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Cognitively Guided Instruction Strategies For Strengthening Fifth-grade Students Understanding Of Fraction Concepts

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by

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CHAPTER ONE

Introduction

Overview

Mathematics is a life skill because it goes beyond just calculating numbers and finding out properties of specific shapes. As teachers, the skills we are trying to teach in math class also become a regular part of our daily lives. Mathematical concepts often influence the decisions we make without consciously realizing that we are using math.

Most of my teaching experience involves fifth grade students in elementary school. During daily teaching, my comfort level with fifth graders in subjects like language arts and science or social studies are comparatively higher than math. I believe that students are born curious, and they naturally have questions wondering how everything works. The format of the questions might appear differently, but a teacher's job in the classroom should be to guide students' minds through the journey of learning. When students can draw knowledge from their questions, their learning will be authentic, and the knowledge they will gain will resonate with them the longest and the most.

Usually, in a fifth-grade math classroom, the student body contains multiple levels of skills and understanding of math knowledge. After five years of experience, I have learned that students in a fifth-grade math classroom also bring in different problem-solving strategies since they all have been 'doing math' for many years. During math lessons, it is significantly challenging to guide the whole math class moving forward with students at different skill levels. Therefore, teachers face demand for differentiated instruction consistently. For instance, it was brought to my attention that my fifth graders often struggle with fraction concepts and operations. Even though they have been exposed to fractions concepts in earlier grades, their

ability to work with fraction concepts is noticeably far from concrete. Negative reactions from students are commonly observed when learning concepts involving fractions because they have 'learned' fractions before, however they still 'don't get it,' which is a phrase students use a lot when they have problems with certain concepts.

My goal for this Capstone project is to explore some instructional strategies for mathematics that are effective for fifth-grade students and thus answer the question: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.* I am looking forward to using my new capstone project to increase students' understanding of fraction concepts.

Throughout the following sections of this chapter, I will discuss my personal experience with mathematics learning as a student throughout my education; my experience teaching fifth-grade math. I will examine issues students have in learning fraction concepts; teacher's challenges with teaching fraction concepts in a fifth-grade math classroom. As well as some possible directions for me to create helpful fraction teaching activities for fifth-grade math.

My Journey in Math

Throughout my learning journey with math as a student, I mostly remember the skill but have very little memory of how I learned. Most of my math teachers applied the lecture method teaching a whole group math class. When I was learning math in Chinese elementary school, during math lessons, math teachers usually started the lesson by introducing a concept in word definition, followed by a formula, figure or graph. After a mini lesson, students would work with sample questions under the teacher's direction, followed by more questions. A significant part of the math class time was used drilling; answers and solutions would be provided by the teacher after work. The math curriculum was built around different question types towards concepts, the

learning goal was for students to know or memorize ways of problem-solving steps not strategies. This is how Chinese schools teach math throughout 12 years of basic education.

After years of training in the Chinese education system, my math skill was built to solve math problems efficiently with working problem-solving steps, lacking the ability to understand the essential questions starting with 'how or why'. For example, I knew steps to find out multiple variables in algebra equations, but I will have trouble explaining the process. The time I really started to develop pedagogy on introducing and teaching math skills in different ways was when I started teacher training in the U.S. seven years ago.

My current math class consisted of students with math skills on their grade level and below grade level based on the leveled math instruction models. The district groups students with high math skill levels in one accelerated math class; this class is taught with a curriculum that is one level ahead of students' current grade level. The district will place students who didn't meet the accelerated math requirements in grade-level math classes sections. This grade-level math section combines students with skill levels vastly different from each other. Some students are very skilled in math but didn't have an excellent enough test performance to enter accelerated math class. Some students have historically low performance in math. Most student population in this math class falls between the two ends mentioned above. In this leveled math class, different student's math skill level combination asked for a high need for differentiated instruction in the classroom. During math lessons, it is common for students to show different speeds when picking up new concepts. The way I have been taught math will not have success in this situation. The challenge I am facing is how to engage students with different skill levels during math lessons and grow students' understanding of new concepts effectively. The teaching practices I have been implementing in my math class included, guided math, leveled grouping,

flipped classroom, and some student-centered activities. Often, after I have tried every method to explain this. If students still didn't get it, I have to go back to the old-fashioned ``I write-you-copy." Students will copy down the ‘correct steps’ from the board and try to memorize steps as their problem-solving strategy. The scenario I mentioned was quite frequent in my math class. However, math in fifth grade is driven heavily by the scope and sequence of math concept knowledge, sometimes forcing teachers to make those hard decisions. Teachers are under the pressure to make sure students master and understand versus without having enough time to help students explore their full potential in math. facing this challenge, I have been thinking about how to integrate more student-centered instruction in math and build a math instruction that is more inquiry-based, student-centered, and engaging.

Fraction Concepts in Fifth Grade Math Curriculum

Fraction concepts and operation is a big unit in my school's current fifth-grade math curriculum. Students are exposed to fraction concepts starting third grade in elementary. As a result, they know how to divide a whole number into different groups, and they know some typical fractions. However, a lot of my students still fear fractions, especially when we are introducing concepts like equivalent fractions, common denominators, and mixed numbers because they don't understand how they work they mix up the parts. They don't know what they mean and what we do with them.

Often fifth graders show difficulties understanding and representing fraction relationships. They are confused about the roles of the numerator and the denominator and the relationship between the two. When asked to compare fractions, the inconsistent strategies they used showed that their knowledge is far from solid. They also didn't understand why and how to make equivalent fractions and why we need a common denominator when adding and

subtracting fractions. The last piece of the fifth-grade fraction learning is multiplying fractions; knowing you multiply the two fractions numerator by numerator denominator by denominator is easy but explaining why is incredibly challenging.

Research Question

My research question is: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.* To find a promising direction that will guide my research, I will look into the current math curriculum our school implements and examine it under the scope of inquiry-based learning and Cognitively Guided Instructions. My project will be to create a series of teaching activities rethinking how to teach fraction concepts effectively. The project will focus on three state fifth grade academic standards that are related to fraction concepts. Guidance of the project lesson design will be under Cognitively Guided Instruction (CGI) strategies. The goal of the project is for students to increase their understanding of fraction concepts.

Summary

Throughout this chapter, I reflected on my history with mathematics, as a student and later as a teacher. I discussed some possible reasons that make learning fraction concepts difficult for fifth-grade students in my math classroom. In the following chapters, I will investigate how to design math instructional activities or mini lessons that will help students understand fraction concepts better, emphasizing Cognitively Guided Instruction strategies.

Next, in chapter two, I will investigate how elementary students learn fractions, particularly fifth graders' learning experience in fractions. I will be searching for good strategies that teachers already apply in math classrooms to help with fraction learning. I will also be

looking into the world of Cognitively Guided Instruction (CGI) to find more approaches to strengthen students' understanding of fraction concepts.

CHAPTER TWO

Literature Review

Overview

In chapter one, I shared my experience in learning math and teaching math teaching. Fraction learning plays a significant role in fifth-grade math education. In chapter one, I tried to identify challenges in the fifth-grade math classroom when it comes to fraction teaching and learning. With this rationale, the research question evolved: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.*

In chapter two, I will examine and discuss literature related to the research question. In this chapter, fraction's role in fifth grade math education will be examined, problems that fifth graders will encounter during fraction learning will be identified, the uniqueness of learning fraction with the Chinese language will be discussed., and the current existing approach of teaching fraction concept will be checked. When teaching fraction concepts, math anxiety about the content cannot be ignored. When trying to answer the question: What is the math fraction content in fifth grade? I will use my district's curriculum and a state math standard from an upper Midwest state. How does math anxiety grow? I will discuss this question from both the students' perspectives and the teachers' perspectives. Cognitively Guided Instruction (CGI), a new approach to guiding students through math learning, brings new possibilities to teaching math content. This chapter will also discuss CGI's definition, why CGI is relevant in fraction learning, and look at some CGI strategies in fraction learning. Hopefully, examining the current literature will guide the research question.

Fractions in Fifth Grade

Why fraction is important for fifth grade math

The importance of fractions extends beyond the math class in school. National Mathematics Advisory Panel (NMAP) also agrees reasoning and sense-making are essential components for using mathematical knowledge to evaluate multiple sources of information and to make informed decisions that affect daily living and engagement in civic activities. An area in mathematics critical for building mathematical knowledge and reasoning is developing children's foundational knowledge of fractions. Understanding fractions is also a building block for developing students' algebraic reasoning and sense-making (NMAP, 2008;) It is very common to see in fifth-grade math classroom there are students who think fraction concepts and procedures seem to have no link to one another and for whom meaning-making in fractions is a challenge (Pitsolantis & Osana, 2013). This is not surprising because research has shown that fractions are one of the most difficult elementary school math topics to teach and learn in ways that are meaningful (NMAP2008). There are at least three reasons why the ability to deal effectively with rational numbers is important: they improve one's ability to understand and deal with situations in real world, provide a rich ground for children for developing the mental structures necessary for continued development, and are the foundations on which basic algebraic operations are based (Post, Behr, & Lesh, 1982).

Many research efforts over the past decade have focused on improving the teaching and learning of fractions for students in elementary and middle grades. It seems that many teachers agree that teaching fractions can be complex and confusing, but that understanding fractions is a necessary skill for students to have as they get older. (Grossberg, B. 2019) Grossberg also expressed the concern that math concepts such as fractions that student do not master in the early grades can go on to confuse them later on and to cause them a great deal of math anxiety. Many math teachers do not realize that the language of math can be confusing to students and that

students must understand the concepts behind the language. With common core standards in place, students who attend public schools now must learn to divide and multiply fractions by fifth grade.

Fraction knowledge is foundational for learning algebra (Booth, Newton, & TwissGarrity, 2014). As such, fractions are a critical aspect of mathematics education in the elementary and intermediate grades (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010; NMAP, 2008). The National Mathematics Advisory Panel (NMAP, 2008) also named fraction learning as a high priority in early schooling to prevent difficulties with secondary-level mathematics topics. Proficiency in algebra paves the way for success in science, technology, engineering, and mathematics (STEM) college courses and vocations (National Mathematics Advisory Panel [NMAP], 2008).

The research on fraction's meaning to students' math learning highlighted fraction should be considered a very important part of fifth-grade math instruction, especially knowing that fifth-grade students are leaving elementary school to the next level; a concrete knowledge base will help greatly. Since fraction is a concept that has been touched and mentioned multiple times starting early elementary, it doesn't make sense to reteach fraction concepts as a designated lesson. I choose to create small learning activities for fraction concepts for this Capstone project. Teachers will be able to use this tool based on student needs.

Fifth grader's challenge when learning fraction

The foundation for understanding fractional numbers begins at the elementary level (Common Core State Standards Initiative, 2010). Based on Flore (2020) cited, as in the primary grades, standards reference halves and equal shares. In third grade, students identify fractions and compare them when given different models. For example, an area model to fill equi

partitioned shapes to represent fractions. Without foundational understanding, students will struggle with complex standards as they advance from grade to grade (Charalambous & Pitta-Pantazi, 2007).

Another hurdle to students' success with fractions stems from the vocabulary that is unique to fraction work (Chick, Tierney & Storeygard, 2007). The lack of ability students have with remembering vocabulary terms demonstrates the deeper issue that students actually do not understand the meaning behind the words.

As (Sharp & Welder, 2014) found out, students often resist the transition from whole numbers to fractions; this limitation can compound their tendencies to lean on whole numbers and limit their awareness of how strategies that work with whole numbers can be extended to work with fractions.

Additionally, Trivena, et al. (2017) found out after interviewing and surveying 23 fifth grade students, their results showed that student's mastery-concept on addition and subtraction dominated by category 'misconception.' They have concluded that fraction addition and subtraction skills of students in fifth grade are still low. This situation would likely impact students' attitude to fraction thinking.

Research on the teaching and learning of fractions over more than 15 years has identified difficulties students have with these numbers (Kouba, Zawojewksi, & Strutchens, 1997; National Research Council, 2001) and strategies for overcoming these difficulties (Cramer & Henry, 2002; Cramer, Post, & delMas, 2002; Moss & Case, 1999).

Teaching fractions continues to be a major challenge faced by elementary and middle-school teachers. Another concern was raised by Pitkethly and Hunting (1996) but more specifically in an accusatory manner toward educators with their comment that the concept of

grasping fractions as numbers is something that students, as well as teachers, have a difficult time understanding. This outcry exemplified the importance of teachers understanding fractions to aid the process of teaching and learning.

All these issues have occurred in students' fraction learning over the years. The negative reactions students have toward concepts involving fractions because they have 'learned' fractions before, but they still 'don't get it', which is a phrase students use a lot when they are having problems with certain concepts. So, it is crucial to change students' attitudes in fraction learning if we are aiming at increasing students' understanding. Learning fraction concepts are also a significant resource of Content Anxiety, which I will discuss later in the chapter.

Making sense of fraction

McNamara (2015) defines Fraction sense as a concept that implies a deep and flexible understanding of fractions that is not dependent on anyone's context or type of problem. Fraction sense is tied to common sense: Students with fraction sense can reason about fractions and don't apply rules and procedures blindly, nor do they give nonsensical answers to problems involving fractions. In Grades 3 through 5, instructional considerations for developing fraction sense include a priority and focus, in terms of understanding fraction equivalence and magnitude, including comparing and ordering fractions, understanding, and using fraction benchmarks, and computational estimation with fractions. (Gersten & Jordan, 2017)

To build fraction sense, Rodrigues, Dyson, Hansen, & Jordan, (2016) concludes after extensive research suggested the use of number lines to build fraction sense. Instructional activities should involve a limited number of denominators and be set in a meaningful context to sustain students' interests. Advancing students' fraction knowledge puts them on a firmer course for algebra success. The number line as a key instructional representation for whole numbers and

fractions alike, especially for teaching and enhancing understandings related to the size or magnitude of numbers (Gersten, R., & Jordan, N. C.(2017)). (Rodrigues, Dyson, Hansen & Jordan, N. C. 2016) Also recommend the use of number lines to build fraction sense. Instructional activities should involve a limited number of denominators and be set in a meaningful context to sustain students' interests. Advancing students' fraction knowledge puts them on a firmer course for algebra success.

As research suggested, the challenge has always laid on the section of fractions in math learning. It is essential to identify different students' possible fields of improvement. Because in fifth grade, everyone's foundation will be different. That's the reason focusing on individual needs will bring max effectiveness. The Chinese language has uniqueness when talking about numbers. The relationship between Chinese language and fraction concept will be discussed to see if the Chinese immersion setting will play an important variable role in the project.

Minnesota Math Standard for Fifth Grade

In fifth grade, with a different version of textbooks, curriculums, and approaches, all the K-12 public schools in my state need to follow our state's academic standards. Students in fourth and fifth grade need to take the state's comprehensive academic test in math. The state standards and the standardized test have provided ideas for the teacher on what content should be delivered to students.

Our state math standards for math have listed two standards which include nine benchmarks for students to achieve before finishing fifth grade. Students are required to be able to read and write fractions, order fractions including mixed numbers and improper fractions, locate fractions on a number line, recognize and generate equivalent fractions in various contexts, add and subtract fractions using efficient and generalizable procedures, model addition

and subtraction of fractions using a variety of representations, estimate sums and differences of fractions to assess the reasonableness of results, solve real-world and mathematical problems requiring addition and subtraction of fractions. (MDE, 2007)

According to the specifications for math State Comprehensive test, in fifth grade, during the online test, students will work on 10-14 items related to fractions that correspond to the state standards. The number of fractions questions take up over 30% of the test (MDE, 2007). Therefore, whether the student has a good understanding of fraction concepts determines the student's testing performance in the MCA. It makes teaching and learning fractions a critical component in the mathematics curriculum for fifth-grade educators and teachers.

Our state standards and benchmarks including the state test specifications reflect the purpose of this capstone project, how to design a math curriculum/unit that will strengthen fifth-grade students' understanding of fraction concepts.

Chinese Language and Fraction

The Chinese immersion program happens to be the setting of the math class . It is commonly believed that there is some performance difference in terms of academic achievement in math comparing Chinese immersion with regular English elementary classrooms (Fortune, 2016). Next, the author will try to look at mandarin Chinese uniqueness and if fraction expression has a different formation in Chinese compared with English.

The Uniqueness of Mandarin Language

Mandarin Chinese is the official language in China and Singapore. It is the most vastly used language in the world. It is also considered one of the hardest languages to learn as a second or foreign language. Studies by the Foreign Service institute show that, as a native English

speaker, it takes at least 2,200 hours of intensive study, which equals 88 weeks and a year plus eight months to master Mandarin.

Unlike English or other phonetic-based languages, Mandarin Chinese is character-based. (Fortune, 2012) Each character is presented as an individual unit with its own pronunciation, tone, and meaning. Learners need to memorize all the elements to comprehend a single character. Character combinations have more extended meanings as the pronunciation or tone might also differ as the context changes (Moser, 1991). Therefore, for any learner who tries to learn mandarin as a foreign language, it will be a tough journey.

Fraction and Chinese language

The setting of the capstone research is a fifth-grade math classroom in a Chinese immersion program. Historically, students from Chinese Immersion programs outperform students from English language classrooms. Fortune (2012) says, when it comes to standard tests, Chinese immersion students whose first language is English can reach their grade level or even outscore their non-immersion peers in English reading and math tests. "Several characteristics of the Chinese language, particularly the structure of its number and counting systems, have been credited in aid of acquisition of number terms and concepts in children" (Chang, 2008, p.3). According to (Su 2019) It is a similar case in fraction. Fractions can be expressed either as parts of a whole (half, quarter, etc.) or as decimal fractions. In English, parts of a whole are stated as "XX parts of YY," with XX being the parts of the whole and YY being the whole. An example of this is saying "two parts of three," which also means two-thirds. However, the phrase construction is the opposite in Chinese. Parts of a whole are stated as "YY 分之 XX." The pinyin of 分之 is "fēn zhī," and is written the same in both traditional and simplified Chinese. Note that the number representing the whole comes at the beginning of the

phrase. One-half can be stated as either 一半 (yī bàn) or using the phrase construction mentioned above: 二分之一 (èr fēn zhī yī). There is no Chinese equivalent to the term one-quarter besides 四分之一 (s ì fēn zhī yī).

After reviewing related studies, it is safe to conclude that Chinese immersion and Chinese language will not post a significant difference in the project. Students in Chinese immersion programs perform better than English language grade peers as a group. Students who are in the regular grade-level section of math class have an even smaller difference in terms of math performance. The project will be developed in English language here so that the project can benefit a bigger audience.

Mathematics Anxiety

What is Mathematics Anxiety?

In 2002, Ashcraft M. defined the phrase math anxiety. It describes the feeling of tension, apprehension, or fear that interferes with math performance (Ashcraft, 2002). In this research, Ashcraft noted that people who have high math anxiety tend to avoid math for academic choices. They tend to get lower grades in math tests, with low motivation in math learning. Their attitude towards math is also negative. Individuals with high math anxiety are often not confident when their career paths heavily rely on math skills. Ashcraft also stated that math anxiety does not indicate one's intelligence. For individuals who have higher math anxiety, the IQ score does not reflect their real intelligence performance because the test includes many quantitative questions.

One other fact Ashcraft found in the research is that people with high math anxiety show lower math achievement and competence. Because of the avoidance and lower self-confidence in learning math, highly math-anxious people are trying not to be exposed to math learning at school. And when math content is taught to them, they learn less. Their performance is

comparatively worse than those who do not have math anxiety in math standardized test (Ashcraft, 2002).

Sian Beilock conducted research that shows that math anxiety is not only about poor math performances. Through a brain scan, researchers found that when people with high math anxiety are getting ready to do the math, their brain area gets active, which is the same area when they are approaching physical body harm (2012). It means that the feeling of math anxiety is like physical pain. It also indicates that math anxiety emerges not only when doing the math problems but also when thinking about doing math problems.

Other than students, teachers also experience mathematical anxiety. Researchers believe that the reasons for mathematics anxiety often include situations in which current and future teachers in elementary school are not experts in mathematics (so they have limited mathematical knowledge and little confidence in mathematics and in teaching it), as well as them having had negative experiences as students (Bekdemir, 2010). Teachers will need effective strategies to help them with math instruction practically on the sections that commonly believe are 'hard' like fractions.

Impact of Math Anxiety

The effect and impact of math anxiety on one's psychological and physical conditions have been stated in many pieces of research. The previous literature indicates that the reason why people with high math anxiety perform lower in the standardized test is not because of lack of mathematical skills, but more due to the high stress when they cannot show their full potential.

Blazer (2011) described the physical, phycological, and behavioral impact on individuals who have high math anxiety. Physically, when math anxiety occurs, ones' heart rate will increase, hands might get shaky, stomach will get sick and head will feel dizzy. Psychologically,

when doing math problems, people who have high math anxiety will have a hard time concentrating, feel helpless and disgraceful. Behaviorally, avoiding math classes, procrastinating math homework, and not engaging in math classes are commonly seen among high math anxiety groups.

Andrews & Brown (2015) stated in their research that teachers' daily instructional practices and assessment procedures increase students' mathematical anxiety. In elementary school, students' assessment results are not the major focus, so, compared with students in middle school and high school, elementary students are less stressed. Considering the students in fifth grade who have gone through the most assessments, understand the importance of testing scores and transition to middle school. They are more likely to be anxious about their math performance in elementary school. For students who are learning fractions in fifth grade, teachers need to make sure that students grow fewer negative feelings on the fraction concept.

To explore more related research to answer the guiding question of the project: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.* It is necessary to examine the strategies that teachers can apply in their daily teaching to make sure that students have a positive attitude toward fraction concepts.

How to Reduce Students' Math Anxiety

Hembree, R. (1990) conducted a study looking at Nature, Effects, and Relief of Mathematics Anxiety. His research used a serious data collection method to look at mathematics anxiety and students' math performance. Hembree also explored the effectiveness of various treatments for mathematics anxiety. Findings from the research suggest that mathematics anxiety has been reasonably prudent in adopting test anxiety's theoretical base for mathematics anxiety. Like test anxiety, mathematics anxiety seems to be a learned condition more than behavior.

Teaching strategies and teachers' attitudes have a great positive impact on students. Some types of treatments Hembree looked at include: Classroom interventions; attempted to relieve mathematics anxiety within whole classes. Reductions in mathematics anxiety levels were sought through changes in the curriculum or through psychological interventions. Psychological treatments were behavioral or cognitive in nature. Behavioral modes proposed to relieve 'emotionality' toward mathematics (feelings of dread and nervous reactions). Cognitive treatments were set to relieve expressed concerns or worry about the subject. Cognitive-behavioral treatments attended to the worry factor but also provided elements to reduce emotionality. Based on the findings, Cognitively Guided strategies will be the step to addressing mathematics anxiety in fraction learning.

Other researchers have found that teachers' teaching strategies have significant impacts on students' math anxiety. Blazer (2011) also examined many pieces of research, and the following approaches could help students reduce math anxiety.

1. *Develop strong skills and a positive attitude toward math.*
2. *Relate math to real life*
3. *Encourage critical thinking*
4. *Encourage active thinking*
5. *Accommodate students' varied learning styles*
6. *Place less emphasis on correct answers and computation speed.*
7. *Organize students to cooperative learning groups.*
8. *Provide support and encouragement*
9. *Avoid putting students in embarrassing situations*
10. *Never use math as a punishment*

11. *Use manipulatives*
12. *Use technology in the classroom*
13. *Use manipulatives*
14. *Use technology in the classroom*
15. *Dispel harmful but popular misconceptions*
16. *Use a variety of assessments*
17. *Prepare students for high stakes testing sessions. (Blazer*, 2001)

Cognitively Guided Instruction

What is Cognitively Guided Instruction (CGI) strategy?

In my fifth-grade math classroom, there is a combination of students with different levels, differentiation in the classroom. Students have a different speed of pick-up new concepts, as well as different models of problem-solving. The challenge teachers face is how to fully engage students with different levels of skills to grow when starting every new concept. In such a learning environment, rethinking how teachers teach is vital. Cognitively Guided Instruction strategies provided answers to the challenge. CGI was developed by Thomas Carpenter and Elisabeth Fennema through a research project at the University of Wisconsin-Madison in the early 1990s. CGI itself is neither a curriculum nor instructional design. Rather, the primary goal of CGI is to help teachers acquire knowledge of children's mathematical thinking and then to consider how teachers can use children's knowledge to design and implement instruction (Carpenter et al., 1998, 1999; Hiebert et al., 1997). A large body of research indicates that conceptual teaching strategies as part of an inquiry-based approach such as CGI (Carpenter et al., 1999; Hiebert et al., 1997; Kazemi & Štipek, 2001) provides a large number of benefits during instructional activities.

Teacher's role in Cognitively Guided Instruction (CGI)

Based on the learning from how to reduce mathematics anxiety, teachers can play a very critical role during math learning; CGI suggested the teacher is the facilitator in the classroom of students' mathematical learning through exploration and discussion with peers. "A classroom rooted in CGI philosophy uses problem-solving as the main vehicle of mathematics instruction and understanding" 27 (Wedekind, 2011, p.29). In CGI classrooms, teachers pose mathematical problems and observe how students solve them; they use the information gained to make conclusions that allow them to differentiate instruction to an appropriate developmental level (Hu et. al., 2014). CGI is naturally carter to a class environment when students consist of a variety of skill level, problem-solving strategies, and knowledge background in math learning.

Although the CGI does not prescribe teaching methods, the teachers who have undergone this professional development (referred to as CGI teachers) deepen their knowledge of how children intuitively solve problems and are more likely to use a problem-solving approach to teaching mathematics to elicit mathematical thinking in their classrooms (Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996). Research has shown improved problem-solving ability in classrooms taught by CGI teachers (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989) and has additionally confirmed this benefit for the sub-populations like English language learners.

Cognitively Guided Instruction strategies and fraction

As Carpenter and Fennema pointed out, we all learn by building on what we understand. Children connect new ideas in mathematics, such as fractions, to ideas they already understand, such as splitting and sharing. We educators have tended to understand the power of supporting children to make these kinds of connections for themselves. Carpenter et al. describe CGI as "understanding how children's mathematical thinking develops and reflecting on how to help

children build up their concepts from within" (1999, p. xiv). Carpenter et al. (1999) also state that CGI seeks to create a classroom environment where children are encouraged to develop strategies and utilize procedures that are meaningful to them instead of determined by the teacher.

Carpenter et al. (1999) mapped the developmental sequence that most students follow when they solve various problem types. This sequence is that first, students will directly model a problem to solve it, then as they develop, they begin using counting methods. The last strategy to develop is using number facts to solve a problem. CGI is able to meet the varied needs of students through the types of discussions that occur as students explain their mathematical thinking. During this process, students are exposed to ideas at levels both above and below their own level of understanding, and there are a variety of viewpoints for students to be able to relate and connect to.

As Empson, S. B., & Levi, L. (2011) mentioned in their book. In CGI's vision, the process of exploring children's thinking provided the opportunity to deepen their own mathematical knowledge along with their own ability to think flexibly and creatively about mathematics problems. With CGI strategies, we will be able to:

1. Building meaning for fractions through problem-solving and discussion

2. Understanding the progression of children's strategies for solving fraction and decimal problems

3. Designing instruction integrating algebra into the teaching and learning of fractions

CGI strategies' meaning also presents both sides of teaching and learning. As a study done by Vacc, N., & Bright, G. (1999), Students can develop fragile mathematics knowledge that

produces correct answers in some contexts, even in early elementary school, but the knowledge may not transfer. Teachers can establish delicate knowledge about teaching fractions in some contexts that may produce behavior consistent with CGI principles, but this behavior may not transfer to all teaching contexts. It is meaningful to add CGI strategies into the curriculum development stage to increase the effectiveness of teaching.

The Cognitively Guided Instruction model has proven its potential on reducing barriers that lie in students' learning on fractions in fifth grade. Foundation understanding, uniqueness of the vocabulary, the connection between concept and procedures, and teacher's understanding of fraction concepts all have their own place under Cognitively Guided Instruction. Along with an upper Midwest state's public schools' instructional framework, CGI will make a great potential model/approach towards my research question: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.*

An upper Midwest Suburban School District's Instructional Framework

Our district's Teaching and Learning Instructional Framework represents this school's instructional core values. The eight interconnected dimensions of the framework have all been identified by the school board as vital to the student experience. Based on these expressed values, the Teaching and Learning team has built a set of tools that are designed to help district teachers create learning experiences for students that are highly engaging. The framework's levels of complexity help teachers stretch what they are currently doing in ways that will increase engagement and help connect student learning to the world around them.

Education is in the process of an important disruptive transformation. The 21st-century workplace looks and feels much different, and it demands a different skill set. The framework helps build student experiences that are rich with the skills that lead to success in the 21st-

century workplace. The goal is for students to have the interpersonal and interactive skills to bring that knowledge to life in situations where they are applying their learning to solve unique problems.

The levels of complexity are expressed in a continuum to guide lesson planning. As teachers reflect upon a lesson or create new learning experiences, identify an appropriate level of complexity. The complexity level should always be directly related to a learning outcome. In many cases, less complex experiences are more appropriate than more complex experiences.

Learning experiences that are further along the continuum provide students with opportunities to develop these dimensions at a more complex level.

Consider the following questions when choosing a level of complexity:

- Where are students currently in their understanding?
- What are the learning objectives and goals for the lesson/unit?
- What level of complexity will best move students toward a deeper understanding of the content?

Based on the framework's suggestions from Minnetonka Public, S. (2016) Cognitively Guided Instruction fits three of the frameworks at a high level:

Authentic and Real-World Learning: Students are engaging in authentic and real-world learning when they define and develop solutions to problems they have encountered or are likely to encounter in their lives or when they complete a task for which they have not received explicit instruction.

Critical Thinking: Students are thinking critically when they systematically go beyond knowledge reproduction to analyze, synthesize, evaluate, or organize information in ways that generate understanding that is new to them.

Personalized Learning: Students are personalizing their learning when they choose the content, product, and or process for their learning, and when they set and monitor their own learning goals.

This upper Midwest public schools' instructional framework has provided a strong scaffolding when working on the design of teaching activities. It will guide me through the process of making useful learning activities for fraction instruction.

Summary

Fraction makes up an exceptionally large portion of the mathematics standards for fifth graders in Minnesota. As this chapter has touched on earlier, students will have a better experience of success as mathematical concepts based on fractions become more difficult in middle and high school. After reviewing the literature on difficulties on learning fractions for students, Math Anxiety in math learning, Cognitively Guided Instruction, and my district's instructional framework. The goal of this capstone project is to design learning activities to improve students' understanding of fraction concepts. Hopefully this project could address issues that have been identified in research to improve students' learning experience in fraction concepts.

In the next chapter, I will outline the methods for creating those learning activities, including the participants, and setting, designing principles and models of the segment, content, format, and teaching procedures.

CHAPTER THREE

Methodology

Overview

In this chapter, I will outline in detail and discuss how I will use my research and learning from chapter two to answer my research question: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts*. As I stated in chapters one and two, learning fraction concepts has been a challenging part of the fifth-grade math journey for many math learners. Hence fifth-grade students' performance on solving fraction problems has been low. Another perspective of my finding pointed out that teachers' lack of practice and knowledge in fractions also affects their experience in teaching the fraction concepts. This is also a chance for me to review my math knowledge about fractions from a curriculum perspective to deepen my own learning. Additionally, my own district has been introducing a new teaching and learning framework and UbD design for a reforming effort of the current curriculum. This project will be meaningful work to provide examples of how a small part of the new format of curriculum could look like under the new design.

For my project design, I will create eight mini lessons with learning activities, focusing on improving fifth grade student's understanding of fraction concepts. Hopefully, this project could address issues that have been identified in research to improve students' learning experience in fraction concepts. I will be addressing three fifth grade state math standards in number operations that related to fraction concepts (Minnesota Depart of Education, 2008):

> 5.1.1.1 Divide multi-digit numbers, using efficient and generalizable procedures, based on knowledge of place value, including standard algorithms. Recognize that quotients can

be represented in a variety of ways, including a whole number with a remainder, a fraction or mixed number, or a decimal.

5.1.2.3 Order fractions and decimals, including mixed numbers and improper fractions, and locate on a number line.

5.1.2.4 Recognize and generate equivalent decimals, fractions, mixed numbers, and improper fractions in various contexts.

When designing the learning activities, the idea of Cognitively Guided Instruction will be incorporated in lesson models and activities. The structure and scaffolding of the lesson will be under a upper Midwest suburban district's Instructional framework's requirement. The final lesson plan format will be based on UbD design.

Setting and Students

The setting of this curriculum will be in a on grade level fifth-grade math class in a public school district. Math classrooms in the fifth-grade Chinese immersion program are very much like the English classroom in this upper-Midwest suburban public school district. In this upper Midwest suburban school district, math instruction is leveled based on students' historical math test performance. Usually based on the performance, students will be leveled into accelerated groups and grade level groups. Students in the accelerated math group will be provided a math curriculum from sixth grade because students already went through the fifth-grade curriculum when they are in fourth grade. Students in the grade-level group will be receiving grade-level instruction with a fifth-grade math curriculum.

Every student in fifth grade possessed a certain level of math problem-solving skills and math knowledge base. In regular grade-level math groups, this characteristic is very much noticeable. Students in a fifth-grade level math group will contain students who are ready for

more new knowledge, students who need more time to work on skills in order to gain bigger progress, and students who are in need of extra support to keep growing. During the fraction concept segment of math lessons, it is common for students in one class group to adopt graphic, number line, and number algorithms.

Math class for a grade level group usually contains about 20-25 students depending on the size of the student body. At our school district, daily math lesson time for an elementary student schedule is 90 minutes which consists of instruction time, activity time, and work time. Last year in my fifth-grade class, math was scheduled for a 70-minute block daily; my grade level also has 20-minute work time set aside by the end of the day. Math intervention or additional support also utilizes that time period. This project will be designed to be used during math class as mini lessons or teaching activities in math supportive time.

One other difference is the education setting will be under a Chinese language immersion program. As I mentioned in Chapter 2, some facts we want to recognize including Chinese immersion students group have higher math performance in general (Fortune, 2012). Also mentioned in chapter 2 that fraction has a different way of expression in the Chinese language, which gives students a different perspective when learning fraction concepts. When teaching fractions in fifth-grade Chinese immersion l, it is safe to assume students have this understanding and vocabulary since they have been taught math in Chinese for five years. Other than the vocabulary, students in fifth-grade level math class process similar skill levels compared with their English grade-level peers. When creating those learning activities, I will use English so that language will not be a variable.

The main math curriculum our school district adopts is Everyday Mathematics version 3. Our school also chooses Singapore Math curriculum as supplementary and differentiation

options in math class. Usually, 12 units of fifth grade Everyday Mathematics version 3 curriculum will be covered during one school year. Among those units, Unit 5 Fractions, Decimals, and Percent, Unit 8 Fractions, and Ratios are the two units that are closely related to fraction concepts. State math standards will also be addressed in these units. Another purpose of this capstone project is to examine these two units and the related material our district has in place, review and recreate new or improved teaching segments for these two units that address the research question: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.*

Designing Principle and Approach

With the setting and student group that I am working with, there are principles that I would like to try during my project. The core value of this project is under the district's teaching and learning instructional framework. This framework contains eight interconnected dimensions, which have all been identified by the school board as vital to the student experience. Based on these expressed values, the Teaching and Learning team has built a set of tools that are designed to help district teachers create learning experiences for students that are highly engaging. This principle is an answer to one of the big challenges in math classrooms, how to design a curriculum that attracts students with different learning styles and problem-solving skills.

Three in eight of the framework dimensions will be take into consideration during the designing process:

Authentic and Real-World Learning: students are engaging in authentic and real-world learning when they define and develop solutions to problems that they have encountered

> or are likely to encounter in their lives, or when they complete a task for which they have not received explicit instruction. (Minnetonka Public, S. 2016)

Fraction is one of the math concepts that is very close to life events and problem-solving practice. Fractions are one of the most important topics students need to understand to be successful in algebra and beyond.

> Critical Thinking: students are thinking critically when they systematically go beyond knowledge reproduction to analyze, synthesize, evaluate, or organize information in ways that generate understanding that is new to them. (Minnetonka Public, S. 2016)

When designing an instructional segment for students based on Cognitively Guided Instruction, the student will be constantly asked to provide solutions and answer questions using their own understanding of the problem.

> Personalized Learning: students are personalizing their learning when they choose the content, product, and or process for their learning, and when they set and monitor their own learning goals. (Minnetonka Public, S. 2016)

Personalized learning falls naturally with the project since I will use Inquiry based ideas and UbD model. The goal is to improve students' understanding of fraction concepts.

Cognitively Guided Instruction (CGI) strategy will be the major approach to creating this project. At the core of the CGI approach is the practice of listening to children's mathematical thinking and using it as a basis for instruction. CGI's research focused on (a) the development of students' mathematical thinking; (b) instruction that influences that development; (c) teachers' knowledge and beliefs that influence their instructional practice; and (d) the way that teachers'

knowledge, beliefs, and practices are influenced by their understanding of students' mathematical thinking". Fraction is a spiral concept that has been taught throughout elementary school grade levels. Students naturally processed different backgrounds towards this concept. With CGI, the problem of different levels of student's knowledge-based will be addressed effectively since CGI investigates where students form in terms of math thinking.

The project will be created following the Understanding by Design model from Wiggins and McTighe's work: The understanding by design guide to creating high quality units (2011). The instructional segment will be created with the result in mind as named by Wiggins and McTighe as backward design. The result of the project will be to increase students' understanding of fractions and create ways to verify the result.

In general, the process will be divided into three stages. The first stage will be to identify desired results (Wiggins & McTighe, 2011). During this stage, the teacher will need to select the standards the students will need to demonstrate understanding of the content knowledge. The requirement will be drawn from our state math standard for fifth grade in the number and operation section's fraction concept-related standards.

The second stage of Wiggins and McTighe's curriculum design approach is to determine acceptable evidence (Wiggins & McTighe, 2011). This stage requires the teacher to think of different demonstrations of understanding. I will work on checklists, activities, and maybe assessments to provide effective evidence.

Plan learning experiences and instruction (Wiggins & McTighe, 2011) will be the last stage. Teachers will now work towards creating valuable lessons and activities. Which the product might have a different format, one possible direction is mini lesson itself could be used

as an independent activity for students who need to review that part of knowledge at a convenient timing.

Content and Format

My goal is to work on a series of mini lessons with learning activities that fifth-grade math teachers can use during math lessons to tackle the challenge of teaching fraction concepts. Those activities can be used as part of the regular whole class lesson to the unit. This tool can also be used as a refreshment in small groups or supportive groups for students with questions about fraction concepts. Hopefully, the product will be addressing my research question: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.* Also, I hope the material I created is something my colleagues can easily pull out and use when needed.

According to our state's math standard, those standards will be closely related to fraction concepts (Minnesota Depart of Education, 2008):

> 5.1.1.1 Divide multi-digit numbers, using efficient and generalizable procedures, based on knowledge of place value, including standard algorithms. Recognize that quotients can be represented in a variety of ways, including a whole number with a remainder, a fraction or mixed number, or a decimal.
>
> 5.1.2.3 Order fractions and decimals, including mixed numbers and improper fractions, and locate on a number line.
>
> 5.1.2.4 Recognize and generate equivalent decimals, fractions, mixed numbers, and improper fractions in various contexts.

This instructional segment will contain several components. There will be a pre-lesson activity to assess students' current understanding of fraction concepts and get an understanding of

the student's knowledge background. During this segment, student's way of math thinking will be closely examined to help instructions coming up next.

With the guidance of CGI, a student-centered approach will be adopted in learning activities in my project. I will start with what your child already knows and builds on their natural number sense and intuitive approaches to problem-solving. Under CGI and UbD's guidance, the instructional segment will focus on students' previous knowledge and problem-solving skills. The lesson design will include guided questions along the way. So that teachers can build skills that make sense to students based on their own level. Sharing and discussing lessons will be the feature of this project, let students share their problem solving strategies will deepen their handle of fraction concepts.

Summary

This chapter is about the methodology of my capstone project. In the chapter, I also provided information about the setting of the classroom and the students that this project is intended for, designing principle and approach about the process, and lastly, content and format of the project. Chapter four summarizes the curriculum writing process to answer the research question: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.*

CHAPTER FOUR

Conclusion

Overview

This chapter serves as a place for reflection on the key learnings and on the process itself throughout my capstone project. This capstone project experience provided an opportunity for me to grow myself professionally as a teacher and researcher. During the development of this project, my understanding of related literature was extended and deepened with new reflections. The impacts, limitations and future directions of the project are also discussed in the chapter. In conclusion, I also recognized the impact this capstone project has brought on my professional skill level of teaching math in fraction for fifth grade.

The goal of this capstone project is to create mini lessons with learning activities that improve students' understanding of basic fraction concepts with the guidance of Cognitively Guided Instruction (CGI) strategies. It was an effort to answer the research question: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.* For my project, I have developed 8 mini lessons for fifth grade math class focusing on basic fraction concepts identified by an upper Midwest state's fifth grade math academic standard. An instructional framework from an upper Midwest suburban public school district provided scope on the level of complexity. The lesson plan structure in the project followed the framework of Understanding by Design (Wiggins & McTighe, 2011). My project included lesson plans, teaching slides, knowledge reviewing videos, CGI student work analysis tools, related online learning platform skills.

Professional Growth

During chapter one of the capstone, I reflected that as a math learner, my experience was quite different from U.S. students. My learning was more focused on mastering problem solving steps and remembering concepts as it was the style of Chinese math education. Over the years I entered the U.S. K12 educational system and started teaching math five years ago. I had the opportunity to examine what I learned from a different perspective. I had a solid knowledge base of certain math concepts, but lacked a method to show students how to get there. My background provided me with only the steps to the problem but little strategies of problem solving, let alone considering multiple strategies to solve similar math problems. This capstone project has opened an opportunity for me to advance my learning about fraction as a math concept itself, the state math standards related to fraction concepts , strategies of teaching fraction concepts and learning models that engage fifth graders in a difficult topic. Math anxiety was a new idea I encountered during this capstone experience. Learning about this concept helped me gain a deeper understanding of student learning experience in my fifth-grade math classroom. Math anxiety provided me with more perspectives to better help learners in my math class. students came with a variety of range of skill levels and widely different attitudes towards math learning. My biggest learning about math anxiety was not only about poor math performance, but it also had a broader impact on students' learning, mental health, and even physical comfort. This capstone project has reminded me of the importance of fostering a healthy and development appropriate math class. The challenge of creating engaging teaching strategies in a multiple level math classroom is significant, while there lays the responsibility. The capstone experience also grew my confidence and understanding of facing the challenge for developing a more learning rich math classroom.

This capstone is a valuable experience as a student, a teacher and future researcher. This capstone experience included developing a research topic, examining and reading related

literature, deciding on a research method, and creating a capstone project was uniquely rewarding to me in terms of academic life.

As mentioned previously, I was born and raised in China, until I finished my undergraduate degree. I moved to the U.S. in 2007 but since then I didn't have many opportunities to conduct academic research under the American higher education framework before I started this capstone project. Graduate level academic research experience was a new adventure for me, I was not familiar with academic writing or styling or formatting. Over the process of this capstone project, I was given a chance to work on my academic writing, literature research, APA style formatting, rules of citations and organizing academic papers. By reading other colleagues' graduate work, I developed a sense of how the project should look like. During my literature review period, I was opened to a vast range of readings that tremendously extended my professional understanding in the field, other than what related to my research, I also located many topics of interest that I would for sure explore in the future. By trying out myself on those academic work, I learned how academic projects are created. Academic writing posts different sets of wording and sentencing, which aim at helping my writing be more accurate and meaningful. By working with other colleagues and professionals, I was able to gain other's great knowledge and learn about different experiences colleagues have as educators or learners. I also appreciated the chance to work in a group environment, not only I learned from my colleagues, but also, I could become a contributor to others.

Literature Findings

My research topic was developed from my experience and current needs in my math classroom. In fifth-grade math class, fraction is a big topic and students' performance was limited. Trivena, Ningsih and Jupri (2017) have found out in an interview that students' mastery-

concept on addition and subtraction dominated by category 'misconception.' This reflects what's happening in my math class. Students have a hard time explaining how they solve fractions problems, their problem-solving strategies are very inconsistent. I agree with Sharp and Welder (2014) that students often resist the transition from whole numbers to fractions; this limitation can compound their tendencies to lean on whole numbers and limit their awareness of how strategies that work with whole numbers can be extended to work with fractions.

During my research, I found out that difficulties of learning lead to math anxiety. The situation of low achievement and low motivation are not unusual in my math class due to the reason that students in my math class consist of a variety of math skill levels. Because of the avoidance and lower self-confidence in learning math, highly math-anxious people are trying not to be exposed to math learning at school. And when math content is taught to them, they learn less. Their performance is comparatively worse than those who do not have math anxiety in math standardized tests (Ashcraft, 2002). Researchers like Blazer (2011) have found that teachers' teaching strategies have significant impacts on students' math anxiety. In order to better help students in my class, I investigated instructional strategies that are suitable to the situation.

Fifth graders came to fifth grade math class with different levels of math skill levels based on their previous learning experiences. Number of the students already have certain strategies for math problems. I believe I need to investigate instructional strategies that focus more on students. Cognitively Guided Instructional (CGI) strategy was mentioned by another scholar. The primary goal of CGI is to help teachers acquire knowledge of children's mathematical thinking and then to consider how teachers can use children's knowledge to design and implement instruction (Carpenter et al., 1998, 1999; Hiebert et al., 1997). A large body of research indicates that conceptual teaching strategies as part of an inquiry-based approach such

as CGI (Carpenter et al., 1999; Hiebert et al., 1997; Kazemi & Štipek, 2001) provides many benefits during instructional activities.

I also examined literature that explained why fraction is important. My current students are from a Chinese immersion program. I also investigated the relationship between Chinese language and fraction. After reading the literature, I decided to create the capstone project in English to benefit a bigger audience. An upper Midwest state's academic standard was used to determine what fraction concept will be reviewed in the capstone project. During project creation, the framework of Understanding by Design (Wiggins & McTighe, 2011) was adapted for design of the lesson plans.

Implications

My capstone project is designed to provide students in fifth grade math class another chance to further their knowledge of fraction concepts. With different levels of knowledge to start with, students had different learning outcomes after regular math curriculum was taught. In addition, my capstone project was designed to help students looking back to what they had processed in certain math problems. With integrated sharing and discussion time in class, students will be able to have their skills to be polished again with deeper understanding of what strategies they already own. For students who did not have solid problem solving strategies with fraction concepts problems, they have got a chance to learn about strategies that their peers own. Students will have better reception when the problem-solving strategies are from a classmate.

With the tools provided teachers will also have a chance to check students' learning progress. One of the tools was the lesson plan designated a time for student strategy conference. By conferencing with students, teachers will have a chance to develop a solid problem-solving

strategy with students. Students' confidence level will increase, teachers will feel more comfortable moving on to the next level of skills in teaching.

This project could have another implication of changing students' problem-solving mindset by guide them look back into what they have when facing math problems. Fifth grade students all came to math class with previous experience with math and pre existing conditions or attitude towards math. By enabling them to provide their own strategies, this capstone project could provide a mindset for students to start looking back at what they know first, then ask questions. Teachers can have a new role as guides to students for self-development in math learning.

I would like to try this project out in my math class first in order to find out more places to improve and perspectives that have not been touched. I also plan to share this project with my grade level team and our math support teachers. The project was created with the purpose of being used with flexibility, feedback from different settings will be incredibly beneficial. After more feedback the next step is to share the project with my district's math chair, to see if the idea of the project will have any value in the upcoming math curriculum review process.

Limitation

A potential limitation for my project is the time needed for application of the project, since the project was intentionally designed as supplementary materials for math class. The model of conferencing and discussion will ask for more instructional time from a busy fifth grade schedule. The length of each lesson is limited to 20 minutes to suit a learning segment or a time slot of a small group instruction. Application of the project can be flexible, it can be used as a mini lesson for the whole class, or as a small group lesson for math group time, or a math support teacher can use the project with smaller student number settings like math support time.

The preparation of the discussion part of the lesson also asks for some time for teachers to collect students' work and analysis with CGI worksheets. My argument is that the time spent is meaningful for teachers to have a closer look at students' work and their strategies. With better understanding of your students, there is more time saved during the lesson when teachers know where students are at.

Another potential limitation could be students' participation in a pair or in a group, also students' hesitation of sharing their own problem-solving strategies. The lesson design of the project includes multiple segments for students to share and discuss their work, which is beneficial for students to internalize the math skills. Teacher's role will be important, the teacher needs to foster an environment where students will feel comfortable sharing and working together. Teachers also need to set the tone of work together as well as help each other during lesson, be mindful of grouping or pairing students together will help for student participation. It is crucial for students to share what they have and help each other, only when students are activated at their close cognitive level, will they have the best chance of gaining solid progress.

Future Research

In the future, I would like to research more about the Cognitively Guided Instruction (CGI) strategies. I am interested in how CGI ideas can be applied in broader math learning, what are other ways to use CGI in other parts of math learning. Let students better understand themselves and give teachers more opportunity and tools to understand their students will create an organic learning environment for the classroom. I want to learn more ways to apply this learning strategy to help students be more successful in the math classroom.

I would also like to learn more about math anxiety and other ways to reduce math anxiety for students. Upper elementary school math classrooms certainly have more anxiety triggers than

lower elementary, harder math knowledge, more standardized tests, moving to middle school. How can teachers help reduce those anxiety benefits not just in math classrooms, but also help students' mental and physical health. Taking into consideration what we have been through the past school year, for example, COVID pandemic has raised the awareness of students' mental health to a new level. I believe not only we have to pay attention to students' health under threat. By making learning more relaxed and less stressful, students will have a better chance to be healthy and balanced with their school life.

Conclusion

This capstone project helped me better understand my path towards math and the reason why math is not easy for certain individuals including myself. I can teach math for fifth grade, but the experience always left me with questions on why certain situations happen during teaching in class and how to improve. Therefore, I took the challenge and set my research question: *How to design math activities that will increase fifth-grade students' understanding of fraction concepts.* After I went through a process of reflecting, researching, drafting, and editing, the whole experience of this capstone also helped me change my mindset on learning and teaching math as a subject. This shift has allowed me to feel more successful not only in teaching math, but also facing future challenges as an educator.

I would like to address my appreciation to this wonderful opportunity that I could grow as an educator. I will keep this piece of work growing and hopefully it will develop into a more meaningful product in the future.

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