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How Culturally Responsive Teaching Can Support Small Group Math Instruction

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HOW CULTURALLY RESPONSIVE TEACHING CAN SUPPORT SMALL GROUP MATH INSTRUCTION

by

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To my fiance Erin, and my family, I couldn't have made it through this process without your support. Thank you to my students and coworkers for inspiring me to be a better teacher every day.

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CHAPTER ONE

Introduction

For this project, the author studied culturally responsive teaching methods and mathematics instruction strategies applicable to teaching fractions to third grade English Learners (ELs) in a small group. Throughout his career as an educator, the author consistently observed the need for additional EL math support . Therefore, the guiding question addressed by the author's capstone project is *How can culturally responsive mathematics strategies be implemented in a small-group EL setting?* The research conducted in this project was used to create a small-group fraction curriculum designed for third grade ELs.

Overview

In this chapter, the author will set the stage for the project to come. In his background section, he will share the story of his evolution as an educator, as well as providing insight as to why he chose this particular focus. In addition, he will provide a summary

English Learners (ELs)

Throughout this project, the author will use the term English Learner (EL) to refer to students whose first language is not English and who are in the process of learning English. This term is interchangeable with the acronyms ELL (English Language Learner), and ESL (English as a Second Language). These additional acronyms may pop up during the literature review or the when

describing the capstone project, but please be aware that it is the same group of students the author is referencing.

Background

Different cultures have always fascinated the author. Growing up and going to public school in a large city in the upper Midwest, he made friends and went to school with kids whose families were from all around the globe. He learned from an early age that there are many different ways to view the world and reality. This knowledge has matured into an admiration of these methods, and a desire to understand how these views interact with the world. This desire underscores his practice as an EL teacher, and was the initial reason why he decided to work in education after college.

Living in Japan

After graduating from university in 2010 with a B.A. in Political Science, the author moved to Okinawa Prefecture, Japan to work as an Assistant English Teacher (AELT) at a private junior/ senior high school. He knew no Japanese, or anybody who lived in Japan, but he wanted to get out there and see what it would be like living in a culture that was completely unknown to him. It turned out to be one of the most formative experiences of his life.

Okinawa is the largest island of the Ryukyu Archipelago, a group of islands in the East China Sea extending from the southern tip of Kyushu, Japan to Taiwan. Independent until 1879, the Ryukyuan people are distinct from the ethnic Japanese of the mainland, with their own culture, customs, language, and religion

(Kerr, 1958). Historically, the Ryukyuan people have been oppressed by the mainland Japanese government, treated like second-class citizens by mainland society, and subject to the de jure suppression of their language and culture (minorityrights.org, 2018).

An example of governmental inequity can be seen in the number and disposition of foreign military bases on Okinawa. Despite heavy opposition from the prefectural government and local population, there are a large number of US military bases on Okinawa. All decision making over the location and size of these bases is done by the central government of Japan, and as quoted from minorityrights.org:

> "This reinforced the feeling among many Ryūkyūans that they have disproportionately been made to pay the price of continued US military presence, including the loss of use and enjoyment of their land because of the discriminatory policies of the central government." (2018)

Additionally, Ryukyuans face racism from mainland ethnic Japanese. In fact, the author was told quite casually by ethnic Japanese both on Okinawa and on the mainland that Ryukyuans were backwards, primitive, lazy, and shiftless. This view is reflected in mass media as well (IMADR & AOCHR, 2017).

The leaders of the school where the author worked were fully cognizant of this discrimination, and made it clear to the staff that a goal of the school was to combat the stereotypes and racism that Okinawans faced, and to show that

Ryukyuan students were as capable as ethnic Japanese students while still celebrating their unique cultural identity.

One way this was achieved was through the success of the school's judo and baseball teams on the national stage. Being only one of five schools in the country to win national championships in these two sports gained the institution a reputation for sporting excellence. The author taught some students who played for the baseball and judo teams, and when asked, they said a major motivation to compete on the national stage was to show the mainlanders what Okinawans were as talented as they were.

This pride and determination was evident in the academic side of the school as well. Teachers were intimately involved in ensuring academic success for their students. Many of the teachers were native-born Okinawans, and understood the pressures and obligations these students were under. Other teachers were mainland Japanese who had moved to Okinawa. They learned and adapted curriculum to help their students. These educators worked long hours, meeting with students before and after school, volunteering to head student clubs, and sacrificing their personal lives to make sure their students had the best possible opportunity at success in life.

The school also incorporated a native martial art, Karate, into its curriculum. Students would be able to choose from three different styles of the martial art, and community experts would be invited to the school to help instruct the students as well. The aim behind incorporating the martial art was to stoke

pride in the native Ryukyuan culture as well as to impart discipline and self-confidence in the students.

While working at this school, the author was privileged enough to witness how much a dedicated group of educators and students can achieve. Students had a strong connection to their cultural identities, and used the hurdles facing them as motivation to achieve success. This incorporation of cultural identity and cultural pride into the academic identity of students is something that had a big impact on the author and informs his practice to this day.

Return to the United States

In 2012, the author returned to his hometown and immediately applied for TA positions, eventually getting hired as an ESL TA at an elementary/middle school, and enrolling in a graduate program with the aim of getting his Masters of Arts in ESL.

His time working at this urban charter school is what stoked his desire to pursue this project. Contrary to what he had seen in Japan, and what he was learning at university, students' cultural identities were not being respected or acknowledged in the classroom. The cultures of the students and the community surrounding the school differed greatly from that of the staff of the school, and little to no effort was made by many of the staff to be sensitive to, or even learn about these differences.

Working as an 1-1 aide with newcomer students made the author especially cognizant of this dissonance. Students would come into school directly

from a refugee camp, with little to no experience in a formal-learning classroom, and were held to the same proficiency standards as their peers who had years of formal-learning experience. When these students did poorly on the state assessments, they were blamed for the failure. A culture of deficit thinking flourished at the school, and students' socioeconomic statuses and ethnicity were given as reasons for low success at the school, with little reflection done of teaching styles or mindsets of the teachers.

An area where this was especially apparent was mathematics. Newcomer students and others with limited English proficiency were at a disadvantage with the language implicit in traditional mathematics curriculum. Students sometimes didn't know the symbols of mathematics themselves. There was no coordination between the content teachers and EL teachers, and so an opportunity was lost to build academic language. Content teachers felt pressured to teach to the standards, and to stay on schedule. As a result, few attempted to differentiate content.

After several years in this environment, the author attained his teaching license, and left. He was hired at a suburban elementary school, where the school and school district have a distinct focus on educational equity. Here, too, however, newcomers and English Learners with low English literacy proficiency struggle with mathematics.

Project Rationale

To best address the guiding question of *How can culturally responsive mathematics strategies be implemented in a small-group ESL setting to support*

struggling learners, the author decided that designing a 3rd-grade small-group fractions curriculum with culturally relevant teaching strategies at its heart would be an appropriate project. This decision was made because much like their fellow ELs in other grades, 3rd-grade EL students have significantly lower proficiency rates in mathematics than their native speaking grade-level peers. These lower proficiency rates have been observed in two of the three tri-annual FASTbridge tests implemented by the district this year, as well as by their classroom teachers. In addition,

Summary and Preview

In this first chapter, the author provided the context and grounding of his practice. His guiding question is rooted in these experiences, and asks *"How can culturally responsive mathematics strategies be implemented in a small-group EL setting?*". The intention is that the research he does improves his teaching and gives himself and his colleagues culturally responsive strategies.

In Chapter 2, the author did substantial research to answer his guiding question. He explored the history and cultural underpinnings of Culturally Responsive Teaching. Also, some common differences between traditional Western-style formal education and the types of learning students from diverse cultures experience were defined. Additionally, implementation strategies of Culturally Responsive teaching were examined. Furthermore, the phenomena of European American Mathematics was examined and contrasted to mathematics systems from non-Western cultures. Additionally, potential barriers to student

understanding of fractions were discussed, and strategies to address those barriers were presented. Finally, the state standards for math were analyzed, and state assessment scores for ELs at both the state and school level were compared to those of the general student population.

Chapter 3 focused on the process of creating a culturally responsive curriculum. In this chapter the goals for the project were highlighted, a more detailed explanation was given of the context in which this curriculum will be taught. Additionally, this chapter detailed the frameworks used for the curriculum designed, and provided details of what the finished project contained. Finally, the timeline for implementation was enumerated upon.

In the final chapter, the initial goals of the project were revisited and contrasted with the outcomes from the finished curriculum. The guiding question was referenced, and the findings from the curriculum were analyzed to see if an answer was attained. Notes are made of the limitations of this capstone project and recommendations provided for future scholarship, and future potential implementation.

CHAPTER TWO

REVIEW OF LITERATURE

Overview

In the first chapter, the author provided the context and grounding of his practice. His guiding question is rooted in these experiences, and asks *"How can culturally responsive mathematics strategies be implemented in a small-group EL setting?*". The intention is that the research he does improves his teaching and gives himself and his colleagues culturally responsive strategies with which to better provide instruction for his students. In this literature review, the author explored the materials and resources that enabled him to create such a curriculum.

The first section of this chapter provided an overview of the concept of culturally responsive teaching, as well as a look at the history of its development as a pedagogy. The second section of this chapter examined the complex and varied paradigms of learning which students from diverse cultures must navigate in our schools. The third part of this chapter explored various strategies used in the implementation of culturally responsive teaching in the classroom. In the fourth part of this chapter, a review of mathematics considerations was conducted, analysing European American Mathematics, defining potential barriers to student achievement and detailing strategies that could be used to overcome said barriers. In the fifth part of the chapter, the state mathematics standards are analyzed, and

the standardized math scores of EL students from the school site are compared to those of other ELs on both a district and state-wide level.

Multicultural Education

Educators have long been aware of the need to develop an effective approach to educate students for whom the systems had not been designed, as embodied in Abrahams and Troike's (1972) call for teachers to recognize that the diversity of their students was a resource to be used, not perceived as an impediment (p.5). As Gay (2000) states, this belief in the value of using diverse cultural referents permeated the thinking of the educators who were instrumental in shaping the multicultural education movement from the 1970s forward (p.26).

Multicultural education is an idea, an educational reform movement and a process (Banks, 1997). A major aim of multicultural education is to ensure reform in schools and other institutions of education so that students of diverse cultural backgrounds can experience educational equity (Banks, 1993, p.3). Culturally Responsive Teaching (CRT) is an essential facet of multicultural education as manifested within the classroom.

Culturally Responsive Teaching Origins

According to Gay (2000), culturally responsive pedagogy or Culturally Responsive Teaching (CRT) has been a central part of multicultural education since its inception in the early 1970s. Culturally responsive pedagogy arose due to concerns over the racial and ethnic inequities that were apparent in educational opportunities and outcomes which continue to this day (p.26). The Bilingual

Education Act of 1967 and the *Lau v. Nichols* (1974) Supreme Court decision requiring students to be taught in their primary language paved the way for federal funding for the design and implementation of bilingual and ethnic studies curricula which, in turn, have contributed to the development of multicultural education (Harmon, 2012, p.6).

Culturally Responsive Teaching Defined

In her 1994 book *The Dreamkeepers*, Dr. Gloria Ladson-Billings defined Culturally Responsive Teaching (CRT) as a pedagogy that recognizes the importance of including students' cultural references in all aspects of learning. As Gay (2000) states, Culturally Responsive Teaching (CRT) is a pedagogy focused on facilitating not only academic achievement but also on social and cultural empowerment. It incorporates into academic instruction the ways of knowing, understanding and communicating that are unique to various cultural and ethnic audiences. It encourages cooperation, communication and mutual responsibility for education among students and between students and teachers. Finally, it integrates high-status cultural knowledge into school subjects and skills, empowering the many diverse cultures of the learners (p.43).

Culturally Responsive Teaching has gone by many different names, including *culturally appropriate* (Au and Jordan, 1981)*, culturally congruent* (Mohatt and Erickson, 1981)*, culturally compatible (*Jordan, 1985)*,* and *cultural synchronization* (Irvine, 1990). However, at the core of all these concepts is the goal to recognize and incorporate the various communication styles and cultural

norms of the students' unique home environment. (Gay, 2000, p.29). This paper's use of the term "Culturally Responsive Teaching" is based on the belief, reflected by Ladson-Billings (1995), that " the term *culturally responsive* appears to refer to a more dynamic or synergistic relationship between home/community culture and school culture." (p.467).

PARADIGMS OF LEARNING

Western-style Formal Education

Most European-American industrialized societies provide a Western-style formal education; yet many EL learners do not have the experience or training to navigate that educational paradigm. As defined by Marshall and DeCapua (2014), Western-style formal education is characterized by a foundation of scientific reasoning, observation and logical deduction. It uses the scientific method to arrive at facts and enlists various processing skills to categorize those facts. The implicit focus of Western-style education is on isolated learning that is abstract and fragmentary, removed from the context of daily life. This method of education is delivered in a distinct school location, with trained teachers delivering pre-established lessons (2).

Communication. As Kochman (1985) explains, the dominant communication style in a conventional Western-style classroom has been described as a *passive-receptive* process. Under a passive-receptive dynamic, students are told to be quiet while the teacher talks. Students are expected to show

they are attending the discourse by sitting still and maintaining eye contact with the teacher.

Individualism. Western-style formal education has a palpable individualistic orientation. Independence is admired, and individual achievement is the focus of this education system (Marshall and DeCapua, 2014). Individualism is in the texts, teaching styles, and promoted consistently from the early stages of formal education, where young students are encouraged to move towards independence and to later, "higher order" thinking models, where students are encouraged to arrive at decisions and discoveries independently (Marshall and DeCapua, 2014 p. 5).

Literacy. Literacy is essential for operating in an European-American industrialized society, as explained by Bernardo (2000):

> In a modern knowledge society where information is accessed through printed and electronic sources, literacy is a key to effective functioning. In this society information is a commodity which people can use to advance their own causes and to influence movements in the larger community. Without adequate literacy skills, a person practically loses the right of entry to most of the important functions and activities of the community. Without sufficient literacy competencies, an individual in effect forfeits his or her input into how the future of the community is shaped. (p.459)

Given this societal dynamic, it is unsurprising that a typical educational approach in Western classrooms is to focus on literacy while subordinating other

forms of learning and expression. Literacy is the benchmark by which Western education measures success. Without some level of literacy, a student may be marginalized and presumed uneducable.

Informal Learning

In contrast to Western-style formal education, informal learning is a type of learning that occurs in the normal flow of everyday life. As described by Marshall and DeCapua (2014), informal learning occurs when family and community members teach youth what they need to know in the hope of becoming successful adults. Informal learning is seen in various settings, including traditional master-apprentice relationships, on-the-job training or activities essential to the family such as laundry, childcare, farm chores, and religious activities. The focus of informal learning is the mastery of essential skills pertaining to everyday life, rather than the abstract goal of learning itself. These experiences, while distinct from formal education and not taking place in a institutionalized school setting, still provide essential opportunities for education (2).

Communication. Many cultures engage in communication styles differing substantially from those typically found in Western society. In contrast to the Western-style *passive-receptive* form of discourse, the *participatory-interactive* method of discourse is used by many different cultural groups, which Kachmann (1985) describes speakers as requiring their audiences

to give active feedback through vocal, movement and motion responses while the speakers are talking.

Collectivism. As previously stated, Western education places a high premium on individual achievement. This emphasis must be viewed in contrast to the collectivist attitude towards education that can be found in many diverse cultures currently being educated in Western school systems. As Gay (2000) explains:

> Cooperation, collaboration, and community are prominent themes, techniques, and goals in educating marginalized Latino, Native, African, and Asian American students. Two major reasons help to explain these pedagogical trends. First, underlying values of human connectedness and collaborative problem solving are high priorities in the cultures of most groups of color in the United States. Second, cooperation plays a central role in these groups' learning styles, especially the communicative, procedural, motivational, and relational dimensions. (p.158)

It is important to note, however, that the collectivist perspective does not exclude individual achievement. As noted by Marshall and DeCapua (2014), Chinese culture is known for being very collectivist, but also having a heavy emphasis on individual scholastic achievement. The main motivating factor, however, is not individual self-actualization, but the conferment of honor and success on the family of the individual. So, while individualism and collectivism

can be portrayed as a dichotomy, in reality cultures range along a continuum on this specific value (p.5).

Oracy. Oracy is the most important means of communication in informal learning, with literacy having little or no emphasis (Marshall & DeCapua, 2014). Oftentimes, the approach to and view of literacy and the written word in the home cultures of different groups of students may clash with those traditionally held by Western-style formal education.

Students that come from societies where informal learning is the norm can experience severe cultural dislocation, express anger and frustration, and perform poorly when thrust into this type of literacy-focused environment (Sarroub, Pernicek, & Sweeney, 2007). Although literacy exists within many of these societies and can be used for pragmatic purposes and specific tasks, literacy is not seen as necessary in everyday communication and transmission of information. (Whitescarver & Kalman, 2009, p. 506).

In addition, the style of literacy focus that is the norm in American schools can be confusing and difficult for students from other literacy-oriented cultures to grasp, as noted by Ndemanu and Jordan (2018) in their work on CRT strategies for African immigrant students in US P-12 schools. They explained that the pace and expectations of children's reading development in U.S. schools can be overwhelming to new African immigrants. In their home countries these students typically approach reading in depth only during later grade levels, as opposed to the United States, where it is the norm to start in kindergarten. Furthermore, in

most African countries there is limited emphasis on children engaging with literature or leisure reading. Reading is typically designed for academic purposes, as opposed to the US where leisure reading time is considered an essential component of classroom routine. (pp.76-77)

Examining these factors through the lens of CRT, one can see how it is imperative that an educator creates in his classroom a learning environment that not only takes these differences into account but works to integrate them into the classroom structure. In order to do so, educators must understand key strategies to implementation.

CRT Strategies

Research into strategies of how to implement Culturally Responsive Teaching in the classroom revealed that the focus is not on lists of activities or lesson plans, but rather on the mindset of teachers. These strategies were not intended as quick fixes or band-aids but were designed as systematic structures that can help an educator establish a classroom based on respect, community and cultural empowerment.

Addressing Deficit Thinking

A key first step towards implementing CRT in the classroom was for the educator to examine his assumptions of the learning ability and styles of the students. As Gay (2000) phrased it: “If teachers do not know how their own cultural blinders can obstruct educational opportunities for students of color, they cannot locate feasible places, directions, and strategies for changing them.”(p.71).

An important term to note here is *deficit thinking*. According to Johnson (1994), deficit thinking is an approach to educational risk that assumes any causes of children's failures in school can be attributed to specific child inadequacies, limitations, incompetencies and deficiencies (p.4).

In other words, by engaging in deficit thinking, an educator attributes failure to meet academic standards as the fault of the student, due to the student's ethnicity or cultural background. In addition, these same educators believe that students of non-dominant cultures are inferior to those who belong to the dominant culture in respect to intelligence, competence, self-motivation and capability (Walker, 2011, p.2). It follows that if a teacher shows deficit thinking towards his students, it is impossible for CRT to be implemented. Only if an educator can reflect upon, recognize and avoid deficit thinking can the next steps occur.

Mastery of the Five Areas of Expertise

In addition to overcoming deficit thinking, Gay (2000) listed five areas where teachers need to develop a level of expertise in order to faithfully implement CRT. These were (1) being able to develop a cultural diversity toolbox that includes content knowledge as well as pedagogical skills; (2) being able to develop a culturally relevant curriculum and instructional strategies; (3) building a learning community and showing cultural empathy; (4) having insight on the etiquette and styles of cross-cultural communication; and (5) creating a congruence between home and community culture and classroom instruction. A

discussion of each of these five elements is necessary in order to fully explore the most effective methods with which teachers can develop an effective CRT strategy.

Knowledge and Skills. Knowledge of the cultures in one's classroom can be gleaned, as Gay (2000) stated, "from the rich bodies of social science, educational, and literary scholarship on ethnic groups' histories, heritages, cultures, and contributions" (p.70). In addition, Marshall and DeCapua (2014) advocate for the educator to develop a positive relationship with a cultural broker in order to help the teacher to better understand the content or concepts from the students' point of view. According to Yohani (2011), the role of a cultural broker can be assumed by many different types of people, but a key to assuming this role is to assist with the transfer of cultural knowledge for improving intercultural communication, teaching practice and relationships (p. 62). With this in mind, cultivating a positive relationship with a cultural broker can also assist in developing a culturally responsive curriculum by facilitating cross-cultural communication.

Culturally Responsive Curriculum. Developing a culturally responsive curriculum, especially with regard to mathematics, is a complex and meticulous task. Not only does it call for a deep understanding of how the various cultures in a classroom conceptualize reality, but it also must take into account the students' depth of association to their own home culture, as well as the bases of reference within traditional European American Mathematics (EAM). Aikenhead

(2017) defines EAM as the academic mathematics conventionally taught in schools and universities. It consists of Platonist conventions inextricably intertwined with content focused on EAM's cultural identity. One flaw of many curricula that try to be culturally responsive is that they try to superimpose structures of EAM onto objects from students' cultures and in the process ignore the cultural significance and peripheral concepts of these objects, an action behavior referred to as projectionism. (p.91-93). An powerful example of this, dubbed by Doolittle (2006) as "Cone on the Range", illustrates some of the vital cultural contexts lost when educators engage in projectionism, in this case when using a tipi as a real-world example of a cone:

> "The tipi is a cone," I have heard countless times. But that is surely wrong; the tipi is not a cone. Just look at a tipi with open eyes. It bulges here, sinks in there, has holes for people and smoke and bugs to pass, a floor made of dirt and grass, various smells and sounds and textures. There is a body of tradition and ceremony attached to the tipi which is completely different from and rivals that of the cone." (p.20)

In order to avoid this marginalization of home culture when incorporating it into a mathematics curriculum, Aikenhead (2017) developed a four-step process as a general guide. While this guide is based on his experience with indigenous populations, it can be adapted to provide a culturally responsive curriculum to the cultural groups present in the classroom:

1.Forge a relationship with a cultural broker, or elder of the community with whom to collaborate.

2. Become familiar with the way the cultural group measures, counts, locates, designs, plays, and explains

3. The educator imposes his understanding of mathematics onto the cultural group's mathematizing, within the scope of his understanding of that mathematizing. In the course of this process, the educator may discard what he considers irrelevant to the lesson, such as the peripheral concepts alluded to above. This is not simple projectionism however, as having fostered a relationship with a cultural broker or elder can give the educator insight into the importance those so called peripheral concepts contain for members of that culture.

4. Instead of discarding those concepts, it is important to keep track of them and use them as future content, by doing so reinforcing the legitimacy of the cultural worldview of the students and community. (p.100)

Community and Relations. The process of building a learning community and fostering positive relationships within the classroom starts with a shift in paradigms in the student-teacher relationship. As Marshall and DeCapua (2014) assert, "Personal connections are not generally viewed as pertinent or important to learning in Western-style, formal classrooms. In formal education, personal and professional roles and responsibilities tend to be highly compartmentalized." (p.14). This approach contrasts with the more holistic view of collective relationships held by many cultures.

In these cultures, relationships are centered around building a web of connections with other people, so that an individual such as a teacher is not merely regarded merely by her professional title, but by other identifying features, such as if she is married, has children, or with whom she lives. While people in individualistic societies deal with people unfamiliar to them everyday, a common coping mechanism in collectivist cultures is to designate certain people to be a point of contact for a particular task or area of expertise. A similar concept exists in the "networking" that occurs in individualistic cultures (i.e. "I know a guy…); however, it is important to note that the social webs that exist in collectivist cultures occur naturally and can be adapted as learning webs within the classroom. That is to say that if the relationship web is strengthened and supported, then the insight a learner gains becomes a group insight. (Marshall & DeCapua, 2014, p.15). A first step an educator can take to start developing these webs is to show genuine interest in students as whole people and to avoid deficit thinking.

Cross-Cultural Communication. As noted in the *Communication* sub-sections above, the paradigm of communication that exists in the traditional Western-style formal classroom oftentimes conflicts with the preferred communication style of students from foreign cultures. In order to better understand how one's students communicate, a working knowledge of communication styles is important. However, Gay (2000) argues that this is not enough. She posits that to properly understand the classroom that one is teaching,

a self-examination of preferred discourse and communication methods is required, along with an analysis of how different students from different cultures respond to those methods. These analyses serve multiple purposes: (1) to ascertain the primary discourse styles of these students; (2) to identify complementary or conflicting features from these styles; (3) to navigate the conflicting features of communication; and (4) to understand the features of the students' communication that are difficult for the teacher. The results from these analyses can be used to identify areas of concern and to facilitate the processes necessary for effecting change (Gay, 2000, pp.109-110).

Cultural Congruence in Teaching. The final area of expertise a teacher needs to achieve is the creation of harmony between classroom instruction and the home cultures of the students. In his 2010 book *Raising Black Students' Achievements Through Culturally Responsive Teaching,* author Johnnie McKinley describes how some Seattle Public Schools educators achieved this goal by including concrete examples and models from students' lives, home cultures and languages. This instruction was described by principals and teachers as a leveler of the playing field for black students. Another key component to this cultural congruence is consistent communication and relationship development with the families of students. That relationship and mutual trust is essential, especially when the educator and the families come from different cultural backgrounds. Cultural brokers can be valuable resources in this area as well.

Strategy Review

As was noted at the beginning of this section, the CRT strategies reviewed here do not consist of isolated activities or fix-all lessons. Overcoming Deficit Thinking, and mastering the Five Areas of Expertise requires sustained effort on the part of the instructor, and significant shifts in mindset. Research, self-reflection, and an intentionality of purpose towards practice are tools that can aid educators in this endeavor.

In the next section, different approaches to mathematics instruction will be reviewed, with particular attention paid to fractions.

Considerations for Mathematics Instruction

This section reviews different approaches to mathematics instruction. The concept of European American Mathematics is explored, and its myth of impartiality and universality debunked. Examples of mathematics in non-European cultures are given. Lastly, potential barriers to student understanding of fractions are given, as are instructional strategies to overcome said barriers.

European American Mathematics

The Merriam-Webster English Dictionary defines mathematics as "the science of numbers and their operations, interrelations, combinations generalizations, and abstractions, and of space configurations and their structure, measurement, transformations and generalizations (Merriam-Webster.com, n.d.). This definition is an indicator of how deeply the European American Mathematics (EAM) paradigm has influenced our culture. As Aikenhead (2017)

enumerates, the prevailing view of EAM being the "correct" has been referred to as "Platonic Belief.*"* This belief set defines mathematics as a static but unified body of certain knowledge. Mathematics is something to be discovered, not invented or created. It characterizes mathematics as being value free, independent of context, culture, ideology, and culture. It is seen as purely objective, always consistent, generalizable, universalist in the sense of being universally true, and therefore is the only acceptable way of mathematizing (a term specifically defined as counting, locating, measuring, designing, playing, and explaining). (p.85-86).

The Myth of Impartiality

However, the traditional view of EAM is undercut somewhat when it is examined more closely. Schiro (2004) describes two myths in particular which bear closer review: that by engaging in mathematics, current-day mathematicians by extension must think in an objective, deductive and logical manner, and that their proofs and solutions to problems are infallible and immutable (p.191). In fact, as Epp (1994) tells us, mathematicians regularly make illogical leaps in arguments, and formulate guesses based on analogy (p. 257). Furthermore, the inherent "correctness" of any mathematical proof or solution is determined by the collective judgement of the community of mathematicians. In the short term, this collective judgement is frequently incorrect, and over the long term, the cultural orientation of the community shifts and changes depending on the members of the community (Schiro, 2004). Thus, what may seem like an acceptable proof in our

culture today might not be applicable or appropriate tomorrow or in another culture.

Contrasting EAM with Different Cultures

With the understanding that mathematics is a living and evolving subject, it's clear that how mathematics is conceptualized and used in a community is highly dependent on the culture of the community. Many factors play a role in this, including cultural perceptions of time and space, the semantics and syntax of the students' home languages, and the methods of determining orientation and location used by the culture. These differences in understanding and perception can cause difficulties for students when learning EAM.

For example, Powell (1986) notes that the semantic and syntactic demands of certain dialects of Chinese impose numerical delineators at intervals of every 4 digits. For example, ten thousand three hundred fifty would be written 1,0350. This is quite different from the Western linguistic structure of imposing numerical delineators every 3 digits (10,350). This difference may be a factor in why students who speak these dialects struggle with reading multi-digit numerals without explicit demonstrations of the place name by the instructor beforehand.

Another example of a cultural contrast to EAM is how Australian aborigines determine orientation and location. To orient themselves in the world, Western cultures use both a relativistic local system of orientation using left, right, front and back, as well as a relativistic global system of orientation that involves the use of Cartesian coordinates with positive and negative directions on

x and y axes. In contrast, Hill (1991) found that Aboriginals solely used the four cardinal points (North, South, East, West) as their absolute system of orientation, even when dealing with things only a few feet away. When required to use the relativistic system supported by EAM, they experienced great difficulty and only wanted to use their absolute system.

A final example of the contrast between EAM and non-western mathematics is how the Navajo perceive time and space. In Western culture, we assume time and distance are measured by a consistently calibrated measuring devices, and that mathematical time and distance are truth, while psychological time and distance is just a figment of our imagination (five minutes is the same amount of time, all the time, no matter if you're bored or excited). In contrast, in Navajo culture time and distance are calibrated by where you are located, and what you are doing and feeling. As Pinxten (1997) explains, to the Navajo, time and space are circularly defined in terms of each other, rather than by terms of absolute standards. Trying to overlay Western and Navajo mathematics leads to cognitive confusion that results in the sociocultural and psychological alienation of Navajo children and adults (p.394)

Fractions: Potential Barriers to Student Understanding

Gaining proficiency in fractions is an essential step in the process of obtaining higher-level algebraic skills, skills which students require to be successful in secondary math (Barnett-Clarke, 2010). Fractions are conceptual, and as illustrated in the previous section, instructors cannot just assume that the

home cultures of their students assign the same importance or context to fractions that EAM does. This is just one example of a potential barrier to student understanding of this concept.

Osana and Pitsolantis (2011) posited that another barrier to student understanding of fractions is their inability to connect concepts to procedures. Students may be able to complete skill worksheets after being taught an algorithm, but are unable to explain why they answered the way they did. This lack of connection can hinder students in transferring their knowledge of fractions into the real world. In addition, Osana and Pitsolantis (2011) cited the findings of Mack (1995), which showed that the way many students had learned how to manipulate whole numbers interfered with their understanding of how to manipulate fractions.

A final example of a potential barrier for student understanding is the specialized vocabulary used in fraction work. As Chick, Tierney & Storeygard (2007) explain, the inability of students to remember a vocabulary term may be indicative that the students do not understand the actual meaning of the word.

Fractions: Strategies for Success

According to Bill & Jamar (2009), if students are to fully engage with important mathematics content, they must develop critical thinking habits that support mathematical tasks, such as visualization and the ability to draw on prior knowledge. The learning of these processes of critical thinking cannot occur in a vacuum. As Willingham (2007) noted, research shows that critical thinking is not

like riding a bike, you can't simply learn it and then apply it at will in any situation. The processes of thinking and the content of thought are inextricably intertwined with one another (p.8). The learning of content through developing critical thinking habits was termed *working on the diagonal* by Geisler (1994).

Learning as an Apprenticeship. In order to attain proficiency in these linked categories, Bill & Jamar (2009) advocated for the viewpoint of learning as apprenticeship; that is to say, the best way of learning these skills is to do it alongside a someone who is already proficient in them. In the classroom, these skills must be modeled and nurtured by the teacher or a more skilled student (p.71). These interactions can provide opportunities for the teacher to conduct formative assessments of the students, which in turn, provide the teacher with information on content or thinking habits which need to be reinforced or retaught. (p.72)

Explicit Connections. Osana and Pitsolantis (2011) encouraged instructors to make explicit connections between the mathematical symbols and vocabulary used in fractions and their exact meaning. Students with no previous experience with fractions cannot be expected to know that the line between the numerator and the denominator is actually a division symbol. By creating these connections, students learn not only the procedures, but the reason behind those procedures.

Student Creators. According to Frankenstein (1996), a highly effective way for students to become better at fractions is for them to write out their own

math problems. When students are asked to write their own math problems, they must use their skills to decide what type of questions to ask, and what answers are most logical. Doing this better prepares students to answer math problems written by other people.

Considerations Summary

This section explored the concept of European American Mathematics, and its myth of impartiality and immutability was debunked. Examples of mathematics in non-European cultures were provided. Lastly, potential barriers to student understanding of fractions were given, as were instructional strategies to overcome said barriers. In the next section, the state mathematics standards will be explained, and the results of the annual state mathematics examined.

State Mathematics Standards

In this section the state mathematics standards were presented, and analyzed in order to get a better understanding of their format. All schools are required by law to teach these statewide standards, and annual state assessments are used to track students' progress and growth along these standards. The author conducted an analysis of annual math assessment scores from 2017-2019. He compared the proficiency rates of the EL population to those of the general student population statewide, and also the two proficiency rates within the project site. The goal in doing so was to gauge the size of the proficiency gap between EL students and the general student population.

The Mathematics Standards (2007) of the state in which this project took place reflect the dual learning process of content and thinking habits described by Bill and Jamar (2009) and are presented as "a connected body of mathematical knowledge that is acquired through the processes of problem solving, reasoning and proof, communication, connections, and representation." (p.2). In the State Mathematics Standards (2007), content has been organized by grade level into 4 different content strands: (1) Number and Operation; (2) Algebra; (3) Geometry and Measurement; and (4) Data Analysis and Probability. Each strand contains at least one standard, and those standards contain benchmarks against which a student's mastery of the content can be measured (p.2). An example of the structure of the standards can be found in below:

Table 1
8th Grade Math Standard

Strand	Standard	No.	Benchmark
Number & Operation	Read, write, compare, classify, and represent real numbers, and use them to solve problems in various contexts.	8.1.1.2	Compare real numbers; locate real numbers on a number line. Identify the square root of a positive integer as an integer, or if it is not an integer, locate it as a real number between two consecutive positive integers *For example:* Put the following numbers in order from smallest to largest: 2, √3, -4, -6.8, -√37 *Another example:* √68 is an irrational number between 8 and 9

Adapted from "2007 Minnesota K-12 Academic Standards in Mathematics by Progressions with Benchmark-item Difficulty," by Minnesota Department of

Education, 2015, Division of Academic Standards and Instructional Effectiveness p. 29.

The figure above depicts the Number & Operation strand of the 8th grade standards. By the end of 8th grade, students were expected to "Read, write, compare, classify and represent real numbers, and use them to solve problems in various contexts." (MN K-12 Standards in Mathematics (2007), p. 29). The students showed mastery of this standard by achieving the benchmark indicators, such as "Determine rational approximations for solutions to problems involving real numbers (Benchmark 8.1.1.2, p. 29). Within this benchmark, various examples are given which are intended to reflect mastery of the benchmark. One such example requires a student to critically understand that $\sqrt{10}$ is between 3 and 4, try squaring numbers like 3.5, 3.3, 3.1 to determine that 3.1 is a reasonable rational approximation of $\sqrt{10}$. (Benchmark 8.1.1.2, p.29). If the student demonstrates an understanding of this concept, the student will be deemed to have mastered the benchmark.

As the annual state assessment is normed to these standards, an analysis of those assessments would be an effective means by which to gauge how well ELs are meeting these standards.

Assessment Data- Statewide

The project site's state has a website that provides online access to district and school data, demographic information and test results going back to 2014. According to statistics provided by the Department of Education of this state, from 2017 to 2019, EL students of all grades had significantly lower proficiency

scores in the Math portion of the standardized test when compared to the general student population statewide. In 2017, 59.1% of the general student population tested proficient in math. Comparatively, only 20.8% of EL students statewide tested were proficient, a significant difference (MDE, 2020). In 2018, 57.6% of the general student population tested proficient, while 19.5% of EL students tested proficient (MDE, 2020). In 2019, 55.5% of the general student population tested proficient while 17.8% of EL students tested proficient (MDE, 2020).

Assessment Data- Project Site

An analysis of the 2017-2019 standardized math test scores from the project site was likewise conducted. In 2017 55.6% of the general student population tested proficient, while 32.6% of the EL population tested proficient (MDE, 2020). In 2018 55.5% of the general student population tested proficient, while 29% of the EL population tested proficient (MDE, 2020). In 2019 56.4% of the general student population tested proficient, while 23.5% of EL students tested proficient (MDE, 2020).

Standards Review

This analysis clearly indicates that ELs at the project site are in need of additional support with math.The consistent downward trend of EL math scores on the state assessment at both the state and school level are clear signs that while the standards may be required by the state, most EL students are either unable to access the content, or lack the appropriate skills to demonstrate proficiency.

Rationale for Research

The literature researched in this review provided valuable answers to the project's guiding question of *how can culturally responsive mathematics strategies be implemented in a small-group EL setting?*. By doing a deep dive on the history of multicultural education, Culturally Responsive Teaching (CRT), and the differences between Western-style formal education and informal learning, the author gained a deeper understanding of why they are important considerations for teachers of multicultural students. In addition, the CRT strategies laid out by the researchers directly informed the design of this project's curriculum.

By examining the paradigm of European American Mathematics (EAM), and comparing it to systems found in non-Western cultures, the author became cognizant that math is an aspect of culture, upon which its form and function are dependent. This awareness influenced how the curriculum is designed. Furthermore, the potential barriers to student understanding of fractions informed instructional planning when designing lessons, as did the strategies given to overcome those barriers. Finally, the analysis of the state standards and the annual state assessments provided definitive data as to why the design of a math curriculum for ELs was an urgent need.

Literature Review Summary

In this chapter, literature relevant to Culturally Responsive Teaching (CRT) was reviewed, as well two main strategies on how to enact it in classrooms: by addressing deficit thinking, and by mastering the 5 areas of

expertise as defined by Gay (2000). CRT advocates for the inclusion and integration of home culture into the academic setting. This concept of making academic content more accessible to students from a non-dominant culture by scaffolding to the students' backgrounds has existed since the Civil Rights era. The difficulties of implementing CRT in the classroom were illustrated by contrasting traditional Western-style formal education with the informal methods of learning that are deeply embedded in the cultures of many students. These contrasts include styles of communication, individualism vs collectivism, and literacy vs oracy. The sometimes dramatic differences between the expectations of Western academic culture and those of students' home cultures may be poorly understood by educators, and facilitate the creation of a destructive mindset called deficit thinking. If an educator is engaged in deficit thinking, they attribute failure to meet academic standards as the fault of the student, due to the student's ethnicity or cultural background.

Also presented in Chapter 2 was research on different approaches to mathematics instruction. European American Mathematics (EAM) is the form of mathematical thought which is heavily favored in traditional Western formal education. It is typified by the Platonist belief that math is a universal truth waiting to be discovered; immutable, non-contextual, and inherently logical. This was debunked by Schiro (2004), who pointed out that what is accepted as mathematical truth is actually just the best collective judgement of the community of mathematicians, and they make mistakes, too. Next, examples of how

non-Western cultures (Chinese, Aboriginal, and Navajo) use mathematics were given, and contrasted with EAM. After that, the author analyzed potential barriers that could hobble student learning of fraction content, one barrier being student inability to transfer knowledge learned in the lesson into the real world. To address these barriers, the author presented research-based strategies such as *learning as apprenticeship,* where a low-proficiency student is partnered with a more skilled student or the teacher for the learning task.

Finally, the author analyzed state mathematics test scores, finding there is a significant mathematics proficiency gap between EL and native speakers at the state, district, and school levels.

Throughout this chapter, the researchers found a number of valuable strategies and ideas on CRT and mathematics instruction that directly address the guiding question "*How can culturally responsive mathematics strategies be implemented in a small-group EL setting?".* In the next chapter this research will be applied to creation of a fractions unit in order to ensure understanding of the concept.

CHAPTER THREE

Project Description

Overview

This capstone project was designed to address the guiding question: *How can culturally responsive mathematics strategies be implemented in a small-group EL setting?* In this chapter, the rationale for choosing curriculum creation as the format is provided through an exploration of the project site's needs. In addition, the frameworks used in the design of the curriculum are reviewed and rationalized, and the logic used to decide what content to be taught is explained. Next, the project site and participants were introduced. Finally, a timeline of implementation was described.

In Chapter 2, literature relevant to Culturally Responsive Teaching (CRT) was reviewed, as well as strategies on how to enact it in classrooms. CRT advocates for the inclusion and integration of home culture into the academic setting. This concept of making academic content more accessible to students from a non-dominant culture by incorporating elements from home culture and community has existed since the Civil Rights era. The difficulties of implementing CRT in the classroom were illustrated by the summarizing of the ways in which traditional Western-style formal education contrasts with the

informal methods of learning that are deeply embedded in the cultures of many students. These contrasts include styles of communication, individualism vs collectivism, and literacy vs oracy. The differences between the expectations of Western academic cultures and the home cultures students may be poorly understood by educators and can lead to deficit thinking: a destructive mindset in which educators attribute sub-proficient student performances to their socioeconomic status and/or cultural group.

Also presented in Chapter 2 was research on different approaches to mathematics instruction. European American Mathematics (EAM), is the style of mathematics that is associated with Western-style formal education. Difficulties can arise when students who come from non-Western mathematical traditions are expected to immediately grasp EAM concepts, due to the instructor's assumption that math is the same across cultures. When compared to three non-Western cultures (Chinese, Navajo, and Aboriginal) it quickly became apparent that mathematics is indelibly influenced by how a culture uses it. Barriers to student understanding of fractions were given, as well as strategies to overcome these barriers. Finally, the author analyzed standardized mathematics test scores, finding there is a significant mathematics proficiency gap between EL and native speakers at the state, district, and school levels.

The major takeaway from this research was that if a math curriculum is grounded in CRT with fidelity, it should be a student-centered curriculum.

Ultimately, the shape and scope of this curriculum depends on the needs of the students that will use it.

Format Rationale

To best address the guiding question of *How can culturally responsive mathematics strategies be implemented in a small-group EL setting to support struggling learners*, the author decided that designing a curriculum with these strategies at its heart would be the best framework. This decision was made because 3rd grade EL students have significantly lower proficiency rates in mathematics than their native speaking grade-level peers, as evidenced by two of the three tri-annual FASTbridge tests implemented by the district this year, as well as by their classroom teachers.

In addition, the author was a member of the district's Elementary Math Steering Committee, and a common concern discussed at meetings was that EL students were having difficulty accessing math content due to language and cultural barriers. EL students classified by the state as Recently Arrived English Learners (having been enrolled in a school in the US for less than 12 months before the time of testing) are a rising demographic in the district, and the district-wide math curriculum was not designed for the variety of cultural and mathematical backgrounds of these students.

In order to address student needs in this area, the district had math interventionists and Math Corps volunteers working at schools to provide extra support to classroom teachers. These instructors were to pull students during a

scheduled WIN (What I Need) time and work on building essential mathematical skills. However, the focus of the district academic coordinators in the 2019-2020 school year was building reading skills. Due to students' multiple needs, WIN time became reading-intervention focused, leaving little time for mathematics intervention.

Anecdotally, classroom teachers have remarked that this focus means that there is limited time to help and correct students with fractions and mixed-number concepts, meaning the gap between those who are not proficient, and those who are is an ever-widening one.

The choice of curriculum design as the format for this project was in direct response to these needs. The EL teachers at the project site have the benefit of a daily 30-minute pull-out time with the 3rd-graders built into their schedules, and the freedom to teach how and what they want. Typically, this involves collaboration with classroom teachers to provide support in areas where EL students aren't fully accessing classroom content, as well as building academic language skills. Therefore, the creation and implementation of a curriculum that supports the fraction lessons of the classroom teachers would be a continuation of this collaborative practice.

The next section of this chapter details the frameworks used to organize this curriculum, and provides rationales as to their inclusion.

Frameworks Used in the Project

The small-group curriculum was designed to support and address the needs of struggling EL students by using two main frameworks: the backward-design unit template of *Understanding by Design* by Wiggins & McTighe, and the WIDA English Language Development Standards, developed by the WIDA Consortium. These frameworks complement each other, and provided a strong base on which to build a culturally responsive curriculum. This section gives insight into the structures of these frameworks.

WIDA English Language Development Standards

The WIDA Consortium is a collection of 39 state educational departments that designs and implements standards and assessments for English Language Learners, Spanish Language Learners, and emergent multilingual children. The state in which this project takes place is a member of this consortium. Knowledge of the WIDA guidelines and Can-Do descriptors is essential for teachers that work with and design curricula for multilingual learners.

History of Consortium. WIDA (formerly known as World-Class Instructional Design and Assessment) was created in 2003 when an Enhanced Assessment Grant was awarded to the Wisconsin Department of Education ("Mission and History", n.d.). In 2004, WIDA released the first iteration of the English Language Development Standards ("Mission and History", n.d.). These standards cover the five areas students will encounter in academic, instructional, and social language settings throughout their time in school and provide educators a connection between content and language development ("English Language

Development Standards", n.d.). These standards are Social and Instructional Language, the Language of Language Arts, the Language of Mathematics, the Language of Science, and the Language of Social Studies.

English Proficiency Levels. The five WIDA Standards listed above have served as the basis of WIDA's ACCESS test, an annual assessment administered to assess students' English language proficiency and growth. The WIDA ACCESS test measures English proficiency in each of the 4 domains of language: Reading, Writing, Speaking and Listening. In order to provide a framework for success in these four domains, WIDA has six levels of language proficiency for EL students, starting with Level 1: Entering (for newcomers and those with little to no experience with the English Language) and ending with Level 6: Reaching (achieved native-like English language proficiency). Students can and often do have different proficiency levels across different domains. In the state where this curriculum takes place, for a student to be considered proficient on the ACCESS test (and be eligible to exit EL services), they must have a 4.5 composite score, and any three of the four domains must be at or above 3.5 (MDE, 2017).

Features of Academic Language. According to WIDA, academic language has three dimensions : 1) Word/Phrase, 2) Sentence, and 3) Discourse. Each dimension has been assigned its own performance criteria and features. The Word/Phrase dimension focuses on vocabulary usage within the content area; i.e. the general, specific and technical language of the content, multiple meanings of

words and phrases, nuances and shades of meaning, and collocations or idioms common to the content area (Features of Academic Language in the WIDA Standards, n.d.). The Sentence dimension focuses on language forms and conventions within the content area; i.e. the types and variety of grammatical constructions, the mechanics of sentence types, fluency of expression, matching language forms to purposes/perspectives and formulaic and idiomatic expressions (Features of Academic Language in the WIDA Standards, n.d.). Finally, the Discourse dimension focuses on linguistic complexity within the content area; i.e. the amount of speech/written text a student may produce, hear, or read, the structure of the speech/ written text a student may produce, hear, or read, the density of the speech/ written text that a student may produce, hear, or read, coherence and cohesion of ideas, and the variety of sentence types to form an organized text (Features of Academic Language in the WIDA Standards, n.d.). When designing lessons to support content, EL teachers must address all three dimensions of academic language in order to assist their students in developing the tools to access that language independently in the future.

Can-Do Descriptors. A final component of WIDA to be examined are the Can-Do Descriptors. These are a collection of processes and actions that EL students should be able to perform when progressing through the six levels of English proficiency. The descriptors are organized by Key Uses (Recount, Explain, Argue, Discuss), which are ways language is used in social and academic settings (The English Language Learner Can Do Booklet, 2012). These Key Uses

are implemented to assist in the differentiation of curricula, instructions and assessments designed in English based on language learners' levels of language proficiency. The Key Uses also facilitate collaboration among instructors and aid EL teachers advocate for equitable access to content for language learners (The English Language Learner Can Do Booklet, 2012).

Understanding By Design

In *Understanding by Design* (2011), the authors endorse a backward-design unit framework (henceforth designated as UbD) that is centered around three stages: 1) Desired Results, 2) Evidence and Assessment.

Stage 1: Desired Results. In Stage 1, the instructor starts by creating the established goals for the unit. These are the learning goals and enduring understandings that the students will have attained by the end of the unit. These goals are divided into three categories: Transfer, Meaning, and Acquisition.

The first category, Transfer, details how students will take what they learned during the unit and apply it outside of the context of the unit. This transfer can occur across academic settings, or between the academic setting and social settings such as the home.

The Meaning category is further divided into two subcategories: Essential Questions and Understandings. Essential Questions are queries that form the framework on which the unit and lessons are built. They can be revisited and revised throughout the entirety of the curriculum. At the end of the unit, if the student can answer these essential questions, they have attained the

understandings needed to do so. Understandings are the big ideas and specific masteries that students will gain by the end of the unit.

The third category, Acquisition, is also divided into two subcategories: Skills and Knowledge. The Knowledge subcategory refers to the key knowledge that the student will have learned by the end of the unit or lesson, and the Skills subcategory refers to the skills and processes the student will have attained throughout the unit or lesson.

Stage 2: Assessment. Using the desired results developed in Stage 1 as evaluative criteria, the instructor now develops the summative and formative assessments that will serve as the means by which students express their understanding of the lesson or unit. Summative assessments are performance tasks in which students demonstrate authentic learning, usually occurring at the end of a unit or curriculum. Formative Assessments are other forms of evidence that demonstrate student achievement of desired results, and occur on both a formal and informal basis throughout lessons and units. An example of a formal formative assessment would be a student reflection journal updated daily or weekly. An example of an informal formative assessment would be frequent comprehension checks by the instructor in the midst of a lesson.

S**tage 3: Learning Plan.** In the final stage of the design process, the instructor designs the learning activities and chooses the teaching strategies that he will use to teach the desired information in his daily lessons. The intentionality inherent in the backward-design framework enables the instructor to design

lessons that focus on the desired results, and reduces the likelihood of creating irrelevant busy work.

Framework Rationale

The backward-design framework of *Understanding by Design* was chosen for this curriculum because of this inherent intentionality, which makes it ideal for Culturally Responsive Teaching. By starting with desired results that reflect the needs and background of the students, the format ensures that culturally responsive strategies and techniques are integral pieces of the curriculum. In terms of its applicability to mathematics instruction, the Acquisition category in Stage 1 promotes the growth of *diagonal-thinking* described by Geisler (1994) through its intentional focus on both the knowledge learned as well as the essential strategies gained throughout the curriculum. In addition, this framework is highly synergistic with the WIDA English Language Development Standards.

The WIDA English Language Development Standards were chosen as the other framework for this curriculum because of district EL and classroom teachers' familiarity with the standards. WIDA levels and academic language are familiar themes for district teachers which would aid in ease of use of the curriculum. In addition, students also are familiar with the WIDA standards due to previous instruction by EL teachers, and the annual ACCESS test that many of them have taken before.

These frameworks form an essential organizational component to the curriculum. The next section will enumerate on the content which was embedded into these frameworks, and provide a rationale as to why it was chosen.

Content Rationale

This curriculum sought to utilize Culturally Responsive Teaching (CRT) strategies to build students' academic vocabulary aligned with the WIDA English Language Development Standards. In addition, it was designed to strengthen students' skills with fractions in the following areas: 1) Recognizing that fractions are a part of a whole, 2) Reading and writing fractions as words and symbols, 3) Understanding sense of scale between fractions, whole numbers, and mixed numbers, and 4) Recognizing different uses of fractions outside of the academic setting. These areas are informed by the standards pertaining to fractions in the 3rd-grade mathematics standards of the state, as shown below:

Table 2
3rd-Grade Math Standards: Fractions

Strand	Standard	No.	Benchmark
Number & Operation	Understand meanings and uses of fractions in real-world and mathematical situations.	3.1.3.1	Read and write fractions with words and symbols. Recognize that fractions can be used to represent parts of a whole, parts of a set, points on a number line, or distances on a number line.
	Understand meanings and uses of fractions in	3.1.3.2	Understand that the size of a fractional part is relative to

	real-world and mathematical situations.		the size of the whole.
	Understand meanings and uses of fractions in real-world and mathematical situations.	3.1.3.3	Order and compare unit fractions and fractions with like denominators by using models and an understanding of the concept of numerator and denominator.

Adapted from "2007 Minnesota K-12 Academic Standards in Mathematics by Progressions with Benchmark-item Difficulty," by Minnesota Department of Education, 2015, Division of Academic Standards and Instructional Effectiveness p.9

Fractions were chosen as the content focus of this project because they are an essential step in the process of obtaining higher-level algebraic skills, skills which students require to be successful in secondary math (Barnett-Clarke, 2010). They are conceptual in nature, a hallmark of European American Mathematics, and therefore may be more difficult for students with limited exposure to this paradigm.

In order to present this content in a culturally engaging way, the author decided to incorporate the preparation of food and its connection to the community and cultures of the students. As Amy Choi stated: "Food feeds the soul. To the extent that we all eat food, and we all have souls, food is the single great unifier across cultures." (2014). Food is an essential and highly accessible component of culture. To paraphrase Edward T. Hall's analogy of the iceberg (1976), culture can be envisioned as an iceberg, with behaviors and some beliefs

visible above the metaphorical waterline (external components), but with even more beliefs, as well as values and thought patterns hidden beneath the surface (internal components). Food would be considered an external manifestation of culture, and a readily accessible one at that. For many people, the first meaningful interactions with cultures other than their own comes through the medium of food.

Mathematics, and fractions in particular are integral to the preparation and serving of food. Food is an excellent means by which to introduce fractions to students, providing real-world examples of intangible concepts. In addition, the vocabulary inherent in both fractions and food preparation are transferable across subjects, as well as outside the academic context. Therefore, mastery of this vocabulary is very beneficial for English Learners.

Project Site

The site for the project is a suburban elementary school in the Midwest United States. It is a small, public neighborhood school that provides services for approximately 320 students. According to state records, slightly more than half of the students qualify for free/reduced-price meals (MDE, 2020). The school is very culturally diverse, with data from the state's school information website showing that 17.6% of the students identifying as Hispanic, 1.2% of students identifying as Native American, 11.8% of students identifying as Asian, 32% of students identifying as Black or African American, 29.3% of students identifying as White, and 8.6% of students identifying as being of two or more races (MDE, 2020). In

grades 3-5, each student has a school-assigned Chromebook, while in grade K-2, each student has access to a tablet.

Participants

This curriculum is designed for the 3rd-grade students from this project site, but can be adapted to fit the needs of students in similar settings. It was designed to be taught in a small-group setting and lasts 30 minutes. Typical small group sizes range from 5 to 10 students, and are taught by a single teacher.

Timeline

This capstone project was started in the Fall of 2018, and was completed in the Spring of 2020. It is intended to be implemented over 10 days in February of 2021 in order to correspond with when the fraction unit is taught in the 3rd-grade classrooms.

Project Description Summary

In this chapter, the author showed how the design of his capstone project addressed the guiding question: *how can culturally responsive mathematics strategies be implemented in a small-group EL setting?* It was shown that the choice of curriculum creation as the format for this project was appropriate due to the needs of the students at the project site. In addition, the WIDA English Language Standards and UbD framework used in the design of the curriculum were presented and their choice as frameworks explained. They are highly synergistic frameworks that will facilitate Culturally Responsive Teaching. The author also provided rationale for the choice of fractions as the content of the

curriculum, referencing the state standards. In addition, he showed how food can be an exciting and engaging method with which to teach fractions. Furthermore, the project site and participants were introduced. Finally, the timeline of implementation was described, with the curriculum taking place concurrent to the fraction unit of the 3rd-grade classrooms.

The following chapter provides conclusions. This chapter will discuss the major learnings from this project, including learnings from the literature review and developing the fraction curriculum using the WIDA English Language Standards and the backwards-design frameworks. This chapter will review the implications and limitations of this project. Finally, it will provide recommendations for future work and emphasize the benefits to the education profession.

CHAPTER FOUR

Conclusions

Overview

For this project, the author studied culturally responsive teaching methods and mathematics instruction strategies applicable to teaching fractions to third grade English Learners (ELs) in a small group. He sought to address the guiding question: *how can culturally responsive mathematics strategies be implemented in a small-group EL setting?* In this chapter the author reflected on the important outcomes he learned when designing this project, a ten-day fractions unit assisting 3rd grade students in their understanding of fractions. He discussed aspects of his literature review that were important in the development of his project. He explored the implications of this project and its potential limitations. Furthermore, he suggested future potential projects that would build on the

findings of this project. Finally he explained why this project would be beneficial to the profession.

Major Learnings

Throughout the development of this project, the author was exposed to a great deal of information that greatly informed his curriculum design. The component that had the most dramatic impact on his learning was the literature review. The research done in the author's literature review can be broken down into three categories: research relating to multicultural education/ Culturally Responsive Teaching, research relating mathematics theory and instruction, and research relating to the state standards and math assessment scores. Each of these categories directly informed the creation of this project, and the author learned something of significance from each.

Culturally Responsive Teaching

Gay (2000) listed five areas of expertise that a teacher must master in order to enact Culturally Responsive Teaching (CRT) with fidelity. These were (1) being able to develop a cultural diversity toolbox that includes content knowledge as well as pedagogical skills; (2) being able to develop a culturally relevant curriculum and instructional strategies; (3) building a learning community and showing cultural empathy; (4) having insight on the etiquette and styles of cross-cultural communication; and (5) creating a congruence between home and community culture and classroom instruction. These five areas have

become integral to the teaching philosophy of the author, and he attempted to faithfully follow their principles when designing this curriculum.

Marshall & DeCapua's (2014) assertion that the social webs existent in collectivist cultures can be adapted to classroom use directly informed the author's teaching style. After reading this research, the author worked to build those connections in his class, and attempted to integrate some of that relationship building into his curriculum.

McKinley's (2010) research into the benefits of embedding concrete examples from students' home cultures also had a great impact on the materials included in the curriculum. The author included recipes for Somali *shah* and Central American *pupusas* in his curriculum due to the significant number of students from those areas attending his school. In addition, explicit inclusion of students' use of the SeeSaw app to record their answer to the daily key question was done because this would facilitate better home-school communication. SeeSaw is an educational app where students are able to record posts by writing or recording themselves on video or audio. The families of these students are familiar with the app, and for some it's the only way to communicate. Thus, SeeSaw's inclusion into the curriculum was a no-brainer.

Mathematics Theory and Instruction

Aikenhead's (2017) definition of European American Mathematics was eye opening for the author. He had never considered before that math as he knew

it was not a universal concept. It made him reconsider the methods with which he taught, and to focus explicitly on providing scaffolds such as manipulatives and example posters to better support students who were not proficient in EAM.

In addition, the research by Schiro (2004) and Epp (1994) left the author somewhat flabbergasted. The idea that the inherent "correctness" of a mathematical proof or solution can change depending on the cultural shifts of the small community of mathematicians was astounding, but once the author was able to get over his surprise, it jived with what he knew about culture as a whole. Furthermore, the research done by Powell (1986), Hill (1991), and Pinxten (1997) into non-western systems of mathematics reinforced for the author the importance of mastery of Gay's (2000) five areas of expertise.

The research of Barnett-Clarke (2010) into the importance of fraction mastery for future success in secondary math was a reason for the curriculum's focus on fraction. Bill & Jamar (2009) advocated for learning as apprenticeship, and it is embedded into the frameworks of the lessons. The Guided Practice the author incorporated into every lesson is a direct result of his reading this research.

When planning this curriculum, the author made sure to include explicit connections between the mathematical symbols and vocabulary being taught, and their exact meaning. This is directly due to the research by Osana and Pitsolantis (2011), that suggested this strategy would benefit struggling learners.

State Standards and Assessments

The troubling downward trend in EL math scores both statewide and at the project site were a major eye opener. The author had known that the proficiency gap existed, but to see the cold, hard numbers in front of him really put it into perspective. Learning the true size of the gap made the author all the more determined to create a curriculum to aid his students.

Major Learning Summary

In this section, the author reviewed the major learnings he took from the Literature Review. These learnings were divided into three categories: multicultural education/Culturally Responsive Teaching (CRT), mathematics theory and instruction, and state standards and assessments. The CRT learnings mainly influenced his mindset and philosophy of teaching, while the learnings of math theory and instruction directly influenced his lesson format. The state assessments and standards reinforced his desire to create a culturally-responsive curriculum.

In the next section the author explored possible implications of his project.

Implications

Through the design of this fractions curriculum, the author has created a template on which future curriculums may be based. By using the Understanding

by Design (1998) framework, the author and other teachers can create additional units to help support struggling students.

This project was intended to help ELs learn to recognize and create fractions while deepening their understanding of the topic. The ten-day curriculum used fractions to make a connection between home culture and school, as well as supplement the content taught in the general classroom. The focus of this curriculum was on enabling the transfer of skills from the small group into the general classroom, and the real world. The use of food to teach fractions was intended to explicitly show students that math is applicable outside of school.

This curriculum was created in May 2020, and was intended to be implemented during the 2020-2021 school year. The desired results expressed by the author are a result of the research he has done, and his experience in the field of education.

Limitations

During the course of this curriculum development, some limitations became apparent. The food chosen by the author was based on the student demographics of the project site and ease of creation. Should another educator want to use this curriculum, they would undoubtedly have to change the recipes to better represent the cultures of their students. In addition, having the students choose or bring recipes to make would have made the content more reflective of the home cultures of the students. Another limitation is the lack of accessibility

for students with significantly low proficiency in English. In the next section, the author shares his recommendation for future work on this project.

Recommendations for the Future

To further improve this curriculum, the author recommends expanding the curriculum to take in more math units related to fractions, such as money, and time. In addition, creating translated materials that could be accessible to students literate in their home language would be very beneficial, especially for students new to the country. The author is also interested in how storytelling, a traditional teaching method in oral cultures, can be used to teach mathematics, and would like to integrate that into the curriculum as well. Finally, the author believes that the inclusion of non-western mathematical systems in this curriculum would benefit students by exposing them to different ways of thinking about math, and by doing so kindle further interest in the subject.

Benefit to the Education Profession

This project has contributed to the inquiry of teaching fractions to ELs. This is an area of study that is vital to the success of ELs struggling with EAM concepts. Through this project, the author was successful in combining food and fractions into an engaging curriculum. He is proud to have contributed to the field of research, and hopes that this project can help others who are looking for ways to provide culturally responsive instruction in mathematics.

Conclusion

Over the past 3 years, the author has developed a capstone project based on the following question: *How can culturally responsive mathematics strategies be implemented in a small-group EL setting?* He created a 10-day fractions curriculum that used researched strategies to better support ELs' understanding of the concept. He combined research, the WIDA English Language Proficiency Standards and UbD to create a project that followed the state standards, and provided engaging lessons to students that supported their learning.

Through his research for this project, his experience as an EL instructor, and the knowledge gained through Hamline graduate courses, the author is confident that the curriculum he created will benefit students' acquisition of fraction concepts.

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