

Ethnomathematics: Incorporating Students' Identities and Communities in Mathematics

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## Table of Contents

Dedication .....	3
Abstract .....	4
Segment One	
Context .....	5
Positionality.....	8
Emerging Questions .....	13
Segment 2A: Developing a Deeper Understanding of the Inquiry .....	15
Action Plan .....	22
Segment 3: Findings and Implications .....	27
Introduction .....	27
Theory .....	29
Findings and Themes .....	30
Theme 1: The Power of Relevant Topics and Real-World Connections .....	30
Theme 2: The Benefits of Collaboration .....	34
Theme 3: The Importance of Active Hands-On Learning .....	37
Implications For Teaching and Further Study .....	40
Inquiry Stance and Social Justice .....	41
Glossary .....	43
References .....	44
Appendix .....	46

*Dedication*

For my mom, Sanjana. Thank you for always supporting my aspirations and making the sacrifices you did to ensure I would have a good future in this country. Love you forever mamas.

To Tesh. Thank you for always being an immense source of support, since we were children. Despite our rough patches, thank you for guiding, anchoring, and inspiring me to become a teacher, and fight for my students every day.

To Jeff. Thank you for guiding and helping me through the toughest days in this program. Thank you for providing warmth and genuineness.

To my 20 creative, rambunctious, outspoken, and loveable first graders. You have changed me as a person, teacher, and student. Thank you for being who you are and inspiring me to be a better teacher every day. I love you all so much!

**Abstract**

Ethnomathematics is the study of the relationship between mathematics and culture. Using community of learners theory, the idea of experience and education, and culturally relevant pedagogy, these studies encompass a holistic classroom where students would be able to relate to the curriculum. These studies integrate relevancy of material, multicultural perspectives, as well as student communities within the classroom. In this inquiry, I explain the findings from a qualitative study that explored incorporating student identities and communities with mathematics. Students engaged in three overarching practices which included: engaging in relevant topics and real-world connections, working collaboratively, and using active hands-on learning activities to promote retention. These findings suggest that teachers can create an equitable and culturally sustaining classroom environment, specifically when teaching math by integrating multicultural books into lessons, asking for parent involvement, creating hands-on activities for centers, as well as encouraging social and peer interactions to promote student-to-student learning.



### **Segment 1: Context**

#### ***School/Classroom Context:***

I teach first grade at a charter school, specifically a primary center in downtown Los Angeles, serving about 300 students in transitional kindergarten, kindergarten, and first grade. This charter organization was founded in 1980, focusing on youth facing homelessness. This school is a Title One and serves families that are economically disadvantaged. Most of the families at this school speak Spanish or an indigenous language from Central or South America. This school also offers its students free breakfast, lunch, and snacks. Ninety percent of students who attend this charter also take part in after school program activities, which begin at 2:10pm, and students stay until parents pick them up at 5pm. We have professional development every Wednesday from 1:35-4pm, but training and support for first year teachers is rarely given. I often find myself asking other new teachers for planning support or research on my own.

I have 20 students, nine males and eleven females. The demographics of my students include, 0.5% South Asian, 10% African American, and 85% Latinx. Ninety percent (18 out of 20) of my students speak a language other than English. Ten of my students participate in the after-school program mentioned above. There are eight struggling readers in my class, four students at reading level A, and three students at reading level B. Ten students are at level at the beginning of the school year and are reading level C texts, one student is at reading level D, and one student is at reading level E. One student has no letter sound correspondence, struggles phonemically, which includes: recognizing initial, medial, and end sounds, and has no concept of print—I have requested intervention for this student, and am waiting for the process to take full effect. At the beginning of first grade students are expected to be level D for reading, they are expected to be at

level H at mid-year (around February), and should be at level J at the end of first grade. Eight students need more support in all subject matters, including reading, writing, phonics, and math.

Every teacher has an instructional aide for approximately two hours of the day. Since the school's mission is focused on social and emotional growth/learning, many of our students are pulled to meet with a variety of specialists for speech support and therapy. I have four students who are pulled twice a week for about 30 minutes for speech therapy. I also have an Instructional Aide who comes in everyday (Monday-Friday) from 10:30-11:28 and 12:10-12:30. We have library every Friday from 9:05-9:35pm, and Physical Education (PE) every Tuesday and Friday from 11:20-12:10pm. The librarian engages students with a read aloud and then allows students to browse the library and read books that they are interested in. Students are allowed to check out one book a week with their parent's permission. We have a PE teacher who organizes instructional playtime for all classes at the primary center. We also have campus aides who watch over students during breakfast, snack, recess, and lunch. There is no actual playground at this school, therefore, the campus aides plan and have the students play constructive games with each other.

At our school site, we are required to use Lucy Calkins' strategies as an approach for our reading, writing, and phonics curriculum. We also use Math Expressions for math and Heggerty to assist our children in phonemic awareness, as well as Smart Start to assist with ELD. We are piloting a new science curriculum called HMH Science Dimensions. There is no required curriculum given for social studies. Each grade level has a scope and sequence for the year that is determined by our ILT (Information and Learning Technology) team. The scope and sequence is supposed to mirror our required lesson plans for the week. However, as there is a lack of collaborative grade level planning from teachers, there is not much accountability in terms of how we are supposed to teach the curriculum. Furthermore, there have been a series of standardized tests

thus far: DIBELS, ELPAC, BOY (beginning of the year) Math Assessment, F&P running records, a Spelling Intervention, and Heggerty (testing phonics).

For teaching Language Arts, I use a document camera, Youtube for some read alouds, the classroom library, literacy centers focusing on phonics (letters, sounds, and connecting pictures with words and writing activities). I have also made book baggies for students containing texts that match their reading levels and pull small groups of students during centers to facilitate guided reading and practice phonics skills.

On another note, I have grown to know my students as the people they are. Each student has their own persona and quirk that makes my classroom wholesome and genuine. I emphasize that “we are a classroom family” to further build a sense of community. My students can work independently to a certain extent. They are all open to learning new things, writing about topics that interest them, and have a love for math and science. My students are practicing kindness and being respectful to one another and are always ready to help their friends. They look out for one another as well and tell me when they think someone is being treated unfairly. They stand up for each other and that is powerful.

***Positionality:***

As a child, I was told education would help me not only progress but succeed in life. School has always played an essential role in my life and continues to be just as significant. I watched my mother struggle to make ends meet as a single parent; there were days when we had neither electricity nor hot water. I remember asking myself, my mother, and god (whoever/whatever that higher power might be), “Why me?”

I had to push myself in school and perform well in order to prove my worth and value. I would not give up because of the adversity that I had to face. I realized from an early age that I was not as privileged or given the same resources as some of my peers; I could not afford supplemental tutoring or take vacations because my mom had to support both of us on one income. I knew I had to work harder in school, no matter what obstacle was thrown in my path. I would overcome my hardships; I would be known and acknowledged for my merit. I would not let my socioeconomic status, single-parent household, or the unequal systemic structure that has been set in place in higher education deter me from pursuing a college degree. My mind was set; nothing would make me give up my educational aspirations. Now that I have a bachelor’s degree, a multiple subject teaching credential, and I am now working on a Master’s in Education, I know for a fact that a person’s background does not define them or their potential.

Throughout my K-12 educational experience, I never had a teacher who identified as being South Asian. There was a deficit in diversity of my educators; I grew up not being able to completely identify with the person with whom I spent most of my days. Even though my educators were not as diverse as I would have liked, school was still a safe haven for me. Walking into my classrooms almost gave me a sense of relief. I knew I was there to learn, therefore, whatever worry or stress that I had prior to the beginning of school would dissolve on its own.

With my experiences in mind, I hold the concept of inclusivity close to me. In order to promote a sense of community in a classroom, every student and their cultures should be valued. Each student should be represented and feel like they belong in their classroom because they, in fact, do. This is where social justice becomes intertwined with my positionality on inclusivity. Social justice means to make the classroom, curriculum, and activities involved in the learning process equitable. It means that despite the adversity students face, they know that there is hope for them to have a better future with their education. Social justice means to prove all stereotypes about people of color wrong and to dismantle systemic racism—brown and black children will succeed too.

Now that I'm a first-grade teacher and I am responsible for the learning of 20 students, I constantly find myself reflecting on my teaching practices. What can I change to help this student? What can I do to support this student in phonemic awareness? How do I make this student feel like this classroom is their safe place? All my students are black or brown. I have two African American students, one South Asian student, and seventeen Latinx students. They all have their own personalities, likes, interests, and stories they like to share from home. Once I learn about their interests, I try to incorporate and implement them into our daily lessons. I use students' names when launching math (adding and subtracting) problems, while also incorporating what students talk about, plushie toys and LOL pets are examples.

I have also realized my students enjoy hands on and interactive activities, which help them retain information better. For example, while learning about sound and vibrations in our science unit, I had students play with actual instruments: a triangle, a bell, a rubber-band, and a thunder noise maker. Now, my students show me how to make sound with rubber bands every

time they get their hands on one and refer to what they hear by using our science vocabulary “vibrations.” I had the students practice their counting with a pumpkin activity, where they had to help each other count and figure out how many pumpkin seeds were in their group’s pumpkin. One group drew pictures to illustrate the number of seeds, another group attempted to add all the numbers, and another group choral counted with each other—the different strategies used were wonderful to see. They then graphed their guess number of seeds and compared it to their actual number of seeds, and we were amazed as to how close or far apart the numbers were. I now see my students using various strategies to figure out adding and subtracting problems while doing math as well. Some draw pictures, a few count with their fingers, and others use equations that are given or come up with their own.

Moreover, it is crucial to maintain and build a classroom community. I incorporate turn and talks, as well as partner shares as much as I can. I validate my students, and we constantly hold meetings where we talk about how we can help, support, and give love to one another. The social emotional learning we are doing in the classroom has helped many students speak up more in class and express gratitude towards each other; I can see my students feel comfortable in our shared space. We were able to discuss what consent means in the class, as well as what appropriate and inappropriate touching means. Some students still refer to our consent conversation and tell their friends, “I did not give you permission to touch me.” I also recently started a “resting time” or five minutes of meditation after lunch. I have the students get comfortable in whatever way feels right to their body; this includes putting on a sweater, laying down on the carpet, staying at their desks, and going to the library. Some take a nap, lay down quietly, or work quietly on a may do assignment. While they rest, I have them repeat these five phrases: “I am great, I am

wonderful, I belong, I am safe, and I am loved.” I have noticed that the five minutes of meditation has been helping with their writing stamina and working with other students in cooperative ways.

I learn something new about my students every day, and I am mistaken for “mom” multiple times throughout the week. I am ecstatic at the progress that I have seen in the past few months. The familial love portrayed between students makes the classroom feel like a second home, and my students also remind each other that we are, in a sense, a family.

I have learned exponentially in the first few months of my teaching career—it is difficult, challenging, and no two days are the same. I have grown to love my students and the people they are. Although teaching is challenging in every way imaginable, with teaching curriculum, being a nurturer, managing various personalities, the emotional toil, etc., being a social justice educator is more than showing up in the classroom and teaching what you planned. You must adapt, be flexible, and keep your students’ needs in mind. Teaching in downtown LA has opened my eyes to hardships my students face daily that I had not realized.

I have learned to make sure each student gets a vocal “good morning” and warm smile, because they deserve to know that they are appreciated for coming every day. My communication with parents has improved as well. I have parents contact me on ClassDojo about homework, tests, for explanations about announcements that come home, and to visit our class in general. The communication is key to our relationship. I was a little uncomfortable at first, but grew more comfortable through the constant communication, and I was more than prepared for our first round of parent-teacher conferences.

I have grown to learn that my students need more support than the materials and curricu-

lum that is provided. I find myself constantly buying manipulatives, supplies, and center activities for my class. I find myself thinking about my students and my classroom when I wake up, when I am in the classroom, and before I go to sleep. To me, being a social justice educator means to put your needs aside and focus on the bigger picture—I am here for my students. I am doing this work because of them. I believe by telling my students that, although I can be strict, I love them and appreciate them, and from this, so much love has been portrayed in the classroom—lots of hugging is also practiced. In the past few months, I have also noticed that I have been bonding with my students well, and I converse with them about their lives in general. I am getting to know them outside of the classroom and learning how they feel about matters that occur at home.

In fact, some of my students ask me to let them stay in for recess and lunch so they can spend more time with me. They all have a special place in my heart, and that helps me remember why I became a teacher in the first place—to help children succeed despite the hardships and adversities they face. School was my safe haven, and I believe the same applies for many of my students. The emotional aspect that goes with this job is still new to me, but it is true, I feel everything. Someone once told me, “if you are not giving your students your all, what are you really doing?” And that stuck with me. I intend to give my students 110% of myself each day because that is what they deserve.



### *Emerging Questions*

While working and exploring with my students, I have learned exponentially about the way that they interact with each other, communicate, and care for one another. They care deeply for one another and the sense of community in the classroom has also increased—not only is it visible but the presence of it is felt in the classroom as well. My vision for my inquiry project spurred interest in introducing various cultural holidays in our daily classroom curriculum. When I started to teach, one of my primary goals was to make my students' learning experience more holistic, in terms of integrating culture and diversity—these two aspects are dear to my heart.

I introduced art projects that included papier-mâché skull candies, lantern making, and diya (candle) making in relation to Moon Festival, Diwali (the festival of lights), and Día de Los Muertos to allow my students to be aware of cultures other than their own. We made paper lanterns with Chinese symbols meaning happiness, love, and moon, while we learned about the Moon Festival. We made diyas for Diwali and made sugar skull popsicles in addition to coloring our own papel picado for Día de los Muertos. My 20 students were excited and eager to learn about different cultures; they were also having discussions about the different identities that were being introduced. While teaching about Diwali and introducing my students to Hinduism, many were mind-boggled about polytheism. One of my students stated, “there is only one god, and he is a boy.” I took that learning opportunity to discuss that different cultures and religions have their own beliefs. I explained that in Hinduism there is more than one god, and each god has a specific job that they do. My students were surprised and eager to learn more. I thought it was wonderful for my scholars to think about such topics at their age. With that being said, cultural

hands-on art projects come to life in the classroom; the room becomes a lively learning environment, full of questions and enthusiasm.

While teaching multiple subjects to my students, I found math to be the subject that I wanted to delve deeper into and further explore the integration of cultures. While researching on ways to implement culture in math, I found the term Ethnomathematics to describe what I wanted to explore. I questioned myself on how I would be able to make mathematics more relevant for my students. I found myself thinking of ways to make math more interactive and hands-on for my students as well, and I think by integrating how various cultures contributed to math and what it is known as today would deepen their understanding of mathematical concepts. I plan to integrate books and read alouds in order to introduce various cultures and their relation to mathematical concepts. Video and songs of various cultures will also be integrated in math lessons, such as counting in Swahili, to have students count numbers in languages other than their own. I will implement math centers, where students will be able to play with the Mancala game and practice counting. We will also look at patterns from different cultures.

My overarching question is: *How does integrating cultural diversity and students' communities in mathematics deepen student involvement, and increase mathematical performance?* Some supplemental questions are: How can implementing cultural poems, stories, and music/lyrics assist students in strengthening their literacy skills and mathematical performance? How will integrating students' identities in math problems affect their overall interest in math? How can I differentiate math strategies for the various mathematical abilities present in the classroom, in consideration of culture and community for my students? With these questions in mind, I believe my MIP will not only be fun and interesting for myself, as well as for my students, but the learning that will come out of my research will be worthwhile.

**Segment 2A: Developing a Deeper Understanding of the Inquiry Question*****Inquiry Question***

*How does integrating cultural diversity and students' communities in mathematics deepen student involvement and increase mathematical performance?*

***Summary of Theories***

As I started my teaching journey last August, I came into the classroom with a desire and will to integrate my students' identities, communities, and experiences into the curriculum. I believe a student learns best by being able to relate to the material presented—why else would they care about what they learn? With integrating students' experiences into various subject matter, specifically mathematics, I found myself bringing into the classroom ideas about experience and education by John Dewey. According to Dewey's theory, a good education should have both a societal purpose and purpose for the individual student. Dewey's progressive learning theory is based on the idea that people are not blank slates waiting to be filled with knowledge from kindergarten to college; rather, students organize fact-based comprehension via metacognition and build on to prior experiences, preconceptions, and knowledge (Gouinlock, 2018). Educators play an important role in a student's educational experiences. Dewey emphasizes experience, experimentation, purposeful learning, and freedom in progressive education because he believes that teaching is not static (Gouinlock, 2018). The quality of an educational experience is critical, and he emphasizes the importance of social and interactive processes of learning. As I dove deeper into Dewey's theory on experience and education, I began to think about ways of making mathematics more holistic and relevant for my students—how would I be able to bring in their experiences and prior knowledge in mathematics and make the content purposeful for them?

In addition, the inquiring nature of thinking becomes all the more apparent where Dewey describes the role of thinking as a reflective experience (Gouinlock, 2018). He distinguishes between the reflective experience and trial and error–like learning. Both kinds of experience follow three steps: "a problem emerges during an activity; an image emerges as to how the problem might be solved; the activity is adapted in accordance with this image" (Ploeg, 2016, p. 5). However, in reflective experience, the second step is more complex than in trial and error–learning (Ploeg, 2016, p. 5). Dewey's concept on reflective experience coincides with CGI (Cognitively Guided Instruction). Analyzing, talking, and having students lead conversations about what happens in story problems deepens their understanding of what is actually happening in the problem, rather than jumping to find the answer. I find the reflective experience being essential for my students because the foundational understanding of what words mean to figure out story problems is pertinent.

By working on bringing students' experiences into the classroom, it is crucial to practice Culturally Responsive Pedagogy (CRP). CRP embodies students' unique cultural backgrounds, knowledge, and characteristics to inform instructional strategies and content. It is founded upon the belief that students succeed and thrive in learning environments that allow their cultural capital to be incorporated in their schooling experiences. CRP gives students the opportunity to build upon their own prior knowledge to make connections to new information in a meaningful way. Gloria Ladson Billings (2013), one of the first scholars to define CRP, refers to it as, "a pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes" (p. 13). CRP also focuses on building critical consciousness in students. Students are encouraged to examine their social and political positionalities, be critical thinkers of society, and be empowered to transform their communities.

As a teacher, it is essential for me to “inspire, motivate, instill values and knowledge that nourish racial pride” and represent the various identities in the classroom (Bassey, 2016, p. 1).

Instilling the concept of community in the classroom also helps students feel accountable not only for, but also for the learning of their peers. I make it a point to tell my class that "we are a community and everything we do is a classroom effort." This encourages my student tutors (high flyers) to aid struggling students. In a community of learners, “students appear to learn how to coordinate with, support, and lead others, to become responsible and organized in their management of their own learning" (Rogoff, Matusov, & White, 2018, p. 225). I have also found that incorporating students’ names, interests, friend groups, and stories that happen in class, excites my students and engages them further while doing our daily math warm-ups; many love seeing their names and their friend's name on the board, in a story problem. As Rogoff, Matusov, and White (2018) mention, it is "inherent to build on interests to learn in new areas and to sustain motivation to learn” (p. 225).

### ***Research of Pedagogy***

As I look at my nineteen scholars, I think about ways that I can bring identities, communities, and cultures in the classroom. Their representation, as well as mine, is significant to my teaching practice—I hold the concept of community and diversity close to me. I found myself thinking about integrating cultural read alouds, alternate ways of counting from various cultures and languages, and understanding the origin of how mathematics came to be, which is the focus of this inquiry project. I currently use Math Expressions, a math curriculum used by the school with my students and find it dull and shallow. When I look at my class, I see nineteen Black and Brown students who deserve better teaching methods and curriculum that involves them and who

they are as individuals. They should also be exposed to, and learn about, identities other than their own—building from their prior knowledge.

Ethnomathematics describes the study of the relationship between mathematics and culture. D'Ambrosio (2001) defines Ethnomathematics as "ingredients that make up the cultural identity of a group: language, codes, values, jargon, beliefs, food and dress, habits, and physical traits" (p. 308). Whereas, mathematics expresses a "broad view of mathematics which includes arithmetic, classifying, ordering, inferring, and modeling" (D'Ambrosio, 2001, p. 308).

Ethnomathematics is learning about mathematical concepts and their origins that are "present in all cultures," although they may "differ from society to society in how they manifest in their cultural content" (Amit & Qouder, 2017, p. 3). Amit and Qouder's research discuss the weaving of culture and mathematics, and how incorporating cultures of students of colors can better aid in mathematical performance, due to the lack of representation for students of color. According to D'Ambrosio (2001), in traditional "mathematics classrooms, the relevance of culture has been strangely absent from the content and instruction" (p. 309). In accordance, Amit and Qouder (2017) assert that we should not be "discriminating against certain students and perpetuating a culture of intolerance and inequality" (p. 3). As D'Ambrosio (2001) explains, it is vital for students to know the history of mathematics and the various cultures that made it what it is today, because mathematics is still transforming and being created by various people.

In order to promote and practice, not only equality, but equity (being fair to all people in accordance to their abilities, skills, and identities), culture must be clearly defined. A person's culture includes their beliefs, values, attitudes, customs, social relationships, art, and literature that define them (d'Entremont, 2014, p. 3). Implementing and integrating a person's culture into a classroom is empowering. Nasir, Hand, and Taylor (2008) write:

I have noticed my students struggling with basic mathematics foundations, such as adding and subtracting single digit numbers, adding tens, and conceptually thinking about more than one way of solving a word problem. By integrating their interests, cultures, and backgrounds, I am hoping to help them deepen their understanding with these mathematical concepts and algorithms, as well as genuinely increase their interest in the subject matter. I want to help my students succeed by giving them the necessary tools and skills to form community relationships and roles with one another, which will allow them to carry out various methods while practicing their math problems (p. 6).

It is necessary for students to have and practice "roles of learners who are purposeful, integral, and active" to be engaged and succeed in their learning (Nasir, Hand, & Taylor, 2008, p. 6). To support this claim, Nasir et al. (2008) compare how basketball players perform on mathematic questions in relation to basketball (an interest) versus mathematics problems that they do not relate to. While asking questions in relation to basketball, the players invented their own strategies and solved their problems by thinking analytically, how their actions would impact their game. When given a standard problem that was unrelatable, the basketball players over-thought the problems and made several errors. When subject matter is relatable and realistic, all students have the ability to critically think and problem solve in their own ways.

Furthermore, within ethnomathematics, multiculturalism and educational equity intertwine. A multicultural education (lesson plans and curriculum designed for students of color) create an inclusive learning environment which makes "schooling more meaningful and responsive to cultural differences among students" (Florence, 1998, p. 9). While analyzing the work of bell hooks, Florence (1998) discusses the importance of representation and genuinely acknowl-

edging the demographics present in the classroom--how are students expected to learn curriculum that they cannot identify with? Noticing, accepting, and being aware of differences present in the classroom can be empowering if identified and represented respectfully and intentionally. As I move on to conduct this research with my students, I hope to learn how creating a more inclusive and culturally responsive classroom environment while practicing intentionality will affect and/or influence them in relation to mathematics.

### *Assumptions*

Since the beginning of the school year, I have noticed my students struggle in all subject matter due to the inconsistencies of teachers and curriculum used in the school. It was brought to my attention that I was playing catch up from kindergarten because of a learning gap. Although many of my students have verbally stated that they enjoy math, their skills and knowledge are not transferred from classwork and our daily math warm-ups to their assessments. I have also noticed that the standardized tests are significantly more difficult for my students; I presume because of the language difference (standard tests taken from their math expression assessment books). My students are better able to grasp and understand concepts that are discussed as a class and have a hands-on component. In social studies, we have read, discussed, and done art projects on Lunar New Year, Diwali, Christmas, Hanukkah, and Kwanzaa. We have also discussed great Latin American influencers, such as Frida Kahlo and Cesar Chavez. My students still remember art activities and science activities from months ago because they were able to play with instruments, use art supplies, and interact with each other by having meaningful conversations and validating each other's work.

In addition, my students constantly talk about their home lives, their likes, dislikes, and interests. I found myself gravitating towards math because it is a subject that I want to immerse



myself in with my students and deepen their understanding of the skills that they will carry with them after first grade. Just as they are able to remember Diwali and what bindis are, and how many candles need to be on a menorah, I hope they will remember math concepts that are integrated with various cultural aspects, long term. Zaslavsky (1996) writes, “Multicultural mathematics education is for all people, whatever ethnic/racial heritage, their gender, or their socioeconomic status” (p. 2). As I bring in multicultural perspectives into math lessons that I will create, I will be able to enrich my students’ learning by broadening their views on how math can be approached; this includes implementing various cultures, identities, and perspectives into their learning materials (Zaslavsky, 1996). My assumption for this inquiry project is, in order to build a stronger sense of community with my students and strengthen their math abilities, being culturally responsive and aware is essential.

### **Segment 2B: Action Plan**

I created my action plan to last eight weeks in order to see if implementing culture within mathematics helps students enhance their mathematical skills and increase engagement in the subject. During the first week, we talked about how we feel about math. My students took an emoji survey that described how they felt about the subject; the feelings varied from "love it, good, okay, sad." I also read aloud *The Patchwork Quilt*. While doing so, my students turned and talked about what they noticed about the quilt in the book, the patterns they saw, and why the quilt was important. We then started a classroom quilt project where I cut construction paper (various colors) into large puzzle pieces. We were working on adding teen numbers, so I put adding and subtracting problems on the puzzle pieces. The students solved their math equations by showing different strategies. After collecting and laminating the puzzle pieces the students put their puzzles together. I taped them together and we did a "What do you notice?" activity. The students talked about patterns they noticed, any wonderings, and asked questions about how their classmates solved some of their problems--many caught errors in their problem-solving strategies, this was a great reflection piece.

In the second and third weeks, we worked on counting in different languages. I read aloud *Can You Count Ten Toes?: Count to 10 in 10 Different Languages*. We discussed the various languages shown in the book and voted on our top three languages that we wanted to count in. We kept the Hindu-Arabic number system, voted on Spanish, and Chinese. After voting on our three languages, we wrote numbers one through ten in each language on chart paper. We practiced counting in each language every day that week. We also had a math center where students worked on counting collections and each table group had their own collection, including colored square manipulatives, beans, toothpicks, and tens and ones foam manipulatives.

In the third week, I introduced the Mayan civilization with a *Brain Pop* video. I charted counting from one to ten using the Mayan number system. We then compared and did a "What do you notice?" activity, and students noticed differences and similarities between the various languages. One student even noticed a high frequency word for the word "er" pronounced "are" for the number two in Chinese. Furthermore, as an extension of the Mayan numeral system, I modeled picking a number of choice (nine) from one to ten in the three languages we voted on (Chinese, Hindu-Arabic, and Spanish). I chose Spanish (nueve) and then found the Mayan equivalent and represented it with toothpicks and beans. Students were then able to pick their own numbers, language, and find the Mayan equivalent. The last day of the third week was dedicated to review. Students reviewed counting in different languages and working on counting collections, and one-to-one correspondence.

The fourth week we reviewed material for our unit five test based on the Math Expressions curriculum. In order to work on review, I used students' names in word problems that show adding/subtracting of tens with their interests, likes, and dislikes in mind. For example, "Jordy had 20 beyblades. He gave 10 to William. How many beyblades does Jordy have now?" We then worked on math cultural centers based on winter holiday themes, such as Diwali, Hanukkah, and Kwanzaa. Students practiced counting and matching numbers to their dot equivalent and used paper ten frames to count. They also used large dice with numbers written in the tens form to add and subtract, matched and counted the sides of various polygons, and graphed Kwanzaa sets of various images. The rest of the week was dedicated to reviewing the test and taking the unit test.

For week five, we focused on exploring and representing data, as well as data collections. I first surveyed the class on how many siblings they have or do not have. I wrote their names under the appropriate group and asked the students which group had more people and which group

had fewer people. I then asked the students how they knew, and they knew the group with fewer students was less because "the number is smaller" than the other group. I then read aloud *My Granny Went to Market* and charted all the places the protagonist went, and all the things that were bought in those places. I made exit tickets asking students whether Granny bought more or less of some of the items and how they knew. We also went over vocabulary words, "more" and "less." The next day, I surveyed students on their favorite fruits. I chose ten students at random by using equity sticks (name sticks) and then we voted on our top three fruits: apples, mangos, and strawberries. Students filled out a worksheet that asked questions like, "which fruit received the most votes and how do you know?" They then graphed the results from the number of votes each fruit received. I brought in fresh fruit salad made from green grapes, strawberries, blueberries, and oranges. Each student received a scoop of fruit salad, counted their fruits, graphed the amount of fruit, and answered more and less questions. I supplemented their learning of graphs and more and less questions by conducting an m&m activity. Students sorted their m&ms by color and answered more and less questions. After doing so, they tallied the amount of m&ms they received, graphed it, and colored in the total number of m&ms.

In week six, we focused on comparing problem types. I read aloud *My Food, Your Food*. There were questions in the book that asked students what kinds of food their families eat for dinner, where in the world their families come from, etc. I used this information to facilitate discussions. I sent a letter home to families asking for family recipes to coincide with our more and fewer unit. Twelve recipes were returned. The students discussed how much of each ingredient their recipes had. Some examples of these questions are: "do you need more meat or more vegetables? Do you need less fruits than vegetables? When making your dish, do you need more foods to go along with it or less foods to go along with it? Students then shared their recipes with

the class, including a picture or drawing of that food item. I introduced the concept of a skit with my students. I had charted scenarios and the type of math on two different chart papers. The students made up groups of three or four and then chose their scenario and type of math, such as: counting from one to ten in a different language, more and less conversations, Mayan bars and dot strategy, counting by 10s, etc.

In week seven, I focused on extension lessons of more and less problems because I found the terminology and language was confusing to many. While integrating nutrition, we made homemade trail mix that included dry fruits (cherries, raisins, and cranberries), pretzels, and cheerios. We discussed the various tastes, our likes and dislikes, as well as which ingredient we thought there was more of. We also had a parent come in and share their family recipe of fruit salad with sour cream and marshmallows. The parent discussed what went in the fruit salad, apricots, apples, pears, sour cream, and marshmallows. The students were enthralled and enjoyed their treats. We then talked about which ingredients were used more and which were used less; marshmallows and apples were added the most. For the duration of the week we continued to work on our skits and backdrops.

For week eight we reviewed the unit 6 test and then tested. We also performed our math skits in class. I then began their shapes and fractions unit with a shape collage and cookie fraction activity. In the shape collage, students were allowed to make art with the shapes cut from their Math Expressions workbook, which included circles, squares, rectangles, and triangles. They then labeled and wrote down how many sides and corners each shape had. I then surveyed the class on which part of the cookie they wanted, a half or a fourth. Many voted on fourths initially. After cutting the cookies in halves and fourths, the votes switched to the halves side--their

learning was evident here. We then ended the week with the How do you feel about math? post-survey.

### **Segment 3: Findings and Implications**

#### ***Introduction***

I initially began my inquiry in Ethnomathematics because of the diverse group of students that I have. They are curious about other people, cultures, and share many stories and traditions from home. At the beginning of the academic year, I noticed a learning gap between half of my students, due to what I believe were extenuating circumstances, long term substitutes and language differences at home. I noticed many of my students struggling, yet enjoying math, which led me to focus my inquiry on culture and mathematics. I began the year with 20 students and currently have 18. My students have grown exponentially and express their opinions and feelings daily. With that being said, I am a first-grade teacher in downtown Los Angeles and work for a charter school and primary center that serves about 300 students. My school includes transitional kindergarten, kindergarten, and first grade. The demographics at this school are predominantly Latinx, while we also serve African American and South Asian community members.

As I noticed what my students were interested in, it made me question what I could do to foster their learning and growth. This led to my inquiry question: *How does integrating cultural diversity and students' communities in mathematics deepen student involvement and increase mathematical performance?* I planned eight weeks of intervention with my students that included cooking, cultural math centers, integrating family recipes, diverse read alouds, integration of art, and learning about other cultures and languages as they relate to mathematics. Their summative project was to create and act out their own math skits. While conducting the intervention, I noticed students needed more extension lessons from previous math lessons, which prolonged my planned eight weeks. I dedicated a week to reviewing materials with my students and going

over the language that was used in Math Expressions, the curriculum we use to teach mathematics. Some examples include, “ring the answer” which means “circle the answer” and “which fruit was fewer than bananas,” which required my students to know what fewer meant and they would need to know how to compare the amount of fruits to each other. I also noticed my students becoming confused with their word problems. It seemed as though instinctively once they saw two numbers, my students thought they should add. I had to reread many word problems repeatedly and point out words like “fewer, more, and than.” Each word meant that the word problem was asking for a different way to solve it. I explicitly told my students “than” meant comparing, and when two things are being compared, they subtract those numbers.

My students loved counting and speaking in their own languages and when I read *Can You Count Ten Toes?: Count to 10 in 10 Different Languages*, they were excited to speak not only in their native tongue, but other languages as well. My students loved food, and from what I noticed, they learned better with hands-on lessons. While conducting my intervention during week five, I brought a bowl full of fruit salad that contained green grapes, blueberries, strawberries, and oranges. They counted, compared, graphed, and ate their fruits. To supplement this activity, I had them count, compare, and graph M&Ms as well. My students were active, engaged, and seemed excited about the treats they got to eat after completing their activity. In order to circle back and see how much my students had grown and learned, I wanted them to show and express their learning creatively—which led me to introduce math skits. They were in charge of picking their own groups, their scenarios, and their math focus. I also chose four focal students to assess their learning throughout the intervention, due to chronic absenteeism and making sure I had enough data from my students when one was absent (see Appendix A).



*Theory*

The three theories that guided my intervention and its focus on Ethnomathematics were: John Dewey's progressive learning theory, Gloria Ladson-Billing's culturally responsive pedagogy (CRP), and Barbara Rogoff's community of learners. Dewey's theory helped me realize that learning should be purposeful and intentional—it is important to explain why students' learning is important. My students learn and grow from past experiences; they are eager to share their stories in class and become gleeful when their interests and names are shared in story problems during math lessons. They build off each other as well and learn exponentially from one another. This also led into my own daily reflections and questions, some of which consisted of: What can I better implement, and what can students practice more?

In consideration of Ethnomathematics, it was essential to represent, discuss, and immerse my students' cultural identities into the lessons. We learned where some of our families emigrated from, shared our favorite foods and recipes, and talked about our interests and what we do at home. Bringing their background and identities into the classroom was fundamental in this inquiry and correlated with CRP. My students were able to build off of their prior knowledge, learn from their peers, and make meaningful connections with one another in accordance with their culture and interests.

By practicing social emotional learning every morning and discussing our cultures, backgrounds, families, likes/dislikes, and interests, a community of learners was created within my classroom. The learning environment transcended into a space of free expression, open-mindedness, and acceptance of all differences—a genuine community was created. They were then able to work with each other independently and create their own skits that encompassed their learning thus far.

## ***Findings***

As we continued to work on our inquiry and intervention strategies, I found myself constantly deviating from the original action plan and teaching more extension lessons to better support my students. Overall, as the inquiry progressed, I saw more engagement, more involvement from students and parents, as well as improved test scores from some students. As I analyzed the data from the inquiry, I found three themes emerging: the power of relevant topics and real-world connections, the benefits of collaborative work, and the importance of active hands-on learning. I use pseudonyms for students' names while explaining the themes and implications.

### ***Theme 1: The power of relevant topics and real-world connections***

I found implementing relevant topics by reading diverse books, such as *The Patchwork Quilt*, *My Granny Went to the Market*, *Can You Count Ten Toes?: Count to 10 in 10 Different Languages*, and *My Food, Your Food*, to name a few, seemed helpful to build real-world connections. The read alouds acted as an introduction to our math lessons. In addition, by asking students to share their interests, family recipes, as well as bringing parents into the classroom also helped make the curriculum and lessons more relevant.

An example of asking relevant questions and surveying the class on topics they could relate to and build connections from was when we were discussing quantities and comparing who had siblings and who did not. I collected the data by asking each student whether they had a sibling or not, wrote it down, and then as a class we counted chorally how many students were in each group (siblings, no siblings). When I asked my students how they knew which number was

Siblings	No siblings
Isabella Genesis (15) More ↳ long list ↳ bigger number	Isabel Madeline Ricardo (3) Less ↳ little number ↳ less than 15

In order to make the concept of quantities (more and less) culturally relevant, I sent home a letter asking family members to write a recipe (see Appendix B). This was a significant moment in our

In order to make real-life connections in accordance to the recipes that were brought into the class, I sent home a math survey (see Appendix D) that would further my understanding on

the mathematical practices that happens at home. I also invited and gave parents the option of coming into the classroom to teach students' something of importance from their culture. One parent responded to the math survey and came into the classroom. My students seemed to be filled with excitement because family members visiting the classroom did not happen before.

The parent who volunteered to share their recipe with the class planned to make a fruit salad with sour cream and marshmallows; which was also one of my student's (Madison's) favorite treats at home. Madison stated, "fruit salad with marshmallows are good," as her dad started to place the ingredients on the

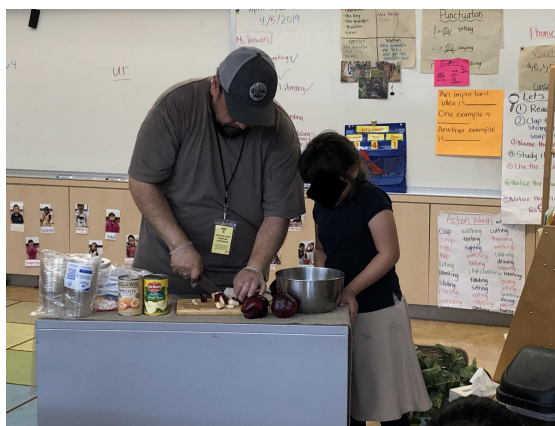


Figure 2: Making fruit salad with parent

cabinet (see Figure 2). The ingredients included: apples, apricots, pears, marshmallows, and sour cream. As a class, we discussed if we thought there were "more apples than apricots" or if there were "more pears than apples." While discussing the quantities of the ingredients, Madison stated, "that's a lot of marshmallows. I love marshmallows." Once she said that, Jordan chimed in and said, "there are more marshmallows than apples." As a class, we came to the conclusion that there were "more marshmallows" than any other ingredient.

Furthermore, discussing relevant topics such as number of siblings, recipes from home, and having a parent share their recipe with the class to supplement students' learning seemed to work well with my students -- they were engaged, and seemed to be responding better to these activities than workbook pages from the Math Expressions curriculum. My students seemed to be excited about topics that were relevant to them, such as sharing recipes from home, talking about their siblings, counting fruits and M&Ms, working together in centers, and practicing their

math skits. My students seemed to respond more positively to these activities, as Richard questioned "this is math?" while counting M&M's. When going over our "more and less" unit, or discussing quantities, I found it most effective when my students were able to see, touch, and taste, the materials we were using. In fact, according to Ladson-Billings' Culturally Responsive Pedagogy, "culturally responsive teachers are multidimensional because they engage cultural knowledge, experiences, contributions, and perspectives" (Aronson & Laughter, 2016, p. 165). This could also be tied with theme three, the importance of active hands-on learning, because not only were my students able to use tangible items as learning resources that supported their senses of see, touch, and taste, it also seemed as if they were able to make real-life connections with them as well.

Another example of implementing real-life connections was in their math centers focused on counting and grouping tens. I used household items in this specific center intentionally to allow my students to see that they can use anything to count, especially items found at home. Students were able to use Dixie cups and beans to group them by tens, they used toothpicks and grouped them by tens to count to one hundred, they used manipulatives, and marbles to make groups of tens as well. I also had my students fill out an exit ticket after they worked in their centers; exit tickets of my focus students Richard, Serena, and Angelica showcased their understanding of counting by tens (see Appendix F).

***Theme 2: The benefits of collaboration***

Collaboration seemed to play a big role in my students' learning while conducting this inquiry. Before starting this inquiry, the majority of my math activities were whole-group lessons that followed independent work. During my inquiry, a few collaborative interventions that I used with my students were our community quilt puzzle, a grouping tens math center, and a winter holiday themed math center which included activities such as Kwanzaa, Hanukkah, and Diwali.

The community quilt puzzle was an activity that followed *The Patchwork Quilt* read aloud. The goal of this activity was to build collaboration with students and for them to learn from one another as they figured how to solve their math problems. I cut puzzle pieces from construction paper and wrote addition and subtraction problems with unknown numbers. My students chose their own groups of three and began to solve their puzzle pieces (see Figure 3). Many students helped each other by using different strategies to solve their math problems as well; some used their fingers to count, some drew pic-

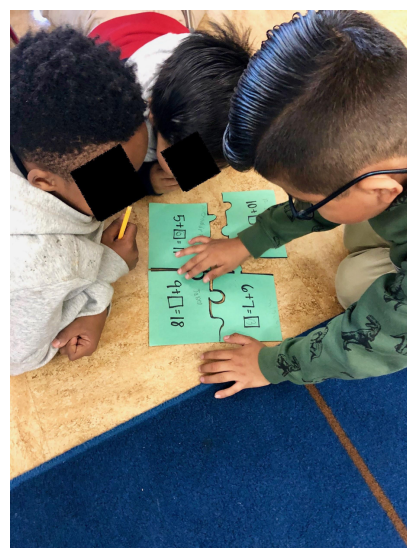


Figure 3: Students collaborating to solve puzzle pieces

tures, and others used the given equation and rewrote it as a subtraction problem to find their unknown. It was amazing to see the various strategies used on the puzzle pieces to showcase the different ways my students thought about and solved their math problems (see Appendix E).

Through collaboration, it seemed as if my students became teachers to one another. While my students worked in their cultural math centers together, I noticed one student, Laylah guiding another student, Aidan while counting by using ten frame pictures to count to twenty. Aidan was having trouble counting to nineteen and Laylah stepped in and counted with him so that he could count to nineteen. We can see Laylah and Aidan then sorting their ten-frame picture and the number nineteen in two different categories, being ten frames and numbers (see Figure 4). After Laylah had worked with and counted with Aidan, he was able to count to nineteen by himself--there



Figure 4: Laylah and Aidan helping each other count and sort

seemed to be significant learning happening through collaborating with one another.

While conducting this inquiry, I found myself reflecting on what worked and did not work for my students. The cultural winter holiday themed math centers seemed to be effective because students were able to work with each other and learn from one another. The centers included: Kwanzaa graphing, Hanukkah dominoes, Diwali sum sparklers (adding 3 single-digit numbers) and counting to 20 using tens frames with representations of people who are celebrating Kwanzaa, Hanukkah, and Diwali. While looking at Serena's exit tickets, I noticed she understood graphing more after this center than she had before (see Appendix G). She was able to write the number of objects in her Kwanzaa center accurately and she was also able to graph the number of items correctly. Before this center, Serena would count down vertically than count up, which would make her graphs backward and incorrect. When looking at her Diwali sum sparkler worksheet, she was also adding three numbers accurately, this concept seemed to be confusing before. Moreover, after analyzing my students' exit tickets, and noticing them adding numbers

more accurately before and being able to graph their counted objects with little guidance makes me wonder if my intervention strategies would be more effective if the activities were more center-based than a linear independent approach.

Our creative project at the end of the inquiry was a math skit where students would think of a scenario and pick a math concept to incorporate. My students picked their own groups, thought of a scenario, such as being in a park, arcade, school, or mall. After, my students discussed in their groups, which math concept they wanted to incorporate; many chose adding and subtracting and one group chose comparing quantities. They worked in their groups to create a story, they chose what characters they would play, and how they would use their specific math concept--this was the biggest collaborative project we had done so far. Angelica, Serena, and Mateo are acting out their scenario which takes place at the mall (see Figure 5). Here Angelica and Serena are acting as customer and cashier, where Serena is purchasing two markers. Mateo is playing a janitor and is using a broom as his prop--they thought of their props and conversations on their own. When Angelica grabbed the two markers from Serena, she said "one plus one equals two... that is 29 dollars" (Field notes 4/5/19). Angelica was able to tell her customer and audience, the class, the amount of items being purchased by adding out-loud, as well as how much they cost. Through their math skit, this group was able to collaborate together, bring in real-life connections and experiences, as well use hands-on learning through props and interacting with each other to implement their creative project.



Figure 5: Students acting out math skit for final creative project



***Theme 3: The importance of active hands-on learning***

Using tangible items to make real-life connections while working collaboratively seemed to benefit my students because they were able to learn from each other. Dewey asserts that "education should guard against restrictive development and promote personal initiative and adaptability" (van der Ploeg, 2016, p. 149). Creating hands-on learning activities, bringing in relatable and relevant material, as well as giving students freedom to play with and think about math in their own ways seemed to have helped my students retain mathematic concepts better.

A few hands-on activities used in this intervention were discussing quantities of more and less while conducting our fruit salad and M&M activity. I found my students were excited to work with food items and eat their treats after working on their math activities. For our fruit salad activity, I brought in fresh fruit, which included: oranges, strawberries, blueberries, and green grapes. I gave each student a spoonful of fruit salad in their bowl and had them count the number of their specific fruits. They then compared the quantities of fruits, which fruit they had the most of and the least amount of. Afterwards, they graphed their fruits. In Angelica's exit ticket for this activity, she wrote she had "fewer strawberries" than blueberries, she had "fewer strawberries" than oranges, and she had "more grapes" than blueberries; she also wrote "I got more grapes I have 9" (see Appendix H). Her answers are reflecting her thinking process and she was able to write which of the fruits she received more or fewer of. She wrote out her answers, and before this activity, her answers were not as clear and accurate. She was also able to extend her answer and essentially write she had more grapes than blueberries because she had a total of nine grapes--she was able to explain her reason as to why there were more grapes and seemed to grasp the concept of comparing quantities.

An extension of the fruit salad activity was counting, comparing, and graphing M&Ms. Similar to the fruit salad activity, I gave each student a scoop of M&Ms; they then grouped their M&M's by color and counted how many of each color there were. When looking at Serena's M&M activity, she answered her comparing quantity questions beautifully. She was able to tell the difference between the M&M color she had the most of and the color she had the least of. The M&M color she had the most of was blue and the color she had the least of was red. When she found the difference, it was 10 (see Appendix I). She was also able to explain why the color she had the most of had the longest bar on her graph. She answered by writing, "If you put 13 fingers up it is more" (see Appendix I). She also wrote and solved her own word problem, "How many emenems do you have? 37" (see Appendix I). By looking at Serena's activity worksheets and other students' work, the hands-on component seemed to help students understand the concept of which item is more and less, and how to compare them by getting their difference. As students were counting, adding, and sorting their M&Ms it seemed as if students were now aware of one color being more or less than the other.

Another example of what seemed to be an effective hands-on activity for my students

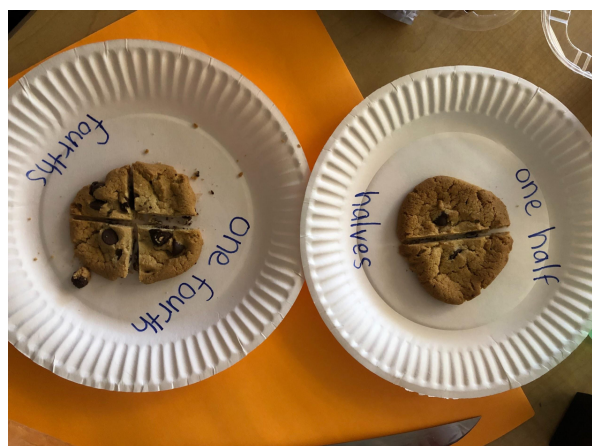


Figure 6: Real-life representation of halves and fourths with cookies

was when I introduced fractions in terms of halves and fourths. I started this lesson by asking my students which part of a cookie they wanted, halves or fourths? I gave them a post-it note, told them to put their names on it and vote. Initially, many students voted for fourths. When I brought in actual cookies and cut them into halves and fourths, the majority of the votes changed, which seemed to suggest a new

understanding of the concept of halves and fourths. They were able to reflect on their previous answer and change it.

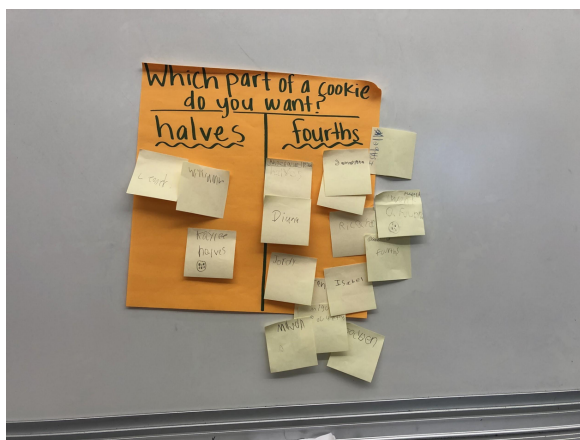


Figure 7: Students' initial vote on part of cookie they want

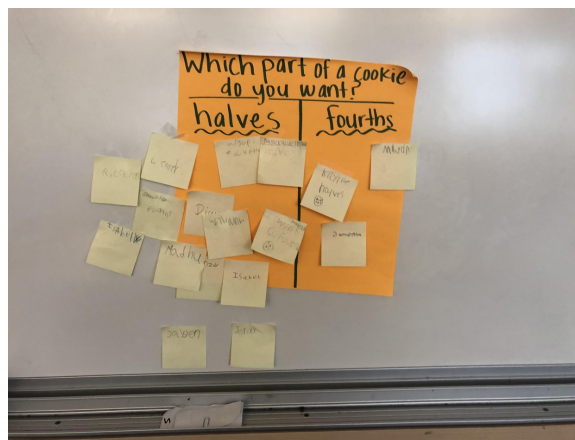


Figure 8: Final vote on part of cookie students want

In accordance to the idea of active hands-on learning, when we began discussing and reviewing 2-D shapes, I found many students had forgotten their shapes from kindergarten. As I proceeded with the lessons in the Math Expressions curriculum, many of my students still could not name their shapes. I thought about different ways that I could make the Math Expression lessons hands-on; I printed squares, circles, triangles, hexagons, and rectangles on various colored papers. I had my students cut out the shapes and then sort them by the number of sides they had, then sort them by the number of corners they had, and then by the name of the shape. Afterwards, I had my students make collages out of their shapes, where they had to name their shapes, and count the number of sides, as well as corners (see Appendix J). I found that by having my students sort their shapes in different categories (which led to the same shapes being grouped together) and then having them be creative with their shapes helped them see shapes in abstract items as well as real-life objects, such as houses and stop signs. For example, when walking around and seeing my students' shape collages, I heard Serena and Jordan conversing about what

they were making in their collages. Serena stated, "I'm making a stop sign," and Jordan said, "I'm making a pizza! My pizza has a circle and triangles."

### ***Implications For Teaching and Further Study***

As I reflect on my teaching practices and this intervention focused on Ethnomathematics, I find myself thinking of extension lessons that I could add to further support and supplement my students' learning. By conducting this intervention, I find myself gravitating to more center work because it is apparent and prominent that students learn a great amount through collaboration and active hands-on learning. Moreover, after this intervention I find myself becoming a more reflective teacher and constantly thinking about ways that I can further support my students' learning. Some things that I have learned about myself as a teacher is that I value incorporating my students' communities and identities in the classroom--their representation is significant. I also enjoy parent involvement in the classroom because through my experience, I found it to be exciting for the students, and it made curriculum more relatable and relevant. In addition, my students taught me that they learn better and retain information better when they work on active hands-on activities with tangible things, like household items and food. My students also enjoy talking about their interests, likes/dislikes, and stories from home--it is important to implement as much of the previously listed items into lessons and curriculum that is planned.

As a first-year teacher, in terms of the larger contexts of schools and schooling, I have learned that education is not equitable in schools, as well as the curriculum that is expected to be taught. I found myself creating numerous lessons I was expected to be taught by curriculum books to meet my students' levels and changing many scenarios in math problems as well as literacy discussions to help my students understand context. I also learned that each child's needs differ, and it is pertinent to practice intervention strategies by pulling small groups and having

center work to build on skills that are essential for their learning--sometimes whole group instruction is not effective.

During this intervention, I realized how important my students' identities are in their learning and they should know that their cultures and backgrounds should be applied in all aspects of the classroom--their cultures should be celebrated. Furthermore, the more small groups I worked in, I was able to target my students' needs and build on their individual skills. Some changes that I would make if this intervention were conducted again, would be to focus on math centers and pull small groups to work with various math level groups and struggling learners. I would also teach more extensive lessons on significant units, such as quantities, for a longer period of time, rather than plan different activities each week. Focusing on and extending lessons would be key to having my students retain more mathematical learning. With that being said, in consideration of my more advanced students, I wonder what effective extension lessons I could plan for them to also retain their learning and build, as well as strengthen, their skills.

### ***Inquiry Stance and Social Justice***

My goal as a social justice educator includes, but is not limited to, creating an equitable learning environment, integrating my students' identities and cultures into the classroom, as well as building community. My students changed me as a person, teacher, and student; I am more reflective and intentional with my teaching practices--always questioning what I can add, implement, integrate, or extend when planning my lessons. I learned center work and small groups work best for my students, and it is effective in focusing on specific skill sets to ensure their learning. I am also now more aware of the systemic inequalities set in place for my students and others from similar communities. In the context of schools, my students' needs were not met with realistic goals. My students were expected to learn specific material in one week, when they

needed more time and adaptive extension lessons--much of the curricular material given were linear, which did not foster student-based learning. In addition, the constant assessments, pullouts, and chronic absenteeism also disrupted the learning environment.

While conducting this inquiry, I found myself constantly researching about different methods I could use to better support and supplement my students' learning, in terms of supplies and resources. My action plan kept changing as the inquiry progressed because I was constantly reflecting on my teaching practices. I questioned what concepts and lessons I could change, modify, extend, and remove. My inquiry stance after reflecting and learning with my students throughout this process is to differentiate learning as much as possible and build on their needs. Active hands-on learning, collaboration, and making curriculum relevant will be ingrained in my teaching practices--student-based inquiry and learning is significant.

From this point forward, I plan to make extension lesson plans for units that I find my students struggling with. I plan to dedicate more time to center work and small groups, rather than spend a large amount of time doing whole class lessons. I also plan to involve as many parents in my lessons and have them come into the classroom to be part of the teaching and learning because inclusion is significant and valuable. As I continue doing social justice work and basing my teaching practices with student-based learning, I hope to become a better and more socially aware educator.

### **Glossary**

**Culture:** the beliefs, values, attitudes, customs, social relationships, art, and literature that define an ethnic group of people.

**Educational Equity:** a measure of achievement, fairness, and opportunity in education.

**Ethnomathematics:** the study of the relationship between mathematics and culture.

**Multiculturalism:** the view that cultures, races, and ethnicities, particularly those of minority groups, deserve special acknowledgement of their differences and similarities within a dominant political culture.

**Multiethnic:** consisting of more than one ethnicity; whether a person is more than one ethnicity, or a group of people encompass many ethnicities.

**Positionality:** the practice of a researcher explaining their position in relation to the study that is being conducted.

### References

- Amit, M., & Abu Qouder, F. (2017). Weaving culture and mathematics in the classroom: The case of Bedouin ethnomathematics. In M. Rosa. (Eds.), *Ethnomathematics and its Diverse Approaches for Mathematics Education* (pp. 23–50). ICME-13 Monographs. New York, NY: Springer. DOI:10.1007/978-3-319-59220-6\_2.
- Aronson, B., & Laughter, J. (2016). The Theory and Practice of Culturally Relevant Education. *Review of Educational Research*, 86(1), 163-206. doi:10.3102/0034654315582066
- Bassey, M. (2016). Culturally responsive teaching: Implications for educational justice. *Education Sciences*, 6(4), 35. 10.3390/educsci6040035.
- Bishop, A. J. (1994). Cultural conflicts in mathematics education: Developing a research agenda. *For the Learning of Mathematics*, 14(2), 15-18. Retrieved from <http://www.jstor.org/stable/40248109>
- d'Ambrosio, U. (2001). *What is ethnomathematics, and how can it help children in schools? Teaching Children Mathematics*. 7. 308-310.
- d'Entremont, Y. (2014). Linking mathematics, culture and community. *Procedia Social and Behavioral Sciences*, 174. pp. 2818–2824. doi: 10.1016/j.sbspro. 2015.01.973.
- Florence, N. (1998). A critical analysis of bell hooks' engaged pedagogy: A transgressive education for the development of critical consciousness (Order No. 9975348). Available from ProQuest Dissertations & Theses A&I; ProQuest Dissertations & Theses Global.
- Gouinlock, J. S. (2018). John Dewey. Retrieved from <https://www.britannica.com/biography/John-Dewey>
- Ladson-Billings, G. (2013). *The dreamkeepers: Successful teachers of African American children*. New York, NY: John Wiley & Sons.



Nasir, N., Hand, V., & Taylor, E. V. (2008). Culture and mathematics in school: boundaries between “cultural” and “domain” knowledge in the mathematics classroom and beyond. *Review of Research in Education*, 32(1), 187–240. <https://doi.org/10.3102/0091732X07308962>

van der Ploeg, P. (2016). Dewey versus ‘Dewey’ on democracy and education. *Education, Citizenship and Social Justice*, 11(2), 145–159.  
<https://doi.org/10.1177/1746197916648283>

Rogoff, B., Matusov, E. and White, C. (2018). Models of Teaching and Learning. In *The Handbook of Education and Human Development* (eds D. R. Olson and N. Torrance).  
doi:[10.1111/b.9780631211860.1998.00019.x](https://doi.org/10.1111/b.9780631211860.1998.00019.x)

Zaslavsky, C. (1996). *The multicultural math classroom: Bringing in the world*. Portsmouth, NH: Heinemann.

## Appendix

## Appendix A: Intervention strategies and data collected

Weeks	Intervention Strategies	Data Collected
Week 1	How do you feel about math pre-survey, <i>Patchwork Quilt</i> read aloud, community puzzle quilt	How do you feel about math pre-survey, community puzzle quilt pieces, field notes
Week 2	<i>Can You Count Ten Toes?: Count to 10 in 10 Different Languages</i> read aloud, practice counting in different languages	Vote on three different languages to count in (charted on paper), field notes
Week 3	Introduction of Mayan Civilization, bean and toothpick counting activity	Mayan numbers compared to different number system art, field notes
Week 4	Unit 5 test review, cultural winter holiday math centers	math center work, Unit 5 test, field notes
Week 5	Class sibling survey, <i>My Granny Went to Market</i> read aloud, fruit salad activity, and M&M activity	Class sibling results charted, fruit salad activity work, M&M activity work, field notes
Week 6	<i>My Food, Your Food</i> read aloud, family letter home to bring in recipes, introduction of math skits	Family recipes were brought into class, students worked on their math skits, field notes
Week 7	Extension of more and less lessons with family recipes, making trail mix in class, working on skits, and parent involvement with cold cooking	Students talk about their family recipes (more of one ingredient versus another), discussion on trail mix, parent cold cooking more and less questions, field notes
Week 8	Unit 6 test review, math skit performance, shape collage, cookie fraction activity, How do you feel about math post-survey	Unit 6 test, math skit videos, shape collages, cookie fraction activity charted, How do you feel about math post-survey, field notes

## Appendix B: Recipe Letter

Dear Families,



In math, we are discussing **more** and **fewer** graphing problems. In order to make math more special and meaningful, please write out a family recipe on the index card attached to this letter. Students should bring their recipes in by Thursday (3/14).

For example:

**Ingredients**  
for 24 cookies

1 box red velvet cake mix  
2 eggs  
 $\frac{1}{2}$  cup vegetable oil  
powdered sugar, for  
topping



**Preparation**

- 1** Preheat the oven to 375°F (190°C).
- 2** Mix everything except the powdered sugar into a bowl (Batter will be thick).
- 3** Spoon into balls and roll in the powdered sugar.
- 4** Place on cookie sheets leaving about 2 inches (5 cm) between cookies. Level with a glass.
- 5** Bake for 8 to 10 minutes until cookies brown SLIGHTLY on the edges.
- 6** Enjoy!

Thank you!

Ms. Teewari



## Appendix C: Recipes from home

Receta de tamales Guatemaltecos de arroz

11 libra de arroz  
 3 cucharas de manteca 1 libra de manteca  
 1 libra de ajonjolín  $\frac{1}{2}$  libra pepitoria  
 10 libras de tomate 3 libra de miel tomate  
 5 piezas de chile guajillo.

Pupusas

1 3 LB. de masa  
 2. 2 LB. de queso mix

1. masa lamasa asta.  
 quedar suave para hacerlos.  
 Las bolitas de masa 2. Las tortillas  
 Para hacer un huequito en el centro.  
 grega el queso y acela (14).  
 Tortilla  
 3. en un comal caliente pone  
 la tortilla 2-3 minutos esta  
 cosinada

Eggs with vegetables Preparation:

Ingredients:

$\frac{1}{2}$  lb spinach  
 4 eggs  
 1 tablespoon oil.  
 1 tablespoon wheat flour.

① preheat the pan  
 ② add the oil  
 ③ mix everything  
 ④ cook for 8 minutes  
 ⑤ Enjoy!

for 24 cookies  
 1 box red velvet cake mix

1 Preheat the oven to 375°F (190°C).



## Appendix D: Math survey asking for parent involvement in the classroom

**Math Survey**

Hello families, I would like to know what you know, and how you feel about math. Please take a few minutes to fill out this survey and turn it in to me as soon as you can.

1. Can you count in a different language? Yes No

If so, what language? I know English & Spanish

2. How do you use math at home?

In different ways like when setting up alarm clocks for the next morning I have to estimate how many shoes I can finish till I have to go to sleep

3. How do you help your student with math at home?

We help her when she has math homework such as how to use her fingers or loose objects to use instead of fingers.

4. Is there a different strategy of math that you teach your student, or that you learned?

I feel we teach the same methods that are used in my daughters class

5. What is one thing that you would like your student to improve on, in math?

I haven't seen her really struggling with math maybe she can improve in doing the worksheet in order, like for example not jump from problem 1 to problem 7

6. Would you like to come into the classroom and share a math strategy that you know or have learned?

[Redacted] would like Yes No

go into the class

Thank you so much!

Parent Name: [Redacted]

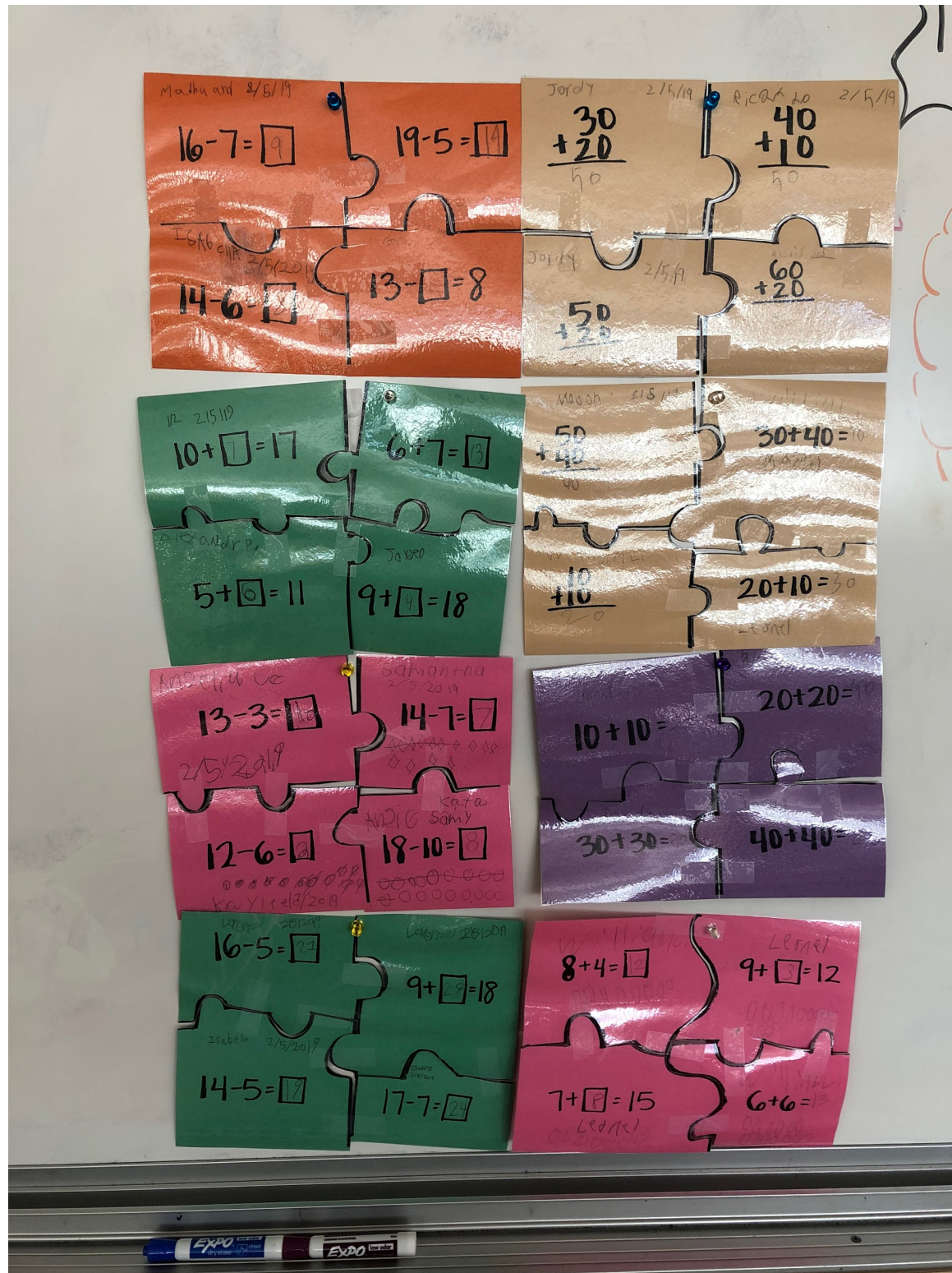
Student Name: [Redacted]

Date: 2/21/2019

**UCLA**  
**BRUINS**



## Appendix E: Community quilt puzzle



## Appendix F: Counting by tens math center exit tickets

Name	Date	Name	Date	Name	Date
Exit Ticket ★	2/12/09	Exit Ticket ★	3/2/09	Exit Ticket ★	2/13/09
① How many groups of 10 did you make? 10		① How many groups of 10 did you make? 10		① How many groups of 10 did you make? 10 group	
② How many tens make 100? 100		② How many tens make 100? 10		② How many tens make 100?	
③ $10 + 10 + 10 = 30$		③ $10 + 10 + 10 = 30$		③ $10 + 10 + 10 = 30$	
④ What did you learn today? I can B I + 10		④ What did you learn today? Kawt with 100 th piks.		④ What did you learn today? to count Beans 10 ten	

Question: What did you learn today?

Richard: "I count by tens"

Serena: "Count with toothpicks"




Angelica: "To count beans to 10"






## Appendix G: Serena's cultural math center exit tickets

**Kwanzaa Graph** Name \_\_\_\_\_

Directions: Use the Set 2 graph mat to fill in the chart and complete the graph below. Then answer the questions.

	Number of Objects
 Fruit	5
 Happy	3
 Kinara	2

Number of Objects	
5	
4	
3	
2	
1	




 Fruit  Happy  Kinara

- How many objects are "Happy"? 3
- How many more fruits than kinaras are there? 5 - 2 = 3
- How many objects are there total? 10 objects in total




Britney Bennett ©

**Kwanzaa Graph** Name \_\_\_\_\_

Directions: Use the Set 1 graph mat to fill in the chart and complete the graph below. Then answer the questions.

	Number of Objects
 Flag	3
 Corn	4
 Cup	5

Number of Objects	
5	
4	
3	
2	
1	

 Flag  Corn  Cup

- How many objects are flags? 3
- How many more cups than flags are there? 5 - 3
- How many objects are there total? 12

Britney Bennett ©

**Sum Sparklers** Name \_\_\_\_\_

Directions: Match the word problems with the number sentences and addition problems below by writing the sums.

<b>1</b>	$5+5+5=$ <u>15</u>	<b>5</b>	$3+3+3=$ <u>9</u>
<b>2</b>	$3+6+7=$ <u>16</u>	<b>6</b>	$6+6+1=$ <u>13</u>
<b>3</b>	$4+3+5=$ <u>12</u>	<b>7</b>	$2+1+7=$ <u>10</u>
<b>4</b>	$8+8+2=$ <u>18</u>	<b>8</b>	$7+7+0=$ <u>14</u>

Britney Bennett ©



## Appendix H: Angelica's fruit salad activity exit ticket

Name \_\_\_\_\_ Date 3/8/2019

**Fruit Salad Graph**

- How many fruits did you get in all? 20
- Did you get **more** or **fewer** strawberries than blueberries? How do you know?  
I know that strawberries I got more than blueberries
- Did you get **more** or **fewer** strawberries than oranges? How do you know?  
I know that oranges I got less
- Did you get **more** or **fewer** grapes than blueberries? How do you know?  
I got more grapes I have 9
- Graph the number of fruits.

Number of Fruits	Grapes	Strawberries	Blueberries	Oranges
10				
9				
8				
7				
6				
5				
4				
3				
2				
1				

Number of fruits: 9 2 6 3

- Which fruit was your favorite? Why?  
grapes and because it is the best

## Appendix I: Serena's M&amp;M activity

Name \_\_\_\_\_ Date \_\_\_\_\_


### M&M's bar Graph

Directions: First, sort your m&m's. Next, complete the tally chart. Color in the m&m's at the bottom to match your m&m's. Then, color in the graph to match your data. Next, answer the questions about the graph. Last, enjoy your m&m's!

tally chart

color	tally	total
blue		13
brown		8
orange		9
green		4
red		3
yellow		6

My total number of m&m's: 97



### Sort your M&M's here!

blue

green

red

brown

yellow

orange

1. Which color did you have the most of? <div style="text-align: center; font-size: 1.5em;">blue</div>	2. How many total greens and blues did you have? <div style="text-align: center; font-size: 1.5em;">16</div>	3. What is the difference between the color you have the most of and the color you have the least of? <div style="text-align: center;">             Bl 13              re 3  <math>13 - 3 = 10</math> </div>
4. Explain why the color you have the most of has the longest bar on your graph. <div style="text-align: center;">             bc you              put 13 in              the blue           </div>	5. Write and solve a word problem using the information in your graph. <div style="text-align: center;">             How many              m&amp;m's do              you have  <div style="font-size: 1.5em;">37</div> </div>	



## Appendix J: Shape Collage

