers build on what students already know and help facilitate learning through problem solving. By helping students to recognize their thought process, students build deep understandings of rigorous math concepts. This section will discuss further how teaching with CGI best practices in mind can enrich and improve students' understanding of multiplication.

It is clear that teachers of mathematics must make changes in the way math is taught. Research has provided teachers with research based guidelines such as those in the Common Core State Standards (2010) as well as the eight Effective Mathematics Teaching Practices provided by the NCTM (2014) in order to foster deep understanding of mathematical concepts in students (Carpenter et al., 1996; Franke & Kazemi 2001). Researchers have agreed that teaching itself is complicated and great teachers cannot

simply be made from being provided with high quality activities, but rather great teachers are able to think about the activities they engage their students in and reflect upon how they teach those activities (Carpenter et al., 1996). CGI is a research based framework that provides teachers with knowledge on how to think about the teaching of mathematics rather than prescribing a way for teachers to teach mathematics (Franke & Kazemi 2001; Moscardini, 2014).

CGI encourages teachers to focus on the development of children's mathematical thinking. It begins by providing teachers with an understanding of how students develop their own mathematical thinking and reasoning and encourages teachers to use what they know about how children learn as well as how their own students learn in their own teaching (Carpenter et al., 1996). This is what sets CGI apart from other teaching practices. Rather than telling teachers how to teach, CGI encourages teachers to engage in thinking with their students and reflect upon the understandings and needs of their students in order to build on the knowledge of their students to reach a deeper understanding of mathematical concepts (Carpenter et al., 1996).

CGI teachers understand that their students come to them with a set of knowledge about mathematics, learned both formally and informally. Teachers use the wealth of knowledge within each student in order to build on their natural number sense and problem solving skills (Carpenter et al., 1996). Through focusing on the cognition of their students, teachers are better able to support their students' learning by creating effective instructional tasks that meet the needs of each individual student (Steinberg et al., 2004). Furthermore, CGI teachers recognize that mathematics in itself is a sense making activity rather than a procedural one (Moscardini, 2014).

A day in a CGI classroom may begin with a teacher providing students with a word problem. As students begin to explore the assigned problem, the teacher engages with their students in order to understand their strategies to find a solution. The teacher will use this knowledge to better inform their teaching so that students can build on their own prior knowledge to reach a deeper understanding (Moscardini, 2014). Teachers may advance students' thoughts through questioning and discourse.

The next section discusses mathematical mindsets, or the importance of a growth mindset to mathematics and how best practices for mathematical instruction can foster a mathematical mindset in students.

Mathematical Mindsets

The idea of growth mindsets has gained attention in many schools, where teachers emphasize that the brain can grow and change and that students don't enter school with a set of unchangeable strengths and weaknesses (Blad, 2015). Those who believe in a growth mindset, realize that the brain can and does change and that everyone is capable of learning anything if they put in enough effort. In this section, I will discuss how a growth mindset is connected to math learning in what Jo Boaler (2016) has called a mathematical mindset. Furthermore, I will discuss how having a mathematical mindset is imperative to math learning and how number talks support a growth mindset in math class.

When it comes to itelligence, Carol Dweck (2010) has identified two sets of beliefs. The first is that of a fixed mindset. Those who believe in a fixed mindset, believe that intelligence is a static trait, something you are born with. They believe that some students are smart while others are not and that is just the way it is. The other belief of

intelligence is that of a growth mindset. Those who believe in a growth mindset believe that intelligence can be created through enough practice and instruction (Dweck, 2010). Having a growth mindset is important for success in school. Students who have a growth mindset are more likely to be successful in school due to the fact that they believe that their intellect can and will increase with enough practice and focus. Furthermore, students who demonstrate a growth mindset, are more resilient and persistence when it comes to making mistakes and learning. On the other hand, students who demonstrate a fixed mindset are often set back by the mistakes they make as they are concerned about being perceived as smart. Furthermore, they believe that when effort is needed in order to learn, that they must be lacking in intelligence and therefore inferior to other students (Blackwell et al., 2007).

Mathematics is a discipline unlike any other. The idea that one is either good at math or not is engrained in the brains of many, even those who demonstrate a growth mindset in other areas (Boaler, 2016). When adults in particular say that you are either a math person or you are not, you are either born with the skills needed for math or you are not, they are giving students an opportunity to quit math before they have truly had an opportunity to begin their exploration in the world of mathematics. For this reason, it is not a surprise that many (students and adults alike) can put aside the fact they do not understand math and justify it by claiming they are just not a math person. Interestingly enough, those who are unable to read typically fake it or try to hide the fact they cannot read. They do not often claim they just are not a reader (Boaler, 2016).

Research shows this idea is deeply embedded in mathematics and furthermore is passed through generations leaving children with little opportunity or desire to want to

explore the world of mathematics (Dweck, 2016). This fixed mindset that many display when it comes to math may have long lasting, damaging effects. For this reason, it is important that teachers help their students to develop a mathematical mindset (Boaler, 2016). A mathematical mindset is a growth mindset for the math classroom. Through mathematical mindsets, students begin to understand that math is about creativity and exploration and that there are many pathways that can be taken to arrive at a solution. Students also begin to see themselves as having an important role in their own learning (Boaler, 2019).

As discussed earlier in the review, traditionally math in the US has been focused on rote memorization of facts and procedures (Delvin, 2020). This has given students the false idea that mathematics is about performance and that those who arrive at the solution the quickest are the best. This is a dangerous belief not only as it encourages a fixed mindset, but it also takes the reasoning, thinking and creativity out of math (Boaler, 2014). Furthermore, research has found that students who display a fixed mindset often lack number sense and are unable to work flexibly with numbers. Number sense is crucial in mathematics and has been linked to overall achievement in math (Boaler, 2016).

In order to encourage a mathematical mindset, math should encourage creativity and illuminate the multitude of different manners in which people see mathematics as well as highlight the many paths that can lead to the solution of any single problem (Boaler, 2016). Teachers can help their students develop mathematical mindsets by the use of open problems (Blad, 2015; Boaler, 2014). Open math problems are those that encourage students to explore strategies, make connections and explain concepts rather than quickly reaching the solution. Through this exploration, students often will find that

there are many different pathways that can be taken to solve any single problem. Furthermore, students begin to recognize that mathematics is about making sense of concepts rather than quickly solving problems (Blad, 2015). This realization encourages a mathematical mindset as it encourages students to take their time. It acknowledges that mistakes will be made along the way, but that it is those mistakes that enable them to learn (Boaler, 2016). An example of an open problem would be a problem where a teacher asked students to draw three different rectangles with a given perimeter. In contrast, in a traditional or closed problem a teacher may give students dimensions of a rectangle and ask that students find the perimeter (Blad, 2015).

With the development of the Common Core State Standards for Mathematics (CCSSM), teachers began seeing the words fluently and automaticity used often within the standards. When confronted with words such as these, it is easy for teachers to think that closed tasks such as timed tests and repeated practice would foster fluency in their students. However, closed tasks are harmful to mathematical mindsets and there are many more meaningful ways teachers can encourage automaticity in their students that also help students develop conceptual understanding while also deepening students' number sense and encouraging mathematical mindsets. An example of such activities are Number Talks. Number talks improve students' numerical flexibility and increase their fluency through demonstrating that mathematics is about flexibility and creativity rather than following a set of rules and procedures which in turn encourages a mathematical mindset (Boaler 2014).

Marginalized Groups and Mathematics

Inadequacies in math achievement can be found within all cultural groups, however there is clear evidence that there is a gap between the success of white students and those who come from traditionally marginalized groups in math (as well as reading, writing and sciences) (Ladson-Billings, 1997). In this section I will further discuss how to best engage learners from marginalized groups and how to effectively teach challenging math concepts, including multiplication, in order to ensure that students can obtain a deep understanding of these concepts. It is important to note, that throughout this section of the review I use the terms marginalized groups and Urban Learners interchangeably to refer to students from many diverse cultural backgrounds including, but not limited to African American, African, Latinx and Native Americans.

Research has found that the math achievement of students from marginalized groups could be due to the poor instructional strategies, policies, and curricula of the schools that educate them (Ukpokodu, 2011). Oakes et al (1990) found that students from marginalized groups are more likely to be put in the lowest math classes. It was found that as a school becomes more diverse, the fewer higher level math courses are offered. Therefore, students who attend schools with a large population of students from marginalized groups have fewer opportunities to be challenged in math which decreases the opportunities they can be given in college and beyond (Oakes et al., 1990). The sad truth is that when urban learners are given opportunities to take higher level math courses, many decline due to fear of failure (Ukpokodu, 2011). All students from marginalized groups must be given opportunities to be engaged and challenged. They must be given the chance to receive meaningful lessons that provide highly engaging learning activities coupled with high expectations (Ukpokodu, 2011). The traditional

approach of learning continues to be the most common teaching practice found in many urban schools. As discussed earlier in this review, the traditional approach focuses on an objective view of mathematics where there is only one right answer and finding this answer quickly determines if you are a great mathematician. Not only does this type of instruction not fit all learners, it diminishes the importance of culture within mathematics (Tate, 1994) .

Culture plays an important role when it comes to cognition and learning. Culture is the way through which one knows and understands the world. How students learn is directly related to their culture (Bottia et al., 2014) and cannot be put aside or forgotten about. This realization has been noted in other subject areas such as reading and social studies; however, it is just as important in mathematics and must be better incorporated into math classes in order for students to find connections between what they know and mathematics (Ladson-Billings, 1997). Middle class, white culture encourages efficiency and consensus of a majority which tends to fit well into the traditional approach of teaching mathematics where teachers encourage repetition, drills, correct answers and predictability. Students are not often encouraged to think about their prior knowledge or question the rules of mathematics. On the other hand, African American culture values expression, community and movement which are typically not incorporated into mathematics classrooms (Ladson-Billings, 1997). Therefore, African American learners tend to be more successful when they are able to be creative and flexible while interacting and problem solving with their classmates and participating in meaningful classroom discussions (Bottia et al., 2014).

In order to fully engage students from marginalized groups, schools need to move away from the traditional pedagogy and move toward a more culturally relevant pedagogy that takes into consideration the differences in learning styles among different groups. Many urban learners are most successful when they are able to learn in more holistic ways (Bottia et al., 2014; Malloy & Malloy, 1998) as students are able to relate to problems and see how mathematics is relevant in their own lives. Mathematics classrooms that provide this type of learning engage students in inquiry based learning activities where the problems students are asked to solve are realistic and relatable. This need can be met by teachers integrating work problems that are culturally familiar as well as including social issues that are important to students' communities (Ukpokodu, 2011). Students must also be encouraged to use multiple approaches when finding solutions. Furthermore, students must be given opportunities to work together and participate in classroom discourse while working toward the common goal of solving a math problem (Malloy & Malloy, 1998).

Research has found that students from cultural groups including African American, Latinx, Chinese, and Native Hawaiian tend to put the success of the group above the success of the individual. These learners are often more successful when they are given opportunities to participate in group activities and work as a collaborative team when problem solving. They appreciate opportunities to tap into each members' knowledge and abilities in order to learn from one another to solve problems (Gay, 2002).

To be culturally relevant in the realm of mathematics, McGustein et al, (1997) developed three components that teachers must include in all mathematics classrooms. The first component states that students must be critical thinkers. This means that

students must not only be able to think critically about their own thoughts, but must also be able to think critically about other's thoughts. This includes developing arguments, investigating ideas as well as validating and justifying their own thinking and answers. The second component states that students must be able to make meaningful connections from their prior knowledge to their new learning. The third component states in order for teachers to guide students through component one and two, the teacher must get to know their students both inside and outside the classrooms in order to better understand each student, their experiences and their culture.

In order to be successful teachers of mathematics to their urban students, teachers not only need to present learning to students in a way that is conducive to their individual learning needs, but teachers also need to believe that each and every student is a mathematician. They need to guide students in the realization that their prior knowledge is valued and important. Teachers must not only ensure students understand that their thinking and knowledge has value, but that it should be shared. Furthermore, teachers must provide students with a safe classroom environment where sharing and discourse can take place (Jackson & Wilson, 2012; Ladson-Billings, 1997; Malloy & Malloy, 1998).

Now is the time that urban schools need to take advantage of the rich cultural diversity within their classrooms. They must begin to not only appreciate the knowledge that their learners are bringing into their mathematics classrooms, but give learners opportunities to share this knowledge with one another. Educators must begin to understand how culture plays an important role in the learning styles of their students. For many urban learners, this means they must be given opportunities to work in

collaborative groups in order to solve problems that are realistic and matter to them. They must see firsthand how math plays an important role in their lives. They must be given opportunities to explore mathematics and the multitude of pathways that can lead to solutions. In order to do this, they must be encouraged to think critically about mathematics and share their thoughts and justify their solutions through meaningful discours with peers (Ladson-Billings, 1997; Gay, 2000; Malloy & Malloy; Tate, 2005).

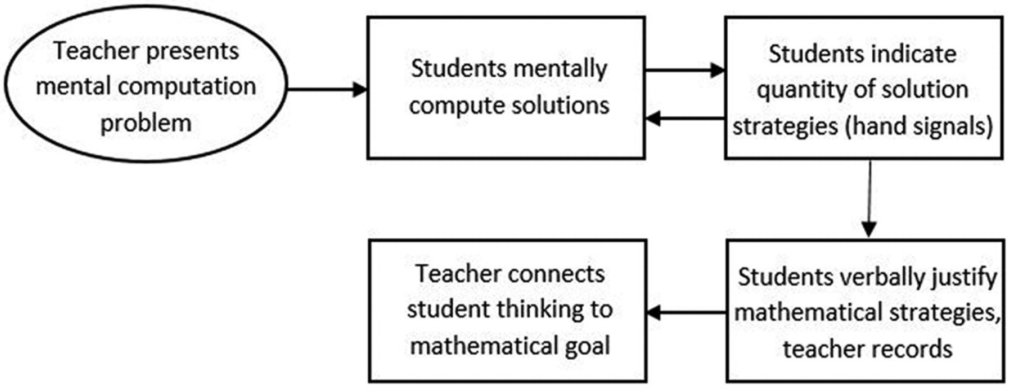
The final section of this review will explore Number Talks as a possible solution to the research question.

Number Talks

Number talks were created in the early 1990s by Ruth Parker and Kathy Richardson (Boaler, 2015). They are short, usually 5-15 minute, teacher facilitated discussions about one purposefully and intentionally, teacher selected, computation problem. Students solve the problem mentally and share their thinking with classmates while the teacher records student responses. Students are given opportunities to justify their solutions, explain their reasoning and participate in mathematical discussions about not only their strategies, but the strategies of their classmates. Through this discourse, students are able to deepen their mathematical understandings and learn from each other. They become aware of the fact that there are multiple strategies and solutions available to each math problem and therefore become more efficient and flexible mathematicians (Humphreys & Parker, 2015; Parish, 2011). Number talks can change perspectives on mathematics. They can take students away from the belief that math is about quickly getting the correct answer, even if how they arrived at the solution did not make sense to them, to an understanding that mathematics can and should make sense. Number talks

allow students to take charge of thinking while realizing that mathematics is open ended and that there are multiple solutions to each problem.

Figure 2



Typical Flow of a Number Talk

(Matney et al., 2020)

Research continues to show that the way in which mathematics is traditionally taught is preventing our students from gaining the knowledge and understanding that is needed to be successful. The traditional algorithms that are commonly taught require very little understanding of mathematical concepts. Students do not need to make sense of the math in order to get a correct answer. The focus tends to be on rote memorization of facts and procedures that are applied without thought. Furthermore, students often dislike math and try to avoid it. Many students also begin believing that they themselves are not good at math (Humphreys & Parker, 2015). Through number talks, teachers can offer students rich mathematical discourse that not only can change their view of math, but that can strengthen their number sense, deepen their mathematical understanding, develop their

mental math skills and encourage creative mathematics where there are many possible solutions to any problem (Boaler, 2015).

In order to successfully implement number talks, teachers must take these five components into consideration: Classroom environment and community, classroom discussions, the teacher's role, mental computation and purposeful computation problems. Number talks are reliant on students taking part in mathematical discourse, it is essential that the classroom environment provides a safe, risk-free environment where students are comfortable and willing to participate in the discussion by not only offering solutions but questioning themselves and their peers while investigating new strategies (Parrish, 2011).

Classroom discussions are the second key component of number talks. Communication is truly the heart of a number talk. Number talks begin with the teacher displaying a problem for students to solve. Next, the teacher gives students the time needed for them to mentally solve the problem. While students are solving the problem, they must communicate with the teacher when they have discovered a solution. To do this, students typically begin with their hands in a fist on their chest. When they have found a solution, they put a thumb up. If more than one solution is discovered, students may indicate this by putting up additional fingers. When that majority of students have discovered a solution, the teacher begins to call on students to share their solution and strategy. While students share, the teacher will write all strategies on the board to be considered by the class. This is the heart of a number talk. Students will discuss, question and investigate strategies to gain a deeper understanding of mathematics, the relationship

between numbers and the flexibility that is really at the heart of mathematics (Boaler, 2017; Parrish, 2011).

The third component of a successful number talk is the teacher's role. Traditionally, teachers have been put in a role of authority where they instruct and pass information on to students. During a number talk, students participate in conversations aimed to make sense of mathematical concepts. They do this through sharing strategies and questioning each other. During a number talk, teachers must act as a facilitator who listens and questions. The teacher must keep the conversation focused on the concept they want students to discover. They do this through posing open-ended questions to guide students as they think critically to make sense of mathematics through reasoning, questioning and exploration (Parrish, 2011).

The fourth component of number talks is the role of mental math. Encouraging students to solve problems mentally is imperative to number talks. Mental computation is a key component of number talks because it encourages students to find relationships and patterns in numbers in order to solve a problem rather than relying on a memorized procedure or algorithm that students are traditionally taught. When students solve problems mentally, they are forced to use what they know about numbers and place value in order to find solutions (Parrish, 2011). Furthermore, mental computation is critical in day-to-day situations when students may need to solve problems in real life situations (May, 2020). During number talks, problems are often written horizontally to help encourage students to build on their prior knowledge (Parrish, 2011).

The fifth and final component of a number talk is purposeful computation. Since the goal of number talks is for students to develop and build on their mathematical

understanding, it is essential that the teacher thoughtfully chooses a problem that will encourage students to elicit the type of understanding that parallels the concept being studied (Parrish, 2011).

Benefits of using number talks. Using number talks as part of the daily routine can support the best practices for mathematics which have been determined by the NTMC (2014) which have been laid out earlier in this review. At the core, number talks are an effective way to increase student's number sense and procedural fluency (Boaler, 2015; Matney et al., 2020; Parrish, 2011).

As teachers thoughtfully determine a high quality problem for students to focus on, they are taking into consideration the first effective mathematical teaching practice, establishing mathematical goals for learning. As the teacher displays the problem for students to compute mentally, teachers are supporting students in productive struggle in learning mathematics, effective mathematical teaching practice #7. While on their search for multiple solutions students are using reasoning and problem solving, effective mathematical teaching practices #2 as well as building procedural fluency through conceptual understanding, effective mathematical teaching practice #6 (NMTC, 2014). Furthermore, as students explore the relationships between numbers, find patterns and make connections between different strategies, they become more flexible as mathematicians (Matney et al., 2020). Their idea of what makes a good mathematician changes from being able to quickly find an answer to thinking deeply about how they got the answer (Boaler, 2015). Finally, this push away from the thought that those good at math find solutions quickly foster a classroom environment where students become more

confident in their math skills as they begin to believe in themselves as mathematicians (Sun et al., 2018).

With Number Talks, students realize they have ideas that are valuable and worth listening to (Humphreys & Parker, 2015). The next part of the number talk consists of students sharing their solutions. By providing students with opportunities to share strategies and solutions teachers are exhibiting effective math practices # 4, facilitate meaningful mathematical discourse and # 8, elicit and use evidence of student thinking. As students share solutions and strategies with their peers, they learn to take risks and become accustomed to making mistakes (Sun et al., 2018). As students discuss solutions and make connections between strategies, they deepen their understanding of mathematical concepts (Parrish, 2011; Sun et al., 2018).

The mathematical discourse that comes with number talks supports the development of a growth mindset in mathematics (Boaler, 2015; Sun, 2018). As students participate in these powerful math discussions, they are proving that they are all capable of being mathematicians. They can engage in, understand and explain mathematical concepts (Sun et al., 2018). Each student is able to share their voice and be heard. When students are given opportunities to be heard, when all students' ideas are valued, math suddenly becomes attainable for all students, and this is especially important for the marginalized groups (Sun et al., 2018). Furthermore, as students participate in discussions and share their strategies, they are given a chance to practice their communication skills as well as their academic language and mathematical vocabulary. This type of dialogue is important to all learners, but has also been found to be especially beneficial for English Language Learners (Sun et al., 2018).

Summary

In order to answer the research question: *How can the use of number talks support and develop a growth mindset and create a deep understanding of multiplication in 5th grade students from marginalized groups?* This literature review explored the themes of best practices for mathematics instruction, cognitively guided instruction, Mathematical Mindsets, marginalized groups and mathematics and number talks.

As discussed in the review, current best practices for mathematics pushes out the ideas of independent, repetitive practice, repetition and memorization of basic facts, formulas, and procedures for more meaningful activities. Activities that encourage students to develop a deep understanding of mathematical concepts through cooperative learning, problem solving, and participating in meaningful classroom discourse all while taking the lead on their own learning as the teacher facilitates.

As the mathematical success of learners from marginalized communities continues to be less than that of their white peers and as a teacher in an urban school, I feel the urgency to transform my teaching to meet the cultural needs of all my students. As discussed in the review, urban learners tend to be more successful when they are given opportunities to be creative mathematicians, interact with peers and participate in discussions about mathematics.

As each theme was explored it became more and more clear that number talks, if implemented accurately, not only can help mathematics teachers teach with a culturally relevant pedagogy, but will give learners from marginalized communities the opportunities they need to find success in mathematics.

As a fifth grade teacher in an urban school, I have noticed that even though many of my students can find a solution to a multiplication problem using the standard algorithm, many lack even a basic understanding of what multiplication is. It is my hope that through answering my research question, I can begin to facilitate my students through an exploration of math that will lead to a deeper understanding of not only multiplication but of mathematics.

Chapter Three will be an overview of my project. In this chapter, I will discuss the theories and framework behind my project. I will also explain my rationale as well as the significance of my project. Finally, I will explain how my unit answers my research question: *How can the use of number talks support and develop a growth mindset and create a deep understanding of multiplication in 5th grade students from marginalized groups?*

CHAPTER 3

PROJECT DESCRIPTION

Introduction

Chapter 2 reviewed the literature related to best practices for mathematics instruction, cognitively guided instruction, mathematical mindsets, marginalized groups and mathematics and number talks. Chapter 3 will provide a detailed description of my capstone project which will address my research question: *How can the use of number talks support and develop a growth mindset and create a deep understanding of multiplication in 5th grade students from marginalized groups?* I will begin by describing my project. Next, I will explain the rationale behind my project followed by an explanation of the setting and implementation for this curriculum.

Project Description

My capstone project is a set of multiplication units that begins with exploration of single-digit combinations and ends with multi-digit combinations. These units have been split into two separate units one that focuses on single-digit combinations and the other focuses on multi-digit combinations. These units incorporate number talks as well as the ideas and strategies of cognitively guided instruction and real-world word problems that can be used to increase the understanding of multiplication while bringing culture and student voice into mathematics. These units were designed to be used in classes that may be newer to, but do have some experience with number talks and cognitively guided instruction. If classes are familiar with Number Talks, teachers do not have to use the more in depth instructions that come alongside these units. Although all problems included in these units may not follow the true routine of number talks, they were

designed to elicit mental problem solving skills, multiple pathways to find solutions and rich mathematical discourse among students where students will not only explain their thinking and reasoning but will question and make connections to solutions found by classmates. All problems included are related to the development of a deep understanding of multiplication as a set of groups. Students will be encouraged to find multiple solutions to problems mentally while staying away from using the standard algorithm of multiplication.

Rationale

Developing a deep understanding of multiplication rather than memorizing facts and procedures must be the focus of the multiplication curriculum in mathematics classrooms. Too often, thinking is taken out of mathematics. This leaves students to follow a set of rules or procedures without an understanding of the math behind the tricks they are taught. This leaves students unable to transfer learning from one concept to the next (Mills, 2019; Steven et al., 2015) and often leaves students feeling as though they are bad at math (Boaler, 2016). In order to put the focus on developing an understanding of concepts back into mathematics classroom, I felt it necessary to develop a curriculum in which students can think, reason and take part in rich discourse in order to not only develop a mathematical mindset, but to develop a deep understanding of multiplication.

A second rationale for this curriculum is that math class is often thought of as a cultureless curriculum. I discussed how this thought is false within my literature review. Math classes built on following the rules and memorizing procedures have been found to be detrimental, especially to students from marginalized communities who often score much lower than their white counterparts (Ladson-Billings, 1997). The curriculum I

designed will aim to bring the culture back into mathematics so that students of all cultures, especially those from marginalized cultures can thrive as they develop an understanding around multiplication that can take them beyond 5th grade and into higher level mathematics courses.

Assessment

As teachers know their students best and tests can be a factor that leads to a fixed mindset (Boaler, 2016), the majority of assessment will be done through everyday classwork and discourse. A rubric will be included to guide teachers in making observations of their students' thinking and problem solving strategies.

Design

I used Understanding by Design (UbD) (Wiggins & McTighe, 2011) in order to create my curriculum. In this model of curriculum planning, the teacher plans backwards using three stages; desired results, evidence, and learning plan (Wiggins & McTighe, 2011).

I began by identifying my goals. The goals for this project were to increase students' understanding of multiplication and increase their growth mindset. Through the exploration of numbers, sharing of strategies and the rich discourse that takes place through numbers talks, I believe this goal will be met.

This curriculum was also designed using the frameworks of number talks (Humphreys & Parker, 2015) and Cognitively Guided Instruction (Carpenter et al., 1996) as well as the ideas of a mathematical mindset (Boaler, 2016) and Culturally relevant teaching strategies (Ladson-Billings, 1997).

Implementation

These units were designed and will be the most successful when implemented in a classroom which has some experience with number talks. However, if classrooms have no experience, this unit may still be successful, it would just be recommended that the teacher previews each of the activities with their students using skills that students have mastered such as addition rather than multiplication. I developed these units with the idea that teachers would start with unit one, single-digit combinations and progress through to unit two. However, it is not necessary for teachers to do this. It is possible to only teach unit 1 or to begin with and only teach unit 2. There are several connections made to unit 1 in unit 2, but if students already have a solid set of strategies besides being able to recall or use the standard algorithm to solve single-digit combinations as well as simple multi-digit combinations such as 12 x 4 teachers may choose to start with unit 2. If students are able to recall single-digit combinations but lack a multitude of strategies including being able to decompose into addends and factors, it is recommended that teachers begin with unit 1.

These units were intended to be used as an entire unit, however, it is also possible that teachers could break apart the lessons and simply use the number talks and problem solving problems and fluency practice activities to supplement with required curriculum. These could also be used after a multiplication unit as a review or in order to guide students to make connections between multiplication and other topics such as division.

These units were designed for use in a 5th grade classroom, however as creating a deep understanding of multiplication is important to students both younger and older than 5th grade, these units may be used at any grade level. These units are intended to be

implemented using number talks routines coupled with problem solving strategies of cognitively guided instruction. While It is not necessary that students and/or teachers have experience with number talks before implementation of this collection, it is imperative that teachers select problems their students have some familiarity with as they begin number talks for the first time.

Evaluation

In order to assess the effectiveness of these units, teachers will use the included rubric and checklist where teachers will be able to record observations of student growth as they progress their thinking and problem solving strategies through the unit. Teachers are encouraged to pay close attention to students during number talks, strategy shares, and class discourse. Most lessons include a problem solving component. Teachers are encouraged to collect these and look over students' strategies each day in order to assess growth in thinking flexibly about numbers. The end of each unit also includes a summative assessment. A large part of this assessment relies on teachers observation during classwork and discussion. Grade will be determined via the included rubric.

Participants and Setting

These units were designed to be implemented in a 5th grade class in an urban school. The school serves students in grades K-6. There are 420 students who attend the school; 32% Asian, 26% African American, 17% White, 14% hispanic, 11% identify as two or more races. 74% qualify for Free and Reduced Price Lunch.

These units were intended for use primarily in a whole class setting. During the 2021-2022 school year, the year this project was designed, there will be two fifth grade sections with roughly 44 5th grade students in all. These units were used by both 5th

grade teachers within their own classrooms. As the teachers planned together some content was taught at the same time, but due to the manner of number talks, both classrooms worked through these units on their own schedule.

Timeline

These units were developed during the Fall 2021 semester and were ready to be implemented in the classroom by mid October, 2021.

Summary

Chapter 3 provided an outline for my project. I described my project in detail and discussed my rationale for the development of this curriculum. I then laid out the frameworks for my project which focus on the ideas of number talks and cognitively guided instruction. Finally, details were given about the implementations of this project including the setting and other important information about the 5th grade students this curriculum was designed for. Chapter four will provide a reflection of the learning that occurred as a result of the creating of my capstone project.

CHAPTER 4

CONCLUSION

Since I began my teaching career, math has always been my favorite subject to teach. Interestingly enough, as a student, I did not like math much. I struggled in class and no matter how much time I spent on my homework each night, I was just not successful. I began to think of math as a special skill that some people were born with and others were not. I began to believe that I was one of the people who were born without the skills needed to be good at math, and therefore no matter how hard I tried, I would never be good at math.

In elementary school, my experience with math was like many others. My teachers focused on speed and accuracy. We were encouraged to memorize facts, formulas and procedures. We would be handed worksheets that were loaded front and back with the repetitive drills and told to complete both sides. We were often taught shortcuts and tricks to help us arrive at solutions quicker and were taught endless catchy songs, jingles and rhymes along the way to help us memorize these tricks, formulas and procedures.

As I entered the world of education, I was introduced to information about how the brain works and how this information was being used to advance the way mathematics was taught. It was suggested that rather than focusing on memorization and speed, mathematics classes should focus on developing a deep understanding of concepts (Boaler, 2016; Mills, 2019; Steven et al., 2015). Furthermore, rather than teaching number facts through repetition, these facts should be developed through engaging activities which have a primary focus on guiding students to a deeper understanding of

bigger mathematical concepts (Boaler, et al., 2015). This information led me to my research question: *How can the use of number talks support and develop a growth mindset and create a deep understanding of multiplication in 5th grade students from marginalized groups?*

In chapter 4, I begin by discussing what my key learnings from my capstone process were from both the perspective of the process as a whole as well as what key takeaways I had from the research and literature review. Next, I discuss both the implications as well as the limitations of my project. Finally, I discuss possible future research/addition project themes I may explore due to the work I have completed throughout this capstone process, how I will determine and communicate my results and the benefits of my project.

Key Learning

I entered the realm of research and research writing with very little experience and lots of anxiety. Although the process was daunting and the work was difficult at times, I feel as though the entire process was very rewarding as I now have many new skills that I will be able to incorporate into my professional work to not only better the education I provide my students but to share with others in the profession.

I had entered my research stage without a clear topic. After reading the book, *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching* (Boaler, 2015), I knew I had wanted to further explore the teaching of mathematics, but my path was still a bit foggy. I was amazed at how much research there was about mathematics and how easy it was to get carried away within the research. Reading this type of research was a new experience for me and it took some

time to figure out how to efficiently weed through the information packed research to find the research that most pertained to my topic. Overall, I really enjoyed reading, learning and making connections between themes found in my research which lead me to my final research question.

I was surprised with how much contradictory information is out there. As I read research, it seemed as though no matter what topic around mathematics teaching I was researching, there was research somewhere that proved it and other research that disproved it. This was a bit confusing and overwhelming for me as I was searching but as I began connecting the themes of math and urban learners, it became easier to find research that helped guide me in the best practices to create my curriculum.

As I began creating my project, which was to consist of a unit to be used to teach multiplication to 5th grade students, my research quickly helped me better focus my idea and the need to create two separate units. Much of my research really pointed to the need to have a deep understanding of basic concepts before being able to connect them to more complex concepts. For this reason, I decided to begin my unit by guiding students to develop a concrete understanding of single-digit combinations before advancing onto multi-digit combinations, which are the focus of 5th grade standards in the state of Minnesota.

Revisiting the Literature Review

As I began reading through research, I was amazed at how much literature there was around math and how easy it was to make connections from one piece to another. There truly seemed to be an endless amount of literature I could have immersed myself

in, if I had let myself. In order to focus my research, I was really drawn to the work of Jo Boaler, Carol Dweck and Gloria Ladson-Billings.

Jo Boaler's book *Mathematical Mindsets: Unleashing Students' Potential through Creative Math, Inspiring Messages and Innovative Teaching* (2015) was what initially sparked my interest in creating a math curriculum that would foster a growth mindset. As I began researching more into a growth mindset I found Boaler's research as well as the many published works of Carol Dweck to be fascinating. Dweck's *Mind-Sets and Equitable Education (2010)* helped me form the theme that math instruction is not necessarily as equitable as some may think. Her ideas lead me to further research math and urban learners which lead me to the work of Gloria Ladson-Billings. Although her work may seem a bit outdated, Ladson-Billings has been calling out the inequities of instruction and opportunities in math, as well as other subjects, for urban learners since the 1990s. She has done much research in the area of Culturally Relevant Teaching and it is her work that inspired me to create units that would better the opportunities for students from marginalized communities.

I was also influenced by the number talk work done by Jo Boaler and Sherry Parrish. Boaler's website *youcubed.org* and Parrish's book *Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K-5* were very useful in the creation of my curriculum.

My time spent digging into research really helped me to form my full research question. I saw lots of work published about math instruction but very little about how math could be tailored to better meet the needs of urban learners. I was able to make my own connections through what I learned about best practices for culturally relevant

teaching as well as those for increasing growth mindsets and flexibility within mathematics.

Implications

During the 2019-2020 school year a small group of teachers throughout my district were invited to participate in training for Cognitively Guided Instruction, although I was not able to attend this training I began noticing that math instruction was in need of a transformation. Fast forward to 2021, CGI has become a focus throughout the district. As one of the few teachers who has been trained in CGI as well as through the research I completed through my capstone process, I feel as though I must share my knowledge with other teachers, not only at my school, but district wide.

I have created what I feel to be a very solid set of units that not only encompass CGI best practices, but is also culturally relevant and fits the needs of urban learners. For my project, I created a set of multiplication units. Even though my units were designed with the needs of 5th graders in mind, the first unit focuses on single-digit combinations. This unit could easily be adapted for use in 3rd, 4th or even 6th grade classrooms. The way my unit was designed, teachers could easily transform any lesson in order to increase or decrease the rigor. In order to decrease the rigor, teachers could easily change the numbers to combinations that are typically easier for students to work with. Furthermore, multi-step problems could be easily transformed into single step problems. In order to increase the rigor, numbers could be changed to include decimals and additional steps could be added to take problem solving questions further.

Many of the ideas in this unit could also be adapted and used to meet the needs of any standard. After teaching my unit(s), teachers would be familiar enough to take many

of the aspects used and incorporate them into any unit on any mathematical concepts. Ideas such as following the number talks routine while completing activities such as Which One Doesn't Belong and 4 Corners could easily be adapted to fit any standard. Furthermore, incorporating a whole group lesson that is rich in mathematical discourse, collaborative team work time and concludes with a strategy share could all be easily incorporated into any unit as well. Finally, the idea that math is about creativity, flexibility in numbers and problem solving can be worked into any unit. Teachers can and should change problems so that they fit the interests and match the culture of the students within their classrooms. This unit was written to match the interests of the students in my class this year and will likely need to be adapted yearly to better match those of each new class that uses this curriculum.

Limitations

The major limitation of this unit is that it takes a step away from using any already created curriculum. For districts that require teachers to use certain resources to teach from or require that certain math books be used with students, this unit may create a challenge as it steers in an opposite direction of many text books. For districts that do require that teachers use a particular curriculum, I would recommend that teachers assign just a few problems from the required textbook or ask the students to think differently about the work assigned. Crossing out and rewording directions could transform any pre-written work. The biggest limitation of doing this, is the idea that culture is not added into the work. In order for students, especially those from marginalized communities to truly understand the work that they are being asked to think about, is if they have a true sense of the situation each problem is asking. Too often questions may involve a sport,

item or food that not all students have a schema for. If students get stuck on what the sport might be or get stuck on vocabulary work, this can create a barrier preventing students from being able to access the math within the problem.

Future Research/Projects

After completing this project and seeing how well it has been taken from not only my students but from other teachers who are teaching the unit, I am energized to continue this work. I have a goal of adding in aspects of this unit across all 5th grade math standards. I am excited about how adaptable the activities are and how they can truly be used across many grade levels and with many different standards.

As I learned in my initial research, it is important that all students, especially students from marginalized groups be able to connect to and deeply understand the ideas, situations, and topics of any question they are being asked to apply learning to. For this reason, I will continue to modify the topics of the questions found within my unit in order to meet the cultural interests of my students each year. I would like to continue my research to find even more activities that could be included as I begin creating lessons to cover new standards.

Communicating Results

My units have a couple goals that I will be looking at in order to assess effectiveness. The first goal was to increase a growth mindset or mathematical mindset. Students took a math thoughts questionnaire before the start of the units. This questionnaire was collected, graded and filed. After the completion of the second unit, students will again take the math thoughts questionnaire. The results will be compared to

those of the first round in order to assess if students' mindsets are beginning to change around math.

The second goal of my unit was to develop a deep understanding of multiplication. This will be assessed through multiple outlets. Teacher will use the included ruric to observe students through class discourse through which the teacher will be able to observe how students are thinking about numbers, their flexibility and if they are making connections between what they know and their new learning. Students will also be completing problem solving work most days. This work should be collected each day in order for the teacher to observe students' thinking and strategy around the math concepts. The goal is that over time, both the teacher and students will be able to see growth in both strategy and thinking around numbers and math.

A third goal of this unit was to increase student automaticity within single- digit combinations. This goal can be assessed through both discourse and problem solving work as students should begin recalling single-digit combinations as they are solving the work. The end of unit 1 exam will also include a fact fluency and strategy check that teachers will give one-on-one with students in order to assess where students are with their automaticity and strategies.

All goals will also be assessed within the end of the unit test. My goal for this test was that it would feel more like classwork than an actual exam. Teachers will use information from both the end of the unit exam and more formative assessments given throughout the unit to compile students' grades according to the included rubric. The intention is that by having enough concrete data via the math thoughts questionnaire, the single-digit combinations fluency and strategy check, problem solving work and unit

exam, student will be able to see their growth and become more energized about who they are as mathematicians,

Benefits to the Profession

Research has indicated that teaching for memorization of facts and procedures may be harmful to students as it sends an idea that math is about speed and accuracy. Rather, math should be about creativity and flexibility showcasing the many possible ways to solve problems. Furthermore, in my research I found not much research had been completed around math instruction and urban learners. The majority of the research I found was around how urban learners learn best, not specific to mathematics. It appeared to me that not much had been created to not only advance student flexibility in math, but to also support and advance learners from marginalized communities. Having taught the past 8 years in an urban school, I have read a lot about culturally relevant teaching (CRT) mostly when it comes to reading and social studies, but have seen very little about CRT and mathematics. Using what I have learned through my research, I have created what I believe to be a unit that will advance and challenge the way all students think about mathematics using techniques, activities and topics that have been shown to be successful with urban learners.

As stated earlier in this chapter, my curriculum will benefit students and teachers across many grade levels as it has been created in such a way that it can easily be adapted and transformed to meet the needs of many classrooms at many different levels. Teachers may use the ideas, routines and activities as guides to create curriculum that meet the needs of their students.

Summary

My project was created to answer the question: *How can the use of number talks support and develop a growth mindset and create a deep understanding of multiplication in 5th grade students from marginalized groups?* Through my research and the process of creating and implementing my curriculum in my 5th grade urban classroom it became clear that math instruction does need to be culturally relevant. Students need to be able to connect with mathematics. They need to be able to make connections and visualize in order to make sense of numbers. Students need to be given opportunities to be the creative thinkers they were before they entered schools. They need to feel successful and hear not only their own voice but the voices of their peers within their classroom. They need to not only be given time they need to make connections and develop an understanding of concepts taught, but need to feel as though they have the time they need. Mathematics is not about speed but rather being able to think flexibly about numbers in order to make the numbers given work for you.

To answer my research question, I created a curriculum based on the Minnesota State Standards in Mathematics for grade 5 around Multiplication. This curriculum includes activities that are rich in mathematical discourse through which students will explore the flexibility of numbers, learn to use what they know to solve what they do not know, share strategies, defend their thinking, change their thinking, make mistakes and ultimately develop a deep understanding of multiplication. Students will participate in a number talk daily, as well as a whole group lesson followed by time to work collaboratively in teams in order to solve problems. This curriculum will hopefully be the starting point for students to begin to view mathematics differently as a subject they are

capable of being great at and for teachers to have an example of how to create more units that are culturally relevant and capable of transforming mathematics for their students.

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