Teachers Theorizing English Learners’ Math-Science Funds of Knowledge Through Community Activism

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THESIS
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I dedicate this thesis to my mother, Shahida Nasir and my father, Mulazim Nasir, whose unconditional love and support made it possible.

I ask Allah to have mercy upon them as they had mercy upon me (Quran, 23:24).

Thank You.
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SUMMARY

Many teachers are inadequately prepared to teach math and science while addressing the cultural and linguistic needs of their increasing English Learner (EL) populations in mainstream classrooms (Duff, 2005). Additionally, many high poverty schools with a large population of ELs mandate scripted curricula which restrict teachers to adapt the curriculum so that they may teach to ELs’ *funds of knowledge* (FoK): bodies of knowledge and skills that are essential for survival (González et al., 2005).

Drawing on the theory FoK, this study presents an additive approach to how a cohort of teachers learn to make meaning and capitalize on ELs’ cultural and linguistic strengths, particularly *math-science funds*, as resources for (language)learning. The study is an intervention and adopts case study methods to examine the teachers individually and collectively as their practices are socially constructed and negotiated. I collected data from weekly study group meetings, interviews, classroom videos, and teacher artifacts from their action research such as written action reports, lesson plans, and field notes.

The first major finding addresses how despite the teachers fear and resistance to conducting home visits, they continued to use FoK to find alternative means to access math-science funds. Exploring ELs’ *life-worlds* through nontraditional activities, such as an ethnographic community walk, surveys, and extending in-class FoK discussions, allowed the teachers to foster *confianza*, mutual trust, with their students. Recognizing the importance of their ELs’ playground practices, prompted the teachers to work as agents of change to mobilize math-science funds for pedagogical action and advocate for a playground at their school while maintaining community support. Additionally, to mediate funds for math and science required the teachers to not be passive agents to scripted curricula, but adapters of it. In doing so, they transformed their traditional roles from instructors of scripted curricula to curriculum designers. The teachers expanded the curriculum from lesson planning a universal shared knowledge on playgrounds to leveraging ELs variations within and between their *multiple funds*. Importantly, a FoK discourse became the language of power since the teachers shifted to make communicating mathematically and scientifically accessible for their ELs to and through their funds. Furthermore, the
teachers transformed ELs participation and content development by mediating FoK in conjunction with role shifts, higher order questions, tension, and third spaces. Finally, the teachers (re)conceptualized the types of FoK from one’s expertise to include experience-based funds because it allowed them to extend the purpose of FoK for a curriculum theme to socially organizing classroom interactions. Also, the teachers changed to see math and science from topics in scripted curricula to recognize math and science found in EL’s life-worlds. This was possible because the teachers situated social problems found in EL’s life-world funds that drew on math and science tools to solve. The significance of this study demonstrates the need to build bidirectional seamless boundaries between the in-school and ELs out-of-school practices so these students, like many of their mainstream peers, may learn from their familiar ways of knowing. An important contribution in the study is the development of mainstream teachers’ language, curriculum, and instructional knowledge for educating ELs in the content areas of math and science.
I. LET’S PLAY A GAME: WHO IS AMBAREEN NASIR?

The students in this study would refer to playing games on the playground. Following their perspective, I invite you to play a scavenger hunt game with me while reading my research. Let’s start off with a question: Who is Ambareen Nasir? On the cover of this dissertation, my name, Ambareen Nasir, represents the author of this book, an educational researcher. For the purpose of our game, I want you to pretend that I am your student and you are my teacher. As you read the following two excerpts, I want you to figure out who I am based on in-school knowledge versus how I describe myself. In particular, pay attention to the ways I am “viewed academically” in both settings.

School Excerpt:
If you were to see my profile in school it would tell you that I am “not exceeding” standards. My last year score demonstrated 20% reading scores and 18% math. My racial box would be checked ‘Asian.’ I’m labeled as a limited English learner. I also am eligible for free or reduced lunch, which indirectly represents my socio-economic status. Previous teachers would tell you that I am shy, but to be cautious of my behavior in school because I’ve had a trail of detention slips where my hijab, head scarf, became a marker for bullying. In summary, I’m an educational problem contributing to low test scores and federal funding income. I’m your “problem.”

Personal Excerpt:
My last name, Nasir, in Arabic means “helper.” In Islam, my name has religious origins referring to the people of “Ansar” who helped the Prophet Muhammad (pbuh) and companions seek refuge when they migrated to Medinah. I would hear religious narratives, like this one, from my mother who had a wealth of knowledge in Islamic history. My historical roots are traced in desert sands of Pakistan. Coming from a small village with no electricity or proper running water, my father studied relentlessly under oil lamps to arrive in the soils of the United States in hopes that his children would not bear the struggles of living in a third world country. However, America presented different challenges for us. My siblings and I found ourselves struggling to live “in-between” the worlds of our forefathers and the practices of the West. We maintained complex ways of living such as attempting to maintain our salat, prayers watching the moon and sun, without a azhan, call to prayer, to remind us. We spoke Urdu, Punjabi, English, and read the Quran in Arabic. My problem became unfolding the layers of who I am and searching for how living “in-between” can provide rich possibilities.

These two very distinct representations of me are quite differently. In school, I am reduced to quantitative numbers and behavioral items. However, in my own description there is qualitatively more to me. But why does this matter? If I was your student and I shared my personal narrative, would you engage in this discussion, or simply disregard my knowledge as something that cannot be discussed during class instruction because it is “off academic topic.” How often do we hear students share stories like this, or moreover, how often do we ask personal questions about our students lives? Quoting the

1 The term “in-between” is drawn from the work of He, M.F. (2003)
words from one of my personal favorite books, *The Little Prince*, why indulge or refrain from such “matters of consequence?”

Well, to you, the teacher, my story might not make sense because it is *strange*. I may have used terms that you do not understand such as “Ansar,” “salat” or “Punjabi.” However, to me, this is how I make sense of the world. This is my *familiar* life-world, and these are my *funds of knowledge* (*FoK*), my everyday lived practices. However, hidden beneath my student identity, you will find layers of priceless jewels, my funds, practices and knowledge that can be leveraged for learning. You may not have seen the potential of my funds for learning because of the ‘strangeness.’ But my life practices exhibit math (i.e. calculating prayer times using astronomy), science (i.e. irrigation, electricity), and literacy (i.e. reading Quran, Islamic history narratives). For Muslims, the Prophet Muhammad (peace be upon him) was viewed as the “living Quran” because he embodied the practices defined in the Quran. Drawing on similar, yet religiously incomparable, metaphors, I can be your “living curriculum” because I have knowledge and skills that are worthwhile for teaching mathematics and science. In other words, I advise you to draw from my familiar funds to teach the unfamiliar, strange, academic concepts.

Throughout my dissertation, I strategically insert my funds to recount this learning experience of using the familiar to bridge the unfamiliar. In our scavenger hunt game, I challenge you in these forthcoming excerpts to learn about my life-worlds. Can you see my ‘funds?’ Can you see the ‘math’ and ‘science’ in these funds? Can you make *meaning* of my life from the perspectives of my funds? Do you know what knowledge is worthwhile to me? Do you know my social, cultural, and linguistic practices? What research or ethnographic tools would you employ to know what I’m saying and mean? Can you compare my life-world to your familiar school-world? Simply put: *context matters*. English Learners (ELs) enter a school environment that is foreign to them, but familiar to teachers. So how can teachers make what is familiar and view it as strange from the perspective of their ELs. Furthermore, how can teachers’ make the strange, students’ funds, familiar for their learning?
Now, why would any of this matter? Why know the multiple dimensions that make up who I, the student, am? Because if educational statistics can label me an “at-risk” problem, then I am reminded of the words of my mother who taught me that every problem has a solution. My mother said the place to begin searching for a solution is found in the problem. I, the student, can hold the solution for you, the teacher, by accessing my funds and mediating them to organize my learning. Take my hand and explore my life-world. Be open to change and make new meanings with me. But don’t fear, together we will create hybrid learning spaces and authentic meaning-making in ways that inform our knowledge of language, math, and science. Let’s enact a curriculum that is embedded in the lived lives of my fellow students and connected to a larger world.
II. INTRODUCTION

My grandparents strived to reach the “land of the pure,” which at the time of partition from India seemed like an impossible task. Crossing the border meant walking between the lines of life and death. Everyday civilians became armed agents. On his route, my grandfather’s leg was shot but the spirit of freedom kept him to continue his journey. This is how I was introduced to the country of Pakistan and my family’s history.

Educational policies on English Learners (ELs) present a language ideology (Razfar & Rumenapp, 2011) that posits “learning” and “language learning” as two separate goals in education. Native English speaking students are to learn academic content i.e. “learning”), such as math and science. In contrast, the Office of English Language Acquisition (OELA) asserts ELs are to learn academic content AND develop English proficiency (i.e. “language learning”). This stance on language has many implications for the (language)learning of ELs and for teacher development in the content areas of math and science. First, it implies that the goals of learning for mainstream students are different than their EL peers. Consequently, ELs are positioned “deficient,” in terms of their lack of English proficiency, rather than the strengths that ELs cultural and linguistic resources can add to the learning environment.

Secondly, math and science is undergoing fundamental reforms in what students are expected to know and perform. The reforms include the acknowledgment of language, in particular (a) communicate mathematical and science thinking through the language of mathematics and science (b) emphasis on problem-solving that arise in mathematics, science, and in other contexts, and (c) recognize and apply math and science in contexts outside of mathematic and scientific connections (National Council of Teachers of Mathematics, 2006). These reforms recognize that language is integrated with math and science explicitly through communications. Also, language is implicitly stated since “communicating” math and science is a skill needed to perform problem-solving and connection strategies. However, these

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2 In this study I use the term English Learner (EL) to refer to students who speak a language other than English at home. In addition, ELs are students who have been marginalized in the educational system by dominant English-only language and Western cultural practices. Finally, the term, EL, emphasizes an additive approach to all “learners” being (language)learners.

3 This study takes the theoretical stance that language is inseparable from learning. See page 298 for further discussion.

4 Reformed math and science “connections” means to relate the in-school and out-of-school math and science.
language views distinguish between knowing every-day English proficiency or Basic Interpersonal Communication Skills (BICS), from learning the academic language of math and science or Cognitive Academic Language Proficiency (CALP). Therefore, native English speakers are to acquire CALP, whereas, ELs are to acquire BICS and CALP (Cummins, 2003). Again, the learning goals are differentiated for native English speakers and ELs, and it appears that ELs need to learn ‘more.’ However, more important than the number of goals, is what means do ELs, compared to mainstream students, have to get to the goal. In other words, we must consider the learning tools accessible to ELs as an outlet to consider their potential pitfalls or gains for their achievement scores.

But why does any of this matter and how does it relate to the math and science (language)learning of ELs? From a language socialization perspective, learning is inseparable from language, since language is the primary tool used for learning. In the United States context of learning, the national goal of English proficiency implies the leverage of Eurocentric language and cultural practices as the dominant tools (Delpit, 1995) used for learning math and science. Therefore, ELs whose resources are found in their funds of knowledge (FoK), such as home language and non-Western cultural practices become marginalized. This contributes toward many ELs’ finding their household funds in conflict with the practices of school (McIntyre, Rosebery, and Gonzalez, 2001). In other words, the national goal on English monolingualism, not bilingualism, prioritizes one “right” language which restricts ELs’ linguistic and cultural funds that are essential to their mediation for (language)learning math and science (Shannon, 1995). The goal of monolingualism has a ripple effect for how policy then positions ELs to be restrictive in their funds and conform to a monolingual America that acquires Eurocentric cultural practices. Furthermore, these goals are expected to be achieved via learning tools that are unfamiliar to ELs, in comparison to mainstream white English speaking students whose cultural tools may be closer aligned to those practices of school.
To complicate matters further, many educators who work with ELs consider themselves not adequately prepared to meet their students learning needs (National Center for Education Statistics, 1996). Additionally, it has been estimated that by 2030 forty percent of all school age students will consist of ELs (Thomas & Collier, 2002). This requires mainstream teachers to learn and adopt theoretical frameworks and pedagogical practices that make content comprehensible for all language learners. Many teachers may believe that ELs must acquire English before learning academic content, although this approach almost inescapably leads students to fall behind (August & Hakuta, 1997). Duff (2005) summarizes complexities for mainstream instructors signifying that: (a) mainstream content courses don’t find explicit combined language and content instruction, (b) a lack of coordination between ESL and content specialists with little or no linguistic training, and (c) misguided perception that ELs needs are not the responsibility of mainstream content teachers, even though they may constitute more than half of the students in their classrooms (p. 49). Therefore, although teachers may be content experts, they may not feel qualified integrating the necessary language development needed for all students.

This study is focusing on the complexities of teacher development for educating ELs in math and science, while recognizing implications on the larger nested issues of language policy that may refrain or sustain their learning. In particular, the students in the research revealed their knowledge and skills on playgrounds. Students’ playground funds prompted the teachers with their students to design a rigorous curriculum and pursuit pedagogical action for a playground at Genesis school. Research on FoK, such as playground funds, are imperative to learn how teachers can provide equitable learning opportunities by giving ELs familiar linguistic and cultural learning tools that similarly, mainstream English speakers have greater access to. FoK leverages students’ own linguistic and cultural funds as mediational tools for resources, instead of deficits. In doing so, students’ funds carry the potential to be central to curriculum and instruction. Furthermore, the mediational tools are grounded in familiar funds to learn
unfamiliar academic content. This study seeks to understand how the teachers’ struggle in learning to use FoK. In particular, the ways teachers access, mediate, and (re)conceptualize ELs’ funds for math and science (language)learning.

A. **Statement of Problem**

Much of the research on FoK emerged as an additive response to the deficit view. The deficit view perceives ELs as disadvantage, lowers their academic expectations, and emphasizes “what these students lack in terms of the forms of language and knowledge” (Gonzalez et. al, 1995, p. 445). However, FoK challenges these misconceptions to view households, from low-income backgrounds, in terms of their strengths and resources for school curriculum. Many of the FoK studies address planning curriculum that is grounded in household funds to teach math (Civil & Bernier, 2006), science (Barton & Tan, 2009), literacy (Moll, 1992), social studies (Olmedo, 1997), and thematic integration of math, science, and language arts (Amanti, 2005). Additionally, research on FoK discusses how the theory informs teacher perceptions of ELs and their households (Tenery, 2005; Hensley, 2005; Gonzalez et. al, 1995). However, some of the fundamental problems with the literature include a limited focus on (a) ELs’ funds derived from their life-worlds, (b) curriculum integration of FoK beyond a peripheral topic, and (c) teacher negotiation and re-negotiation of curriculum grounded in ELs’ funds.

ELs’ out-of-school practices can be an important resource used to contextualize and mediate learning. In particular, the literature on out-of-school literacy practices, recognizes students’ social worlds have abundant and diverse forms of uses and functions of literacy in contexts other than school (i.e. email, instant-messaging) that may contrast with traditional genres (i.e. short stories) introduced in school (Hull & Schultz, 2002). Although FoK overlaps with out-of-school literacy practices found in households, the theory focused on children as participant observers to adult household practices. However, children create their own social worlds which may be independent from adults (Moll, 2005). Including funds that are derived from ELs’ life-worlds is necessary as it can expand the types of funds
beyond households which are relevant to students’ everyday practices. Drawing on life-worlds situates students’ funds central to curriculum that is relevant to contextualize their learning. A FoK nuance to out-of-school literacy practices is its emphasis on extending the learning community from traditional teacher to student relationships to participants from households and community. Similarly, funds derived from life-worlds may foster relationships between members in students’ life-worlds and school to create a learning community that enhances learning. In addition to relevant curriculum, these relationships are beneficial to further contextualize and familiarize the learning community for ELs as well.

An important factor contributing to the gap between ELs’ life-worlds and school is how the culture of schooling may be in conflict with students’ culture or FoK (Lee, 2005). Culturally responsive pedagogy responds to this conflict to situate students’ culture in the curriculum by developing cultural competence, academic achievement, and critical sociopolitical consciousness (Gay, 2000). However, culturally responsive pedagogy expands to include teaching student culture that may not be exhibited in their everyday practices, such as international historical movements that are beneficial knowledge, but may be removed from ELs’ personal experiences. Integration of culture in curriculum from a FoK perspective, as living practices, represents knowledge and skills that are familiar to the sense-making of ELs to then learn unfamiliar academic content. Problematic to current FoK literature are limited studies addressing ways students’ funds can be integrated into the curriculum other than inserting students’ funds as curriculum topics. Integrating FoK in curriculum can include incorporating ELs’ (language) learning practices based on the distribution and social interactions of how they come to know what they know derived in their life-worlds. For example, “zones of comfort” reveals adult to child learning interactions fostering making mistakes and experimenting which may be discontinuous with school practices (Velez-Ibanez & Greenberg, 1992). There is dearth research that examines a deeper integration of FoK in curriculum for ELs that aim to minimize the unfamiliar variables (i.e. learning context) and allows ELs to access their tools, such as cultural and linguistic funds, to mediate their
Exploring beyond a peripheral FoK curriculum topic, allows for multiple layers to contextualize curriculum when socially organizing learning.

Many elementary teachers struggle with developing math and science curriculum activities because they lack content knowledge and confidence to teach effectively (Crawford, 2000; Martinez & Martinez, 1996). To complicate matters further, elementary teachers of ELs are inadequately prepared to meet the cultural and linguistic diverse needs of their students (Duff, 2001) within the content areas of math and science. Given these multiple complexities, its problematic how teachers navigate the tension between making sense of what counts as math and science and mediating the language development of ELs using cultural and linguistic resources for math and science learning. There is limited research addressing how teachers negotiate and re-negotiate developing and implementing curriculum grounded from everyday math and science funds. As teachers strive to contextualize math and science for ELs, there are “tensions between ‘formal’ mathematics and ‘informal’ mathematics or between everyday mathematics and academic mathematics” (Khan & Civil, 2001, p. 49). This (re)negotiation is crucial for understanding teachers’ development in their FoK curriculum practices to contextualize ELs’ (language)learning opportunities.

B. Research Questions

My research interest stems from acknowledging that there may be a gap between ELs linguistic and cultural practices and dominant schooling practices. However, the “problem” is not the rich diversity of ELs background, but success and failure may lie in the social organization of schooling and in the organization of the experience itself (Moll and Diaz, 1987). My study seeks to explore one such additive theory, FoK, and how ELs linguistic and cultural funds can be resources for math and science (language)learning. Traditional definitions of FoK examine household knowledge and skills that are essential for survival (Moll, 1992). I, however, interpret FoK as skills and bodies of knowledge, derived from households and individual life-worlds essential for their well-being. My study addresses how
teachers develop to learn using FoK for math and science, specifically aiming at the three questions below.

1. How does a cohort of teachers’ access ELs’ math-science funds?
2. How does a cohort of teachers’ mediate ELs’ math-science funds for math and science (language)learning?
3. How does a cohort of teachers’ (re)conceptualize FoK?

I articulate how these three questions design the components to what I call “funds of knowledge-ing.” It is a process in which FoK is examined on three fronts: accessing, mediating, and theorizing FoK. Part of my findings for this study will reflect on the relational aspects of these three fronts. In the first question, the teachers’ learn how to access ELs’ math-science funds, whereby FoK represents an outcome. Secondly, I aim to research how the teachers’ learn to use FoK as a mediational tool. In particular, how the teachers’ mediate FoK in their lesson plans and during classroom conversations. Finally, FoK is examined by how the teachers’ theorized, as they conceptualize and re-conceptualize, the interplay between FoK with math and science.

C. **Significance of Study**

US Secretary of Education, Arne Duncan, raised concern how US lagged behind other developed countries ranking 23rd or 24th in most subjects, including math and science. He argued “we can quibble, or we can face the brutal truth that we’re being out-educated” (NY Times, December 6, 2010). However, the numbers are even more concerning for ELs math and science achievement. According to National Assessment of Educational Progress (2007), 32% of Latina/o fourth graders scored below basic in mathematics, and in 2005, only science, 28% of ELs scored basic. Furthermore, the increasing influx of ELs into mainstream classrooms, warrants teachers to consider the linguistic and cultural needs of this population. Rather than blame language proficiency or student ability for these underachieving scores,
we must turn toward the educational experiences and social organization of learning for ELs. Given, the underachievement scores in math and science, my study contributes to understanding the outcomes for arranging ELs schooling by using their strengths, found in their funds for potential possibilities of success in their (language)learning.

An important contribution in the study is the development of mainstream teachers’ curriculum and instructional knowledge for educating ELs in the content areas of math and science. As mentioned earlier, many elementary teachers struggle with developing math and science curriculum activities because they lack content knowledge and confidence to teach effectively (Crawford, 2000; Martinez & Martinez, 1996). Adding to the complexity with reformed math and science initiatives, teachers must be competent to include language, such as communicating effectively the language of math and science, in addition, to teaching rigorous problem-solving activities. However, many mainstream teachers lack language acquisition or language socialization theories for integrating language with pedagogical math and/or science content knowledge (Gomez and Madda, 2005). Furthermore, there has been little regard for the linguistic and cultural resources that ELs bring to math and science classrooms and how these resources can be integrated to enhance math and science (language)learning (Lee, 2005). Also, it is problematic that limited studies address mainstream teachers (re)negotiations in lesson planning and instructional practices in working with ELs in the math and science. This study adds to literature on mainstream teachers’ curriculum design for math and science activities, instructional approaches on mediating linguistic and cultural resources for EL populations, and teacher perspectives on ELs (language)learning of math and science.
III. LITERATURE REVIEW

“If anyone travels on a road in search of knowledge, Allah will cause him to travel on one of the roads of Paradise” (Prophet Muhammad, PBUH).

For many ELs, learning English, not learning, has become the goal of instruction for these students (Moll, 1986). FoK theory aims to transform (language)learning by reducing the curriculum’s level of complexity for ELs without having to water down content by enacting children’s “cultural tools,” or funds, to mediate (language)learning. The FoK studies in the literature review argue for a sociocultural approach to (language)learning. For instance, the research recognizes how re-organizing schooling that draws on EL’s linguistic and cultural resources can create dynamic (language)learning outcomes.

As mentioned, there are limited studies on ELs language development and learning in math and science, specifically teacher development in this area. Therefore, the literature review encompasses studies on ELs language and cultural practices in math and science. In addition, research on FoK in math and science are also summarized and critiqued. Exploring these empirical findings will demonstrate how my study contributes the need to understand how teachers learn to use FoK for ELs (language)learning of math and science.

A. ELs’ Language and Cultural Practices in Math and Science

Findings on ELs have shown that there may be discontinuity between students’ cultural and linguistic practices with schooling practices in math (Lave, 1988, Saxe, 1991) and science (Lee, 1999; Lynch, 2000; Warren et. al, 2001). Multicultural education contributes the gap to math-science schooling practices representing the “culture of power” (Delpit, 1995) of those dominant in society, which may ignore minority students’ cultural practices. In science, Lemke (1990) addresses the gap to school curriculum privileging “Western science.” For instance, the study revealed how ELs home
practices which rest upon speaking with emotions, personal narratives, or humor clashed with Western science discourse being highly objective, distance, and emotionless. As a result, the science teachers were unable to recognize EL’s language practices containing science relevance since their ways of speaking were in congruence to traditional Western science discourses. Similarly, Brown’s (2006) research argues the problems with science classrooms are that teachers are bounded to the belief that science is culturally objective which may neglect considering the cultural tools of ELs as resources for learning science. However, Kearsey and Turner (1999) found ELs are not intellectually deficit, but in their native language can demonstrate scientific knowledge, but when assessed in English led them in a position of failure. Furthermore, bilingualism should be treated as a resource to foster understanding of scientific language (Curtis & Millar, 1988).

In math, Carraher, Carraher, and Schlieman (1985) explain students in school instruction and their out of school experiences can impede on their mathematic learning. McBride (1989) contributes the gap in EL’s different cultural backgrounds to the history of Western Eurocentric views dominated by white male, elite math discourses that are far removed from students’ everyday locally situated meaning makings. For math teachers, Secada’s (1992b) research addresses a problem in educators being unaware of the relationship between minority students’ language and math instruction. ELs may be held to inconsistent high expectations without providing needed support or low expectations in which students are withdrawn access to quality math learning.

In addition, there is a lasting myth that ELs English proficiency is not an issue in mathematics because it is a “universal language” (Gutierrez, 2002). However, the research by Garrison and Mora (1999) demonstrate EL’s English proficiency is linked to critically solve complex math problems. Specific to the language of math is ELs struggle to adopt “mathematic registers,” such as the sense-making for mathematical purposes (Halliday, 1978). In particular, Khisty (1995) provides an example of how “un cuarto” has multiple meanings in Spanish as a room or in English a quarter meaning a coin, but
in math register meaning a fraction of a fourth. Implications for math teachers are addressed by Brilliant-Mills (1993) research indicating to “understand the ways in which a register of interaction are constructed because there is no one register…registers are situationally constituted” (p. 302). These researchers suggest that what counts as math and being a mathematician is represented in particular settings.

B. Implementing FoK: Connections, Perspectives, and Challenges

The FoK literature pertaining to science and math reveals connections, perspectives, and challenges. The studies display a variety of findings that I have thematically arranged. First, the literature addresses connections made from funds to math and science. Second, teacher perspectives in their development to plan and instruct curriculum grounded in funds are examined. Lastly, there are researcher implications on challenges when integrating funds to conceptualize math and science.

1. Connecting funds with math and science

The literature reports how funds can connect to the (language)learning of math and science. For instance, Conant’s et. al (2001) legitimizes FoK as a valid source for teaching science. The research describes implementing an innovative curriculum that interconnects Haitian students’ knowledge on drum rhythms to the science of wave sounds. Students generated sound waves from computer software to develop inscriptions as a resource to analyze and compare different sounds. Therefore, the authors describes how children’s’ ideas and ways of knowing are scientific. The affirmation of funds being mathematical is addressed in the work of Andrews and Yee (2006). Their study found students’ demonstrating mathematical practices, such as managing money, in their out-of-school knowledge, which show rich accounts than their in-school experiences appeared to acknowledge. The authors also argue when connecting funds to content, educators need to consider the dynamic nature of funds changing as new learning and new interests emerge over time. However, topics such as money may be more apparent for teachers to identify math in students’ funds, but topics such as drums may be
difficult to readily view as scientific. For instance, Conant’s et. al (2001) briefly identify that the teacher initially did not see the science in drums. Therefore, even though these studies affirm the nature of funds can be scientific and mathematical, there still needs further analysis on how teachers come to see these funds as math and science.

Bouillion and Gomez (2001) describe a dual problem where students’ may not see how science in school connects to their lived experiences, and subsequently, schools may not see how students’ experiences have value and learning to do science. The authors’ propose a “connected-science” curriculum bridging students’ funds to solve the problem of pollution nearby their community river. The findings from the study reflect a bi-directional partnership with local organizations, where the (language)learning experiences of students are enriched and the organization benefited from students’ science experiment findings. In math education, Kahn and Civil (2001) draw on gardening funds, with the assistance of parents gardening expertise and students’ interest to design a Navajo weave, to connect the math objectives of area, perimeter, and graphing. The teacher in the study recognizes that identifying continued math problems in gardening that was relevant to the lives of the community, allowed the curriculum to develop and build deeper math understandings. Therefore, connecting funds to a single problem (i.e. design a weave) can evolve to multiple math problems to solve (i.e. area of irregular shape).

The studies thus far have researched how funds can connect to developing a curriculum topic for math and science, with limited exceptions (Moje et. al, 2004, Barton and Tan, 2009). For instance, the research of Barton and Tan (2009) examined hybrid spaces to bridge cultural knowledge and experiences to academic knowledge. The researchers studied students’ funds as they emerged in the classroom discourse and transformed three hybrid spaces for learning: physical, political, and pedagogical. The physical space changed to resemble the environment that students’ were familiar with in their out-of-school lives, such as the classroom being similar to a kitchen setting. The political space
shifted as students became the experts and the teacher a facilitator. Pedagogical practices also transformed as students became co-planners to their curriculum. These hybrid spaces reflected students increase in participation to talk and act in scientific ways. Additionally, students’ were found to overlap funds when constructing arguments, such as popular funds with peer funds. This research demonstrates an example for where my study seeks to explore alternative methods for connecting funds beyond a curriculum topic and into the organization of learning.

2. **Teachers’ perspectives on a curriculum with FoK**

The literature on FoK in math and science, also addresses teachers’ perspectives on planning and instructing a curriculum grounded in funds. Upadhyay (2009) researches a case study of a teacher learning to integrate Hmong culture into science instruction. The findings indicate balancing cultural tension between Hmong students and non-Hmong students when implementing lessons. For instance, the teacher negotiates ways to activate connections simultaneously between funds from non-Hmong and Hmong students’ connections when teaching the objective of mixtures and solutions. The teacher recognizes the need to cross both cultures and navigate terms (i.e. gasoline in America versus petrol in Hmong) that are familiar to all students. Furthermore, teacher-researcher, Sandoval-Taylor (2005), describes the problem of how much advance planning to do to develop a math curriculum with construction funds. Balancing the teachers’ academic objectives and students interests was resolved when the teacher recognized co-constructing mini-activities in the unit that would be student-led based on topics they wanted to explore. The teacher also accounts negotiating what the assessment would include since topics like construction were not a common theme to work with and fewer resources were accessible to teach with. However, the author advocates that pursuing a curriculum grounded in funds requires negotiating curriculum, and searching for alternative resources to relinquish teacher-directed instruction. Both of these studies reflect how teachers navigate curricular tensions, such as teaching to multiple students’ diverse funds and co-constructing curriculum with students’ funds. However, further
analysis is needed on teachers’ negotiating curricular tension that doesn’t occur in single-instances, but evolve longitudinally throughout the school year. For instance, there are continuous complex struggles that teachers’ may negotiate and re-negotiate ways they plan and instruct using funds as they develop from one unit to the next.

3. **Challenges to conceptualize math and science with funds**

Emerging literature on FoK shows that exploring funds can orient how science and math is perceived. Gonzalez, Andrade, Civil, and Moll (2001) identify the “discourse of mathematicians have not included perspectives on the situated nature of knowledge, nor on the language of power” (p. 258). The finding from their study reveals challenges to uncover math in everyday life situations. For instance, a parent exhibited mathematical practices of sewing skirts, but was unable to provide math logic for how and why she cut the proportions. On the other hand, the math researcher, Marta Civil, explains “my training in academic/school math may make it harder to see other forms of mathematics” (p. 259) such as math in sewing. Conceptualizing math meant to explore the tension between conceptualizing everyday math in funds versus academic notions of math from formal schooling. Additional research from Hammond (2001) explains challenges to perceiving science between parents and architects. The authors frame conceptualizing science from a multicultural perspective to “multiscience” framework which includes integrating indigenous science, personal science, and Western modern science. The study researched building a Mien-American house, where parents, students, and architects assisted in the science construction. However, the researchers found conflict between what materials would work best from Western building materials, advocated by the architect, and/or Mien building materials, such as saplings. The intercultural tension arisen revealed to be an additive learning experience as various ideas about science, technology, and problem solving emerged. Therefore, the study implications show how different perspectives on science, rooted in funds and culture, can make negotiated meanings in the context of solving problems. However, Hammond (2001) acknowledges that parents’ building funds
were privileged and students’ funds needs to be explored further to contextualize their learning. Although what counts as math and science is contested in these studies, further research needs to pay attention to how teachers’ develop conceptualizing math and science in students’ funds to lesson plan and teach, so that students’ can become aware of theorizing math and science in their lived experiences.

C. **Summary of Literature Review**

The literature review summarizes key elements. First, EL’s linguistic and cultural practices may be in conflict with the math and science schooling practices. Given this gap, many researchers have turned toward FoK as a tool to mediate learning for ELs. FoK researchers have found that teachers can design activities that connect students’ funds to math and science curriculum topics. In doing so, FoK is legitimized as a source of knowledge that is scientific and mathematical. Furthermore, FoK can be used to facilitate learning beyond a curriculum topic and into developing hybrid spaces. Students can draw upon multiple domains, such as peer and popular culture knowledge funds to produce claims. Furthermore, teachers are informed by students’ funds to negotiate their instructional and curricular planning practices. In addition, an outcome of practicing FoK is contested views on what counts as math and science between the everyday math and science in students’ funds and the academic notions of math and science in formal schooling.

Notably, majority of the FoK studies emphasizes in-service elementary teachers. Therefore, secondary schooling contexts also need to be explored further. Also, the methodology is prominently qualitative in nature. Implications on these findings reveal that there is further need to uncover how funds can be explored in the social organization of learning, such as hybrid spaces, as more than a topic in curriculum. In addition, how teachers’ negotiate and re-negotiate their students’ funds in the curriculum informs teacher development on how to educate ELs language development and learning in math and science. Further studies need to address ways’ teachers can privilege and navigate between multiple students’ diverse funds, rather than selecting one particular fund. Lastly, conceptualizing math
and science with funds from a teachers’ and students’ perspective is necessary to enrich learning. My study contributes to the literature to discuss ways teachers’ select math-science funds. Furthermore, I convey how teachers’ negotiate tension in planning curriculum and mediating funds for (language) learning in classroom conversations. Finally, I add to the literature findings on how teachers’ come to conceptualize “math” and “science” with funds, and reciprocally, view what counts as “funds” in math and science.
IV. THEORETICAL FRAMEWORK

My mother and I spent a great deal of time at fabric stores because she was raised in a culture where buying clothes required customizing your shalwar kameez from scratch. Unlike going to a store and trying outfits, you needed a creative mind and knowledge on the types of fabrics, laces, and buttons to tailor your own clothes or work with a local seamstress on the design.

This chapter explains the foundational underpinnings to the FoK theory that frames my research. I break down the important concepts of FoK into these parts: funds, knowledge, culture, and (language)learning contexts. Within these parts, I draw on other theoretical frameworks to compare how FoK is similar or differs. Importantly, I am not advocating that one theoretical orientation is “better” than the other, but rather how these theoretical frameworks compliment one another to understand what defines the FoK theory.

The first section, “Funds” in FoK, describes the origins of the term, distribution of funds, accessing funds, and provides a definition for FoK and types of funds. The second section, “Knowledge” in FoK, compares the theories of prior and background knowledge to FoK based on their orientation to students’ knowledge. The third section, “Culture” in FoK, represents how culture is approached according to the frameworks of multicultural education, culturally responsive teaching, and FoK. The last section, “Sociocultural (Language)Learning Contexts” frames what is meant by contexts, mediation, and (language)learning theory by drawing on the intersection of FoK with sociocultural theory, cultural-historical activity theory, and language socialization theory.

A. “Funds” in FoK

This section explores what is meant by the term “funds” in a FoK framework. I articulate the origins of the term, how funds were socially distributed, and ways to access students’ funds. Furthermore, I show a shift in the unit of analysis, area of study, and information tapped from the traditional FoK to current methods in accessing funds. Finally, I lead into the researcher’s understanding of FoK, particularly the term “life-world” and define types of funds.

1. The origin of “funds”
The theory of FoK emerged as a response to deficit theorizing. The deficit theory accuses minority students’ to carry “deficiencies,” such as entering classrooms with limited English proficiency or insufficient home literacy skills. These deficiencies, grounded in students’ cultural backgrounds, are perceived as causes for minority students’ academic underachievement. Vélez-Ibañez and Greenberg (1992) challenged an additive perspective on Latina/o students’ cultural identities being reservoirs of rich resources, not deficits.

Vélez-Ibañez and Greenberg’s (1992) study extended the work on Wolf’s (1966) discussion of household economy. Wolf (1966) describes various “funds” households juggle to maintain their well-being, such as caloric funds, social funds, and ceremonial funds. The researchers sought to explore how such funds were historically learned, formed, transformed, transmitted, and socially distributed in US-Mexican households. The researchers found in order to cope with uncertain and difficult economic circumstances, working-class Latina/o families acquired complex knowledge and skills to survive. For instance, knowledge on ecosystems, farming, and medicine became essential for living. In particular, sample findings revealed knowledge and skills on soil, plants, hydrology, veterinary medicine, medical herbs, and animal husbandry. Therefore, these non-monetary funds became the “currency of exchange” within and between households for survival. Vélez-Ibañez and Greenberg’s (1992) coined the term “funds of knowledge” to account for the “bodies of knowledge of strategic importance to households” (p. 314). Their research demonstrated that minority students’ households were not deficient, but on the contrary, contained ample resources representing a mastery array of knowledge of skills.

2. **Social distribution of funds for learning**

Although Vélez-Ibañez and Greenberg’s (1992) debunked the deficit theory, implications on household funds and the schooling of ELs need to be explored further. Notably, how are household funds related to children? The researchers discovered households gain and transmit funds in labor markets and from interactions with other households, thereby, creating clusters of household networks.
As funds were socially distributed in these household networks, children accessed funds, as participant observers, in the exchanges of knowledge and skills for household functioning.

Moreover, why were these funds important to children’s education? In examining the social distribution of funds from adult to child interactions, Velez-Ibanez and Greenberg (1992) uncovered the way children learn funds at home were possible sources of conflict to learning practices in school. Children’s learning environment fostered “zones of comfort” where they can indulge in errors without feeling a loss of self-esteem. For instance, children were found in control of their learning as they facilitated the question-answer process, not the adult, compared to traditional teacher-centered discussions observed in school. In addition, children were encouraged to make mistakes and experiment with finding solutions, compared to schooling practices resulting in punitive measures if tasks were not completely performed.

Significant to this study are implications on successful schooling strategies for ELs. The research informs educators and policy makers to consider household funds as potential resources for ELs academic survival. Recalling the concept of zones of comfort, we find that knowledge and skills that are historically accumulated include the ways members in and across households interact culturally and linguistically for survival. More specifically, household language practices are important sources of funds for educators to consider how they develop (slanguage) learning for ELs.

3. **Who are my students?**

FoK is a process on the intersection of pedagogy and students’ lives. I consider viewing FoK as a theory that answers the question, what do I know about the lives of my students, their families, and their communities? How can I draw on these living practices to teach? Answering these questions was apparent in the study of Moll, Amanti, Neff, and Gonzalez (1992). The researchers set out to study the household literacy practices of Latina/o students, where they uncovered the lives of children engaged in “thick” and “multi-stranded” relationships. For instance, a child may learn knowledge on herbal
remedies from their mother. Similarly, a child may be exposed to multiple adults, such as grandparents or aunts, residing in their households given economic hardships. Therefore, a child learns interactional patterns with diverse age groups and peers, including linguistic styles. Furthermore, a child may perform cultural practices such as attending religious gatherings or fixing household repairs. These examples demonstrate that knowing the life of a child is complex and includes funds that represent domains of knowledge, interactional patterns, cultural and linguistic practices (Tenery, 2005).

A question emerges asking how a child’s thick and multi-stranded relationships are informative for their education. As discussed in the everyday transfer of funds, a child is involved in various learning environments mediated by multiple adult like “teachers.” Moll et. al (1992) compared children’s household relationships to school relationships. The researchers argue that children’s in-school relationships are “thin” and “single-stranded.” For instance, the teacher “knows” a student’s academic performance within confines of school walls. In contrast, “to the households and their social networks, the classrooms seem encapsulated, if not isolated, from the social worlds and resources of the community” (p. 134). Exploring funds provides teachers the opportunity to know the child as a “whole” person, in the multiple spheres of household activity, and not merely as a student. Teachers can build on the multidimensionality of students and their families to enrich learning goals that reflects the culture and language of students’ lives.

4. **Accessing funds: Conducting a FoK project**

Turning toward the various methods in how funds are accessed can capture its theoretical framework. Gonzalez et. al (1995) study represents traditional approaches to a FoK project, grounded in anthropological methods, whereby teachers and researchers conducted ethnographic home visits to access household labor/social practices. The study explored how families develop social networks that interconnect them with their environments, such as other households. These social networks reciprocate in the exchanges of resources (i.e. funds). Importantly, the study sought to extend the social network to
include school as part of the dual exchanging of resources. In other words, teachers, via home visits, learn household funds, and in exchange children are provided with new contexts for learning through their funds. However, if education is to promote the network between school and home, the exchange of resources is predicated on establishing confianza, mutual trust for mediating social relationships (Velez-Ibanez & Greenberg, 1992) between teachers and families. The reciprocal practices, through confianza, are established and reestablished to sustain long-term relationships between social networks. Thus, schools and families social networks needed to maintain confianza.

So, what then were the methods to employ such goals? Well, there were three main project components to establishing the FoK project.

“(1) community: featuring an ethnographic study of the origin, use and distribute of funds of knowledge among households;
(2) after-school “lab” or study groups as settings to enhance the collaboration of teachers and researchers to discuss research findings and to plan develop and support innovations in instruction; and
(3) schools featuring classroom studies to examine existing methods of instruction and implementation innovations based on the households study of funds of knowledge and conceptualized at the after school site” (Gonzalez et. al, 2005, p. 446).

The first component, “community,” addresses teachers to use ethnographic tools to conduct household visits and access funds. The teachers were forming new relationships with families and establishing confianza. The second component involved the creation of an “after-school lab” or a study group to develop the teachers as qualitative researchers. The third component, “schools,” focused on pedagogical practices and ways funds can be resources for teaching. However, the researchers in the study emphasize their project methods are not a “recipe,” but encourage teachers to co-construct their own “theory and practice behind research-based household visits” (p. 446). As such, other researchers conducted methods for a FoK project that vary in modifications to the traditional FoK project.

a. **Extending household unit of analysis**

Drawing from the literature synthesis of Hogg (2010), other researchers have shown nuances to their methods and understanding on FoK. I noticed a conceptual shift in the unit of
analysis, area of study, and information tapped. In Gonzalez et. al (1995) research, their unit of analysis was the family/household. The area of study took place in the home. The information tapped, or funds, were household/labor social practices. However, many FoK researchers have steered away from a household unit of analysis, and provide alternative methods to access funds which are not rooted in studying the geographical space of homes. One major nuance in adapting FoK is eliciting funds from in-school contexts, specifically student classroom discourses (Fraser-Abder et. al 2010; Bouillion & Gomez, 2001). For instance, as a participant observer, Hedges et. al (2011) tapped information of funds as ‘popular culture,’ ‘interests,’ and used an interpretivist methodology (Flick, 2006) to document children’s funds during informal and formal class discussions. Upadhyay (2005) studied funds as ‘lived experiences’ and accessed students’ funds through science classroom discussions. Riojas-Cortez et. al (2009) learned adult funds by audio and video recording workshops at a family literacy institute. These researchers examined families fostering social development of preschoolers, extending the term to include “family beliefs” (p.188) and “values” (p. 190). Researchers such as Dworin (2006) and Olmedo (2004) explore family stories as spaces to conduct oral history interviews and learn about extended family members funds, such as grandparents. Furthermore, Smythe & Toohey (2009) exhibited funds through community spaces defined as a 2-3 km radius around the school. Methods to access community funds included “community scans” both quantitatively via socioeconomic and demographic data, abstract mapping, and qualitatively through concrete mapping. Other researchers elicited popular culture funds (Moje, 2004) and used methods of photography (Allen, et. al, 2002).

These studies reveal a conceptual shift ranging from the unit of analysis on family/household to the individual. The area of study shifts from the home to physical places like the classroom or the community. The information tapped extends from household/labor social practices to popular culture, interests, experiences, or values. Perhaps Gonzalez and Moll (2002) encouraged or even predicted these shifts as their research states it’s important to “not reify the concept, to keep in mind that is both
theoretical and transitory…the concept is not static, that it evolves through each new iteration, and that is must be renewed, that is, modified and adapted to local conditions” (p. 277).

5. **Defining FoK**

Given the range of nuances from the traditional FoK research to current studies, one may ask the question where my study falls in this spectrum. I turn now to explain the (evolved) definition on FoK for the focus in this research. When the term was first introduced by Vélez-Ibañez and Greenberg (1992), they defined FoK as “bodies of knowledge of strategic importance to households” (p. 314). In this definition, the emphasis is placed on strategic knowledge for households’ survival. Building on this definition, Moll and González (1994) refer FoK to be:

> “historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being. As households interact within circles of kinship and friendship, children are “participant-observers” of the exchange of goods, services, and symbolic capital which are part of each household’s functioning” (p. 443).

In this definition, the information tapped extends from “knowledge” to also include “skills.” Furthermore, funds are not static but dynamic and continuous given their nature to be “historically accumulated” and “culturally developed.” However, the key component from which the definition for my study stems from is Moll and González’s (1994) acknowledgement on “individual functioning.” The researchers explain the role of children as *individuals within households* that “are part of each household’s functioning.” As previously stated, Moll (2005) recognized that households may not be the only place where children’s social worlds can exist. Therefore, I added the term “life-world” to emphasize the role of the individual and their well-being holistically in the household and across other worlds. Although the word “life-world” has been found in other FoK researchers’ literature (Hammond, 2001; Thomson & Hall, 2008; Barton & Tan, 2009) to explain childrens’ out-of-household spaces, its’ definition may be ambiguous. We turn next to examine the concept of life-worlds and then provide a definition of FoK in this study.

a. **Life-worlds**
So what then is meant by an individual’s life-worlds in my study? First, I examine Habermas’s (1978) approach to life-worlds, and then reflect on its relevance to FoK. Habermas’s (1978) concept of the life-world, is viewed from a language perspective on “communicative action.” He describes that society requires boundaries between the “private sphere” and the “public sphere.” However, a mutual interchange can exist between them, known as the life-world. In other words, individual’s don’t just live isolated in a physical tangible world, but humans interact to create life-worlds “by imbuing it with meaning through inter-subjective experiences and interactions with others that are constituted primarily through language (Kovarsky, 2008, p. 50). Similarly, according to Buber (1965a) the fundamental fact of human existence isn’t in the individual, but interactions between “(hu)man to (hu)man” through communication in the various spheres, or life-worlds. Therefore, life-worlds are “shared common understandings, including values, that develop through face to face contacts over time in various social groups, from families to communities” (“Habermas,” n.d.). In summary, Habermas’s life-worlds can be characterized as mutual communicative participation between individuals’ various social groups. Social interactions then are linguistically mediated communications between actors to produce and reproduce their life-worlds.

There are two characteristics to life-worlds that are important to my study, and also where I differ from Habermas (1978). First, life-worlds are comprised of an individual’s shared social “space.” Secondly, life-worlds have networks that may function like “household networks.” In the context of FoK, it’s important to clarify that life-worlds should not be interpreted as a space that is out-of-households, rather life-worlds include households as well. In other words, households are part of the network in a child’s life-world to maintain their well-being. In fact, in my study I found life-worlds to be both a physical space and an ideological space where funds can exist. Physical spaces were comprised of locations such as the house or the playground. Ideological spaces are social memberships, such as belonging to families or peer groups (i.e. friends). Both the physical and ideological spaces represent the
life-world. In addition, even though I refer to the term as life-world, as represented in Habermas (1987), it’s really an individual’s “social” life-world. So just as households network in the exchange of resources, which are also mediated by language, similarly children, grounded in their social life-worlds, have networks for their survival as well- which may include the household. For instance, a child may function in a playground based on the interactions of knowledge produced for how to go down a slide safely. The children in my study demonstrated knowledge or skills, like functioning on a playground, and are important to my definition on FoK for an individual’s well-being. Therefore, in defining FoK, and in particular, explaining individual functioning, I adapt the following FoK definition to signify the importance of life-worlds:

Historically accumulated and culturally developed bodies of knowledge and skills essential for household or an individual’s life-worlds functioning and well being. (Adapted from Moll and González, 1994).

6. **Summary of “funds” in FoK**

Funds can be thought of as a “currency exchange” between and within households to survive, like familial knowledge on medical herbs. Funds are distributed through “household networks” and children are often participant-observers learning the adult practices of these funds. A child’s funds represents the “thick” and “multistranded” relationships that are uncovered in his/her life. Teachers who learn students’ funds discover the pupil to be more than a student but the whole of a child. Funds are traditionally accessed via home visits, but other researchers have employed out-of-household methods, such as the use of photography and in-class discussions. In doing so, there is a conceptual shift from a household/family unit of analysis to an individual. Also, the area of study shifts from the home to the classroom or community, and information tapped on funds extended from household/labor social practices to, for example, experiences.

Although traditional FoK approaches to funds referred to household or individual functioning, in my study I emphasize the individual’s life-world, which may include households. This change is made
to signify how children’s life-worlds may be different than household adult practices. Life-worlds are comprised of spaces, both physical (i.e. playground) and ideational (i.e. friends). In addition, life-worlds have networks that may function like household networks. In summary, the diagram below depicts how I frame “funds” in the theory of FoK.

![Diagram of funds types]

**FIGURE 1. TYPES OF FUNDS**

According to my study, “funds” in FoK can be thought of as knowledge, skills, culture, and language. Knowledge consists of what students’ know which can be expertise or non-expertise domains of knowledge. Skills, refers to the ability what students’ can do in their life-worlds. Culture is defined as the everyday practices of a student, and can include the social interactional patterns as well. Language, in the context of funds, is referred to as a “linguistic fund.” A linguistic fund was identified as an ELs’ native language, in this study Spanish, and the code-switching of using mixed Spanish and English in talk. These four characteristics of funds are not in isolation, they all can overlap one another. For instance, the knowledge of a person can be derived from their practice. Furthermore, language is a form of a skill. However, in my study I examined funds in relation to these four areas, specifically the representation of math and science concepts within students’ funds.
B. “Knowledge” in FoK

There are many different approaches to activate students’ “knowledge” for acquiring academic “knowledge,” such as prior knowledge, background knowledge, and even FoK. However, by exploring the term knowledge in each of these domains, we can build a theoretical understanding to “knowledge” in FoK and explain what student knowledge means for ELs’ learning. An important note, is this section is not claiming one theory is “better” than the other. Each theory has a purpose for student learning and the teacher must recognize how to incorporate each theory or combine various theories to contextualize learning. Furthermore, this section provides how FoK, as an alternative perspective, can be beneficial to mediating student knowledge for (language)learning. This section begins with a definition of the terms and then explains how knowledge is constructed for (language)learning.

1. **Defining prior and background knowledge**

Many researchers indicated in the literature that the differentiation between defining prior and background knowledge is relatively vague (Dochy, 1999; Strangman & Hall, 2004). According to the National Center on Accessing the General Curriculum, Strangman & Hall (2004) acknowledge that background knowledge and prior knowledge are “parent terms” generally used interchangeably. Prior knowledge has been referred to by Dochy (1999) as “the whole of a person’s actual knowledge that: (a) is available before a certain learning task, (b) is structured in schemata” (p. 146). In other words, it’s the “schemata” that learners bring to the “learning task” based on previous knowledge and learning. I interpret Dochy’s (1999) definition of prior knowledge to include previous academic knowledge or experiences that students bring to the lesson (Balderrama and Diaz-Rico, 2006). Similarly, background knowledge is “content area knowledge or topic familiarity learners possess” (McNeil, 2010, p. 884) or what a student already knows about a subject (Stevens, 1980). In background knowledge, it can be argued that what one knows about a subject can be derived from in-school knowledge and also include
an individual’s out-of-school knowledge. Therefore, according to these definitions, all prior knowledge is essentially background knowledge, but not at all background knowledge is prior knowledge.

So how do prior and background knowledge relate, or not relate, to FoK? Let’s say a science lesson objective asks students to identify characteristics of organisms. A student’s prior knowledge could reveal in-school knowledge from last year’s learning that all organisms are living things. A student can describe his/her background knowledge by explaining an experience with animals at the zoo. In a FoK example, a student could share their household fund of planting a garden with their family. Each of these examples refers to “knowledge” but there are differences and similarities. In the first example on prior knowledge, the student’s knowledge of “living organisms” could be thought of as knowledge learned in the institution of school taught by a teacher. In the case of the second and third example on background knowledge and FoK knowledge, there may be an overlap. For instance, since background knowledge is comprised of out-of-school knowledge, and FoK also occurs in out-of-school contexts, then background knowledge can include FoK. For instance, the student’s knowledge of gardening, derived from their household funds, is a FoK and background knowledge. However, to say the reverse, that FoK are types of background knowledge may be inaccurate. Elaborating further, background knowledge includes in-school knowledge and FoK emphasizes shared distribution of knowledge with children and members in their life-worlds, in out-of-school contexts. Another way to think about “knowledge” in FoK, is how knowledge and skills found in FoK are reflected in the everyday lived practices that are essential to households or individual’s well-being. Unlike prior and background knowledge, FoK privileges knowledge from the perspective of practices. Therefore, the student’s knowledge of gardening practices is relevant to the daily life of the student.

2. **Approaches to knowledge for teaching ELs**

Although the differences in “knowledge” may seem slight, they hold larger implications for ELs learning. Prior and background knowledge stem from cognitive schema theory (Anderson,
1977), which posits all knowledge being organized into units. Within these units of knowledge are stored information in the brain’s memory. Prior knowledge “activation involves the transfer of available knowledge from long-term memory to working memory...if... meaningful information is related to the... existing knowledge held in working memory, this information can be integrated in the existing knowledge base” (Wetzels et al., 2011, p. 275). For example, one’s schema for “egg” may include background knowledge such as eggs having a yolk and a shell. Their prior knowledge may inform birds hatch eggs, from which new knowledge is taught that birds are warm-blooded creatures (Davis, 1991).

Examples of common strategies for activating prior and background knowledge have generally included “use of other books, oral discussion, exposure to media, or use of pictures or other visual prompts combined with text in order to build schemata” (Diaz-Rico, 2008, p. 174). Fisher and Frey (2010) refer to building background knowledge through direct and indirect experiences. For instance, these authors suggest direct experiences like field trips or guest speakers providing more information on the academic topic. Indirect experiences would include modeling how teachers think aloud about content. These examples demonstrate the ways “knowledge” is learned, through prior and background knowledge, as instructional approaches.

In prior and background knowledge, students share what they know about a specific predetermined topic. Since the curriculum topic is predetermined, it may not be derived from students’ own knowledge or familiarity. But why would this matter for ELs? Well, Strangman and Hall (2004) recognize that students’ bring different topic areas of familiarity, and this is understandably a factor of interest when investigating the effectiveness of prior and background knowledge. In fact, although studies have reported the benefits of prior and background knowledge for literacy learning, for ELs their level of L2 knowledge constricted the power of background knowledge (McNeil, 2010; Al-Shumaimeri, 2006). Therefore, turning toward a FoK perspective to knowledge may be beneficial for ELs learning.
In contrast to prior and background instructional approaches, FoK situates a sociocultural approach to students’ knowledge *central to the curriculum planning*. A curricular approach to FoK is where teachers can plan and create “activity settings” that combine students’ cultural and linguistic practices to provide opportunities for children to integrate their knowledge into schooling (Balderrama and Diaz-Rico, 2006). A sociocultural perspective would argue that the quality of learning is in children’s availability to use their mediational tools which include cultural and linguistic practices. In other words, “knowledge,” in FoK, represents ELs cultural and linguistic practices. Therefore, planning curriculum that builds on these tools can mediate ELs quality of learning. Furthermore, students’ funds become the curricular topic of familiarity. The knowledge displayed in a curriculum grounded in FoK is a “deep appreciation of how people use resources, of all kinds, most prominently their funds of knowledge to engage life” (Moll, 2001, p. 17). It is a question of whose knowledge, and definition of knowledge, is central in the curriculum?

3. **Summary of “knowledge” in FoK**

In the literature, prior and background knowledge are used interchangeably framed by cognitive schema theory. In my study, I differentiate prior knowledge as in-school knowledge or something taught by a teacher in the institution of school. Background knowledge is open-ended, referring to knowledge student has about a topic, and includes both in-school and out-of-school knowledge. In this perspective, background knowledge includes prior knowledge and FoK. However, FoK does not always include background knowledge, since it filters background knowledge that is privileged in students’ out-of-school *practices* essential to students’ well-being.

A fundamental difference on “knowledge” isn’t just its definition of where, how, or what a student knows what they do, but how students’ knowledges are appropriated in the (language)learning contexts. ELs varied level of L2 knowledge constricted the effectiveness of prior and background knowledge, signifying that language development theories are important to contextualize
(language) learning of students. In contrast to prior and background knowledge, FoK privileges linguistic funds as knowledge to facilitate math and science content. Instead, prior and background knowledge permeate within predetermined curriculum topics, which may be foreign to ELs, and focus on instructional practices to ‘activate’ knowledge. In other words, students are expected to derive their background knowledge to any expected curriculum topic. FoK advocates for developing curriculum, in addition to instructional practices, that are grounded on students’ funds as curricular topics. Therefore, students’ knowledge, from their funds, are central to their learning environment.

In my study student knowledge is represented in their funds, but the teachers and I had to differentiate between what was a FoK and a students’ prior knowledge and background knowledge. Often, to answer the differentiation between FoK and other types of knowledge, would require the teachers to follow up with questions from students, such as where or how they learned what they knew. In addition, this was a limitation in the methodology of the teachers accessing funds because they didn’t conduct household visits. Furthermore, the study filtered all types of funds, to specify only knowledge that revealed math-science funds in students’ life-worlds. Therefore, prior and background knowledge relies on students’ self-recognition to see the math and science in their knowledge, whereas, FoK assists students to ‘see’ the math and science in their funds, through teacher mediation in developing a curriculum on their funds.

C. “Culture” in FoK, Multicultural Education, and Culturally Responsive Teaching

In this section, I explain the cultural goals of multicultural education, culturally responsive teaching, and FoK. Then, I define culture and its similarity and differences to teaching culture from a FoK and culturally responsive standpoint. Finally, in the summary, I show how culture is informed in my study.

1. Cultural goals: Cultural democracy, cultural diversity, and cultural strengths
In multicultural education, culturally responsive teaching, and FoK, culture can be viewed through the goals of each framework. In multicultural education, researchers argue that the theory is a phenomenon “without an agreed definition, and the implementation of the concept appears to depend largely upon the standpoints of individuals, whether they take an assimilationist, cultural pluralist, or an anti-racist approach” (Modgil, Verma, and Mallick, 1986, p. 5). Although multicultural education is a contested definition, Banks (2004) argues researchers have similar goals in the field. Banks (1997) defines multicultural education as an idea, an educational reform movement, and a process.

“Multicultural education is an idea or concept, an educational reform movement, and a process whose major goal is to change the structure of educational institutions so that male and female students, exceptional students, and students who are members of diverse racial, ethnic, and cultural groups will have an equal chance to achieve academically in school.” (Banks, 1997, p.1).

Within the definition, the goals of multicultural education are described to reform schools and create a civic community that works for the common good. In other words, the goal is a “cultural democracy” for the purpose of equity and justice for diverse groups of people.

Culturally responsive teaching stems from multicultural education theory and provides a framework for achieving the goals outlined above. The theory is defined by Gay (2000) as “the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them”(p. 29). There are two main cultural goals in culturally responsive teaching. The first goal overlaps with multicultural education’s investment in the public good. Ladson-Billings (1995), states the theory helps “students to accept and affirm their cultural identity while developing critical perspectives that challenge inequities that schools (and other institutions) perpetuate” (p. 469). A second cultural goal is “acquiring a more accurate knowledge base and ways of knowing about ethnic and cultural diversity in United States” (Gay, 2004, p. 40). From this perspective, knowledge is a social construction whereby no group, such as Western cultural knowledge, should have exclusive dominion over in schools. Therefore, the goal of culturally responsive teaching is
to enact “cultural diversity” by learning alternative interpretations of non-Western cultural groups which reflect the multilingual and multiethnic population of the United States (Gay, 2004).

Cultural goals in FoK is to provide an additive view of minority students’ cultural backgrounds as resources, not deficits to their learning. Moll (2004) adds to this goal of FoK as a curricular reform to “give teachers theoretical and methodological equipment to address diversity through a process of engagement with the everyday conditions of life” (p. 700). As teachers address diversity, they research ways of knowing students funds’ they bring to school and search for ways to tap into their strengths (Moll, 2004). Therefore, the cultural goal of FoK is a focus on mediating students’ “cultural strengths” for academic achievement.

2. **Defining culture**

Given the variations in cultural goals, each theory informs similarities and differences in defining culture. Recalling on Gay’s (2000) definition on culturally responsive teaching, there are parallel terms found in FoK as well, such as students’ “knowledge” and “experiences” that make learning “relevant.” Although these ideas do overlap and may seem similar, there are differences between the two theories in regards to how they define and teach culture. Culturally responsive teaching in multicultural education refers to culture as:

> “a group’s program for survival in and adaptations to its environment…consist of knowledge, concepts, and values…shared beliefs, symbols, and interpretations within a human group…that distinguish one people from another in modernized societies” (Banks, 1995, p. 8).

There are three points to be made in regards to this cultural viewpoint from the perspective of FoK and culturally responsive teaching. First, similar to FoK, culture is viewed as a way of “survival,” but in FoK, culture, is not viewed as a “group’s program.” In FoK, survival is maintained through exchanges of resources between and within household networks. Second, culturally responsive teaching adds additional cultural components, apart from culture as a form “knowledge” in FoK, such as “concepts,” “values,” “interpretations,” and “symbols.” Thirdly, according to this definition, cultural groups share
these components since people “within a culture usually interpret the meanings of symbols, artifacts, and behaviors in the same or similar ways” (Banks, 1995, p. 8). Similarly, Ladson-Billings (2004) defines culture in the context of “cultural systems…learned behavior that has been normalized and regularized” (p. 109). The idea that members from a given culture may have shared traits, values, or regularized behavior, is a concept that FoK is careful to differentiate. In FoK, culture is defined as everyday practices “what it is that people do, and what they say about what they do” (Gonzalez, 2005, p. 40). This isn’t to say that similarities may not exist within cultures, but when culture is viewed as practices, culture is moved away from shared group culture, and issues of contestation, ambiguity, and contradiction are the focus of an ethnographic analysis (Gonzalez, 2005).

All three theories acknowledge pitfalls in adopting a limited view of culture as tangible surface markers. For instance, Banks (1995) recognizes a potential problem of how many educational practitioners may restrict culture to specific “heroes and holidays” approaches, even though particular multicultural literature may not advocate for such a theory. The FoK perspective on culture as everyday practices can be beneficial to avoid culture as special events, food, or typical costumes, who may not practice all these traditions of their cultural past (Amanti, 2005).

3. **Teaching culture**

Culturally responsive teaching and FoK address teaching culture from different perspectives. One strategy to teach culture in multicultural education is culturally responsive teaching. Ladson-Billing (2001) draws on three propositions for culturally responsive teaching strategies: *academic achievement, cultural competence, and sociopolitical consciousness*. I explain each of these strategies in relationship to its recognition in FoK but difference in approach. The first, culturally responsive teachers focus on students’ academic achievement. This is of similar importance to FoK as Gonzalez (2005) states “drawing on student experience with household knowledge is not to merely
reproduce household knowledge in the classroom…build on the familiar knowledge bases…to enhance learning in…content areas” (p. 43).

Secondly, in culturally responsive teaching, teachers develop students’ “cultural competence” in four areas: “(a) teacher understands culture and its role in education (b) teacher takes responsibility for learning about students’ culture and community (c) teacher uses student culture as basis for learning, and (d) teacher promotes a flexible use of students’ local and global culture” (Ladson-Billings, 2001, p. 98). Although FoK view of culture as practices have primarily focused on local household practices, the theory recognizes, similarly to culturally responsive teaching, that practices are embedded within larger structures (Rios-Aguilar et. al, 2011). To promote cultural competence teachers may engage in the “knowledge construction process” (Banks, 2004) to provide frames of references from diverse cultures. An example of fostering cultural competence, according to culturally responsive teaching, would be to provide frames of references where an African-American child in the United States would learn about the life of an African boy in Malawi who wants to build a gallimoto (Ladson-Billings, 2001). The child grows to understand and respect their own cultures as well as others. However, a FoK approach to cultural diversity is examined in that the focus on processes of everyday practices, forms daily activities, as frames of reference which take into account multiple perspectives (Gonzalez, 2005). In other words, exploring practices reveal the differences within cultural groups and their varied ways of living in households.

Although both theories recognize teachers should learn students’ culture they have different approaches in doing so. Ogbu (1992) argues how “multicultural education theories and programs are rarely based on actual study of minority cultures and languages. Many proponents of multicultural education models have not studied minority cultures in minority communities” (pg. 6). FoK can offer a perspective for teachers to learn students’ culture through ethnographic home visits. Moll (2000) describes teaching through culture by “connecting our ideas of culture with empirically grounded
knowledge, not handed to the teachers by academics but developed firsthand through their own inquiry about a group of people and their lived experiences, about what their everyday life is all about” (p. 262).

Lastly, culturally responsive teaching proposes teaching with a sociopolitical consciousness. Sociopolitical consciousness refers to knowing the larger sociopolitical context of the school-community-nation-world, investment in public good, and academic experiences that connect students to the larger social context (Ladson-Billings, 2001). As mentioned earlier, FoK differs on its primary focus of a local culture in households. However, the life histories of the households have provided a difference perspective on emancipation. For instance, as parents responded to personal narratives on their cultural practices, they had a heightened historical consciousness that brought them to where they are now (Gonzalez, 2005). Sociopolitical consciousness, then differs from culturally responsive pedagogy emphasizing a more global perspective, compared to FoK sociopolitical consciousness existing within a historical trajectory of one’s’ lived practices.

3. **Summary of “culture” in FoK, multicultural education, and culturally responsive teaching**

Goals of culture are exhibited differently in multicultural education as “cultural democracy,” in culturally responsive teaching as “cultural diversity,” and in FoK as “cultural strengths.” Culture in FoK premises on every day practices compared to culturally responsive pedagogy encompassing values, traits, and behaviors. Both FoK and culturally responsive teaching demonstrate addressing to teach “cultural competency,” in frames of references, and “sociopolitical consciousness.” However, FoK varies in the methodological approach to teach culture grounded from ethnographic tools.

In my study, culture is referring to the everyday living practices of students in the contexts of their life-worlds. The types of funds associated with culture in this definition move beyond the prevailing notions of culture in schools centered around observable and tangible surface markers:
dances, food, folklore, and a realization that culture is a dynamic concept, and not a static grab bag of tamales, quinceaneras, and cinco de mayo celebrations (Moll et al., 1992). Hence, in my study, I examine looking deeper into students’ everyday living practices as it relates to math and science.

In terms of learning students’ culture, home visits were not conducted in my study. Instead, appropriating a FoK theory led the teachers to explore culture in the students’ neighborhoods. Whether it be households or neighborhoods, culture is learned in the communities and/or places where students’ life-worlds exists. In doing so, educators used ethnographic tools, observing authentic and rich ways culture is practiced by their students. These cultural practices, derived from minority students’ communities can then inform educators’ ways they can teach to and through culture.

D. Sociocultural (Language) Learning: Mediation, Discourses, and Language Socialization

A sociocultural approach to (language)learning can provide insights into the practices of school and how an investigation of social contexts can contribute to the success or failure of ELs math and science content. In this section, I explain (language)learning is culturally mediated in a “context” that is a goal oriented activity. Next, I turn to how sociocultural theorists have examined social contexts for learning in the theories on zone of proximal development, cultural-historical activity theory, Discourses, and language socialization. Finally, I summarize my study’s rationale for the term “(language)learning” and how these theories inform the framework of my study.

1. Defining a social context

This study draws on the work of Diaz, Moll, and Mehan (1986) to define what is meant by (language)learning in a context. The authors describe context to be not a physical location, like the classroom, but thought of as interactional terms, such as what participants are doing. In other words, people in interaction serve as social environments for each other. A context, then, is a process of interactions between individuals and their environments. Diaz et. al. (1986) describe how the contexts for learning informs schooling.
“These interactionally constituted environments are embedded in time and change from moment to moment. In dynamic settings, such as schools, interactional contexts may shift rapidly from one moment to the next; the important analytic task, therefore, is to integrate the participants’ interactional activities within the particular context of their occurrence” (p. 193).

The researchers refer to contexts as “interactionally constituted environments” that are not static but “dynamic” and “shift” because they are “embedded in time and change.” The challenge is how educators can “integrate the participants’ interactional activities within the particular context.” The authors argue, as do I, that the social organization in contexts are fundamental to the outcomes of a child’s (language)learning. In reference to my research, I am interested in studying the teachers, as the unit of analysis, and how they inform themselves about their students’ math-science funds in (language)learning contexts. Specifically, how the teachers mediated ELs’ math-science funds that develop over the school year, from the first to third unit, to shift the (language)learning contexts in their lesson plans and evolving interactions during classroom discussions. This leads to the question of what is meant by mediation and is answered below.

2. **Mediation and zone of proximal development**

In sociocultural theory, (language)learning is culturally mediated. Human beings react to and act upon “culturally mediated artifacts” such as *language* as the primary tool, signs, symbols, instruments, leading to an outcome (goal) of learning. Vygotsky (1978) described learning as the movement through the zone of proximal development (zpd) “between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). Therefore, the zpd is what children can do with assistance from capable peers or adults using cultural mediational tools. Vygotsky (1978) further articulates how the zpd can be reached by linking the dialectical relationship between schooled (scientific) and everyday (spontaneous) concepts together. Scientific concepts are academic materials learned at school, whereas everyday concepts are developed in collaborative participation in purposeful daily activity.
Parallels can be drawn between Vygotsky’s learning theory and my research. For instance, what students can do without assistance is grounded in their FoK. Additionally, students’ funds are the “everyday” concepts which, similarly, can be linked to “scientific” concepts, such as math and science objectives. Furthermore, there is potential for teachers to reach ELs zpd by using ELs’ math-science funds as mediational tools for (language)learning. My study builds upon learning through the zpd by seeking to understand how teachers mediated students’ math-science funds, or between funds (everyday) and content areas of math and science (scientific). Consequently, as students learn academics through the mediation of their own funds, the learning acquired becomes “new” scientific knowledge (outcome) and a part of students’ everyday concepts. For instance, in the figure, if a teacher is teaching a math concept of counting to a hundred to a child, the child can interpret this new concept based on his/her own language and cultural practices, such as a video game like “Sonic the Hedgehog” who collects coins. However, once the child has mastered the concept of adding, this becomes registered now as part of a learned understanding and can be tapped to further repeat the cycle with a new academic skill. In this perspective, learning isn’t the “transfer” of information, but is continuous as it is re-organized in social contexts using mediational tools to achieve the activities goal.

2. **Mediation and cultural historic activity theory**
Engeström’s (1987) cultural historical activity theory (CHAT) extended the concept of mediation developed by Vygotsky (1978). CHAT explains that learning is not an isolated individual task, but rather is mediated through cultural and historical activities as they transform and determine the future activity system. Mediation occurs through the subject but also in rules, community, and division of labor in the activity or social context.

Figure 3. ENGESTROM’S (1987) CULTURAL HISTORIC ACTIVITY THEORY

These activity components consist of the subject, people who are in the immediate activity, such as the teachers and students. Community members who have extended relationships to the immediate people involved in the subject, including families. There is a division of labor from which participants within the activity articulate specific roles, such as a teacher being a facilitator. There are rules for how the activity will be implemented, like grouping students heterogeneously. As explained earlier, mediational tools are used to achieve the object of the activity. The object are new understanding to build meaning to the outcome, such as becoming a scientist. The outcome is the net goal, in particular socializing into a Discourse (Gee, 2008). To sum up CHAT and its complexity, Roth, Lee, and Hsu (2009) state,
“CHAT focuses on what people (participants) actually do, the objects that motivate their activity, the tools they use the community which they are a part, the rules that pattern their actions and the division of labor they take in the activity. Tools, community, rules and division of labor are the social and materials that both enable and constrain human agency that is they are the resources that mediate the relationship between agents and the objects of their actions” (p. 141).

CHAT is a heuristic tool for analyzing the activity system to examine my study on multiple fronts. The triangle helps reveal relationships between certain parts of the system. The triangle also allows for researchers to create a representation that accounts for these relationships. For instance, in one activity FoK can be the outcome, in the next a tool, and in the latter an object. I refer to FoK in these various activity components to situate my study.

First, it frames an understanding of how the teachers’ designed and redesigned activities to access ELs math-science funds as an outcome. Secondly, CHAT frames how teachers’ mediated ELs math-science funds, as mediational tools, for (language)learning math and science, when lesson planning curriculum and in conversational classroom discussions. For instance, funds are not simply inserted as a curriculum topic, but are complex in the way it is designed to have teachers think about curriculum integration and to organize social interactions that expand on linguistic and cultural resources. Finally, CHAT provides a perspective in the teachers’(subject) development about the theory of FoK (object) to become instructional leaders and curriculum designers (outcome). FoK is the object of attention when teachers generate theories of practices. This includes how teachers’ conceptualize and re-conceptualize FoK for student learning.

What is important about the triangle is that it visually represents the activity and the possible tensions, relationships and interactions that occur as a result of changing conditions (one reason we see production, consumption, exchange and distribution connected to the various CHAT categories). CHAT recognizes that tension can exist between the relationships within the activity component. For example, there could be curricular restraints between adopting students’ funds and state mandates. However, the emergence of tension isn’t a hindrance to learning, but can produce new activities for a meaningful and
authentic learning experience. Therefore, CHAT focuses on human agency and a system where new knowledge emerges and is exchanged in the form of meaningful artifacts that can be used across systems.

4. **Discourses and language socialization**

Thus far, we have examined how mediation occurs in social contexts, specifically through interactions. Additionally, (language)learning is a process where mediation are culturally derived artifacts, such as funds or primarily language, used by a more experienced peer or teacher that can facilitate the learning of a student. Furthermore, (language)learning is socially organized in activities (CHAT) that are mediated toward a goal-oriented activity, or the outcome. Here, I describe in my study what is meant by the “outcome” in CHAT and how it relates to the understanding of ELs becoming proficient in English. Furthermore, I address how learning a language relates to the understanding of the reciprocal nature of language-learning, thus the term “(language)learning.”

a. **Learning as Discursive shifts**

In activity theory, the subject uses culturally mediated tools transforming the object to produce an outcome. The outcome represents a space that enables identities to be transformed (Litowitz, 1993). (Language)learning is reframed not as accumulation or transmission of knowledge but as a process of becoming an active participant in various communities of practice (Lave and Wenger, 1991). Gee (2008) defines these identities, as social practices in a Discourse, “ways of behaving, interacting, valuing, thinking, believing, speaking, that are accepted as instantiations of particular identities by specific groups” (p. 3). Hence, outcomes represent processes of socializing into *Discursive identities*. For instance, in many mainstream classrooms, teachers teach English to ELs through grammar and vocabulary definitions. An EL may be provided with a definition of the term animal “cell” and demonstrate a shift in science knowledge on the term. However, (language)learning isn’t the transfer of knowledge, such as defining a cell, but the outcome would be a Discursive shift in a student becoming a
biologist. The outcome of a biologist represents the student socializing into new practices, orientations, and understanding of practices that biologists do (i.e. biologist Discourse). Furthermore, appropriating a Discourse is a life-long process, where not only novices, like children, are being socialized, but even more experienced members in the community, like teachers, are gaining competence in new ways of representing meanings and communicating ideas throughout one’s life. Hence, why (language)learning is a life-long process. Linguistic competence would then be using language appropriately in ways that are determined by members in the community of practice. For instance, even though the teachers in my study are competent “math teachers” and “science teachers,” they were also socializing into new meanings of what are the practices of a mathematician or a scientist, and how this informs the ways they teach ELs using their funds. Thus, (language)learning is a shift in Discursive identities.

b. **From language acquisition to language socialization**

What does (language)learning as a shift in Discursive identity have to do with the intrinsic relationship between language and learning, and specifically how ELs develop language proficiency? Let’s begin by examining current language acquisition theories. Krashen’s (1985) theory on acquisition learning hypothesis has been profound as a second-language instruction in the United States (Diaz-Rico, 2004). In particular, “comprehensible input” is part of a larger framework, operationalized as $i+1$, indicating the person’s current level of language ability should be one step beyond the level of competence in a natural order of development. If there is comprehensible input than the brain automatically generates necessary grammar because it is acquired subconsciously with the assistance of the “internal language processor.” In other words, Krashen’s (1985) emphasis is placed on *individual*, developmental, acquisition of language in the brain. Additionally, language is acquired (unconscious process of language for real communication), not learned (knowing rules of language).

However, missing from language acquisition theory is the role of social interactions and how human beings learn from others in society, including language. In following the footsteps of Vygotsky’s
sociocultural theory, this study perceives second language learning as a process in language socialization. Socialization is defined by Garrett and Baquedano-Lopez (2002) as:

“process through which a child or other novice acquires the knowledge, orientations, and practices that enable him or her to participate effectively and appropriately in the social life of a particular community…this process…is realized o a great extent through the use of language, the primary symbolic medium through which cultural knowledge is communicated and instantiated, negotiated and contested, reproduced and transformed” (p. 339).

ELs, through interactions with more experienced persons, are socialized into the knowledge and practices that are necessary for them to function as competent members of their communities (i.e Discourses), including becoming students in school Discourse, mathematicians in math Discourse, and scientists in science Discourse. Language socialization is the socialization through language to use language in socially appropriate ways (Ochs and Schieffelin, 1984). For instance, recalling our example on animal cells, simply stating a cell definition doesn’t mean the child knows how to appropriately use the word in social contexts. For instance, a cell could also represent a jail “cell”, a “cell” phone, or even in other parts of the world, like Pakistan, “cells” are batteries. Therefore, important to how ELs gain English proficiency is when they are able to recognize, negotiate, and co-construct meaning using language in socially appropriate ways with others in various Discourses. Hanks (1996) refer to communication between people as “neither sufficient nor necessary that they ‘share’ the same grammar. What they must share, to a variable degree, is the ability to orient themselves verbally, perceptually, and physically to each other and to their social worlds” (p. 229). In summary, contrast to language acquisition theories referring to language self-contained in the mind, language socialization theorizes language as meanings that are socially situated, and people are socialized through language to use language.

5. Why the term “(language)learning?”

Thus far, we have examined “learning” from a CHAT framework, in addition to “language” from a language socialization perspective. So how then are the terms “language” and
“learning” intrinsically linked to one another? Roth and Lee (2007) describe how in CHAT language can be considered a cultural mediational tool as well as a form of activity (goal). The authors describe language as a primary mediational tool used for action in pursuit of goals. When “language is viewed as action, it becomes an explicit tool (e.g., reflecting on action, representing situations)” (p. 208). Furthermore, they claim language exists as the totality of the activity system (Roth and Lee, 2007, cited from Rocha & de Carvalho, 2000).

“The individual always learns and uses the sense of the word in the process of participating in activity, where he or she encounters its material envelope (sound) as an invariant property. Like other material tools and artifacts, the sense of a word or utterance arises from the relationship between action (goal) and activity (motive). Using a certain sound (word) means pursuing a certain goal” (p. 209).

Another way to think about the relationship between learning and language is through a popular phrase that I was told when I taught elementary school: “students learn to read so they may read to learn.” In this phrase, reading, which is language to decipher symbols or words, is the goal of the activity. In the latter, reading becomes a mediational tool for learning a concept. Similarly, we can draw from the same analogy to say: “we learn to use language and we use language to learn.” In this regard, language is the goal of the activity. Students “learn words through using them in particular situations defined by the object, division of labor, and community (Roth, 2005c). In my study, the teachers’ activity lesson plan goals are for students to learn the “language of math” and the “language of science.” But remember, ELs are learning how to use a language in socially appropriate contexts (i.e. language socialization) by appropriating the Discourse of math and science, since language is situated in a social practice. Additionally, language is a mediational tool used for learning math and science because all interactions are embedded in language. Language is the primary mediational tool through which students make connections, problem-solve, and communicate.

Therefore coining the term “(language)learning” implies three main points. First, the term symbolizes that in activity theory, learning is never void of language in learning contexts, and vice-versa. Second, (language)learning is both a goal and the mediation of the activity. Lastly, the term
recognizes that (language)learning is not something specific to ELs becoming “English proficient” but all learners, including native English speakers, are also socializing into Discourses, like math and science. Therefore, it symbolizes that ELs are not ‘deficient,’ but like all people, are life-long (language)learners.

5. **Summary on Sociocultural (Language)learning**

My research question explores teachers’ mediating ELs math-science funds for math and science (language)learning, as well as how teachers (re)conceptualize FoK, thereby theorizing FoK for (language)learning. To explore these research questions, it is important to know what is meant by ‘mediation’ and ‘(language)learning.’ For the purpose of my study, (language)learning occurs in social contexts, where people in interaction serve as social environments for each other. Furthermore, (language)learning contexts are socially organized activities that are mediated toward a goal-oriented activity.

Mediation, and more importantly, *access* to mediational tools that are familiar to ELs, like math-science funds, are foundational to the success of schooling. Vygotsky (1978) examined mediation through the zpd. The zpd can be reached by linking familiar everyday concepts, like math-science funds, with unfamiliar math and science scientific concepts. Additionally, CHAT theory extended the concept of mediation to cultural-historical activities, including rules, community, and division of labor. CHAT helps reveal relationships, even tension, between these components in the activity system. In doing so, CHAT aids to examine factors contributing to the success or failure of ELs math and science learning by exploring the social organization of schooling and the social manipulations that produce educational change (Moll and Diaz, 1987).

For instance, in my study ELs math-science funds are the outcome in the activity that teachers’ develop to elicit their funds. Also, FoK are objects in the activity when teachers’ (re)conceptualize FoK for theorizing (language)learning. Furthermore, funds are examined as mediational tools when teachers
design lesson plans and engage in conversations with students. Therefore, understanding funds from a CHAT perspective, allows the researcher to see whose funds are the teachers accessing (i.e. subject, community). How funds are distributed in the math and science activity (i.e. division of effort, rules). How the theory of FoK informs teacher development (i.e. object). Also, how math-science funds are used to socialize students into math and science Discourses (i.e. outcomes). All of these aspects are imperative when studying FoK with respect to mediation and (language)learning.

(Language)learning is dialectically linked. A person learns to use language and uses language to learn. In this respect, (language)learning can never be void in the activity system since language is both a tool and a goal of the activity. Furthermore, ELs are socialized how to use language in socially appropriate contexts (i.e. language socialization) by appropriating the Discourse of math and science. Thereby, (Language)learning is a shift in Discursive identity, embedded in ways to use language, and not a transfer of information.

However, certain types of mediation and social practices are privileged more than others. For ELs their cultural and linguistic tools may be marginalized compared to dominant Western culturally mediated tools employed in schools. Hence, a study on FoK seeks to re-organize schooling situating ELs’ funds central to the curriculum. In doing so, funds that are familiar to ELs are mediated to (language)learn the unfamiliar content of math and science.
V. METHODOLOGY

Desis may think daal is the easiest thing to make, but with over 20 varieties of lentils it’s harder than it seems. Although it seems like your cooking through trial and error, there is a method to this dish. You have to know the right color, smell, and texture of the masalas. The ratio of water to daal is key. At the end, be careful of the tarka because it sizzles, smokes, and makes a loud noise.

In the following I explore the methods used for this study. The study explores how a cohort of mainstream teachers learns to use and make meaning of FoK as they design curriculum and engage in teaching ELs math and science. A review of the research questions are stated below:

1. How does a cohort of teachers’ access ELs’ math-science funds?
2. How does a cohort of teachers’ mediate ELs’ math-science funds for (language)learning math and science?
3. How does a cohort of teachers’ (re)conceptualize their understanding on FoK?

The research study adopts a participatory action research model (Razfar, 2011) modified to guide teachers in using sociocultural theory and tools. Here, participatory action research is focused on the teachers’ problem-solving and generating knowledge from the process. My study involved the teachers in the act of researching their own classroom, and in particular, their teaching practices and ELs’ learning with respect to math, science, and FoK. Additionally, the teachers’ action-oriented research led them to explore their school and students’ community on playgrounds. Positioning the study as a participatory action research model allowed for a collaborative research between the researcher and the participants, that is fueled by the needs of the participants. As the researcher, I could collaborate with the teachers as we explored our own intersecting research questions. For instance, as I explored teachers’ meaning making and FoK practices, the teachers were nested within their own action-research questions. Karen was inquiring about fostering ELs participation, and Abby expressed interest in studying the role of tension for (language)learning. Therefore, working within a participatory action research model, I could actively participate with the teachers as a mentor to facilitate their research as we collectively explored the teacher’s FoK practices in our study group meetings. Furthermore, a participatory action
research model intends to lend itself to “participation, self-determination empowerment, and change” (Bentz & Shapiro, 1998, p. 127). In my study, change is recognized as the teachers being active learners, designers of their teacher development, becoming independent thinkers and problem-solvers, developing new ways to work together (Razfar, Troiano, Nasir, and Yang, forthcoming) as our FoK meaning-making and practices are socially constructed and negotiated.

Also, the study is both interventive and interpretive (Faltis, 1997). The researcher, who is also part of the cohort as a participant-observer, provides intervention strategies for the teachers to use FoK for ELs’ math and science (language)learning. These interventions are conceptual in how the teachers identify, define, and integrate FoK (language and culture) with math and science content areas for lesson planning and instructional practices. Other interventions are in practices where the researcher suggests specific activities to access ELs’ funds, modifications in FoK instructional practices in relation to other project LsciMAct coding tools, and redefining teachers’ roles such as co-teaching. The research is also interpretive because the study seeks meaning-making from the perspective and practices of the teachers’ themselves. The remainder of the chapter includes a description of the school site and participant, role of researcher and teachers, as well how data was collected and analyzed to frame an understanding of the study.

A. **School Site and Participants**

The teachers, Abby, Karen, and Lorena all taught at Genesis school. Unique to Abby and Karen is that they both began and grew together in their careers at Genesis. They were both assigned as first grade teachers when they started teaching and for the past three years had the opportunity to build an extensive collaboration with one another, especially during grade level meetings. The remainder of this section will describe the Genesis school site, the EL participants, and the teacher participants in the study.

1. **Genesis school site**
At the time of the study, Genesis is an underachieving school with a large population of ELs’ ‘at-risk’ and placed on academic probation located in an urban public school district. Genesis, consists of over 875 students with racial demographics of predominately 95% Hispanic students, 3% Black, and 2% classified as “Other.” Genesis is situated in also a predominately Hispanic neighborhood consisting of low-income community where 98% of students qualify for free or reduced lunch. Those students labeled as limited English learners constitute 31% of the student population. Although Genesis has adopted a Transitional Bilingual Education (TBE) program for grades K-4, the teachers and students in this study were in a monolingual English classroom, where many students have either transitioned out of the program, are receiving pull out ESL services, and/or may still not be English proficient.

a. **Abby**

Abby is a monolingual, English, Caucasian teacher, who taught primary grades for four years. Abby demonstrates a science background holding a bachelor in Teaching Elementary Science degree and is Genesis’ lead science teacher and after-school science club coordinator. Her classroom consists of twenty eight first graders, of which she concentrated on four particular ELs for her action-research. Abby selected these four students to collaborate in a small group throughout the year based on their differentiated academic performance and language proficiencies. The first student, Alex, is Spanish proficient who has average scores in reading, math, and science. Holly, also speaks Spanish as her home language and has low reading, math, and science scores. James, is a student who is English and Spanish proficient with high reading scores across math, science, and reading. Finally, Alexis, is also English and Spanish proficient with low science, but average math and reading scores. Abby is particularly concerned with science content knowledge and participation for Alex and Holly.

b. **Karen**

Karen is a Caucasian, English monolingual teacher who has taught first grade for three years. At the time of the study, this was her fourth year teaching, but her first year teaching second
grade. Karen has a strong reading background with a bachelors’ degree in Elementary Education with a focus on language arts. She is Genesis’ lead reading teacher. Many of Karen’s students were prior students she had in first grade or Abby’s former students. She has twenty eight students, of which six are part of the prior years’ gifted program. She selected to focus on four students for her action research because they all spoke Spanish as their first language, as well as to obtain a balance gender, participation, and academic standing. Brock, is an EL, whose home language is Spanish and who she retained when she had him in first grade due to his low achievement. He receives services for speech therapy and has been labeled with Attention Deficit Hyperactivity Disorder (ADHD). His academic performance is underachieving across reading, math, and science. Charlie, a gifted student, has high participation and academic standing across content areas, and is English and Spanish proficient. Yolanda is bilingual, Spanish and English, and has low math and reading scores, but average science scores. Chelsea is also proficient in Spanish and English, and has average scores across content areas. Although Yasmin was not part of Karen’s focus group, she is a gifted student, also bilingual, who often participated highly in discussions with the focus group in whole class discussion.

c. **Lorena**

Lorena represents a unique case. Her role is limited in the study because she was displaced from Genesis and did not have her own classroom. However, she was a valuable cohort member in the study because of her wealth of knowledge in the school and community would assist Karen and Abby to advocate community support for a playground at Genesis. She had taught for eighteen years at the school, lived in the community, and was the lead bilingual and ESL coordinator. She is Mexican and bilingual in Spanish and English. She had close relationships with many families in the neighborhood as she would host weekend family programs for parenting, arts and crafts, yoga and martial arts, as well information on high schools. In the study, she co-taught in Karen’s classroom as an attempt to foster a bilingual learning community in the second and third units for a total of six lessons.
B. **Role of Teacher**

The teachers are situated amongst a community of practitioners and researchers in a university-funded project called “Transforming Literacy, Science, and Math through Participatory Action Research” (LsciMAct). Project LsciMAct is a professional development program providing in-service teacher training to address the needs of ELs by integrating language and culture with literacy, math, and science. Teachers work in collaborative cohorts participating in a cyclical process, working alongside with a researcher, in collectively planning, implementing, and analyzing their curriculum and instructional practices. The teachers attend university courses, to learn about the projects’ theoretical framework on FoK, discourse analysis, action research, language ideologies, and third space theory.

Project LsciMAct required the teachers’ to learn about their students’ FoK. The teacher then transfers the FoK learned to an “inventory table” which aligns math and science standards to develop three thematic units, each three weeks in duration. Next, the teacher develops activities based on Engeström’s (1999) “activity triangle.” As the teachers implement activities, they are to write field notes and at minimum are required to be video recorded once a week for three weeks.

The teachers are responsible to watch three of their recorded classroom videos per unit using an observation protocol. In the first unit, the teachers randomly selected the classroom video, but in the second and third unit the teachers selected those classroom videos that guided their action-research question. The observation protocol is divided into two minute increments allowing the teacher to mark one time when they see an occurrence of the following codes: FoK, multiple languages, questions, tension, third space, and/or participation shifts. The teachers chose a two minute episode to transcribe based on the observation protocol. The teacher has read articles, watched video examples, and engaged in discussions about these terms with me and the other researchers and practitioners of LsciMAct when they took the action research course of which I was a teacher assistant for.

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5 See appendix B.1
6 See appendix B.2
At the end of each unit the teachers provide an individual and cohort analysis reporting on their emerging themes and participate in a focus group interview. Throughout the process, the teachers are encouraged to keep a personal journal to self reflect. All of these artifacts are collected after each unit implementation and compiled in a secured online database known as “blackboard” to be a part of the teacher’s portfolio. Further description of each teacher artifact is described in the data collection section. It is understood that these requirements are not meant for the teacher to do all by herself. Instead, the teacher collaborates with her cohort and with the researcher, the mentor, in weekly study group meetings to participate, reflect, and work on those required materials. Throughout this process, the teacher is actively engaging in reflecting her practices and areas for her own further research interest on FoK for ELs during the study groups.

C. **Researcher Role**

As I am involved in project LsciMAcT, I became a mentor to the teachers in various ways. When the teachers began the program in 2009 they took a course on “Teacher Action Research” in which I aided as a teaching assistant. Throughout the course, I mentored the teachers by having in-class discussions about FoK articles to frame a beginning definition of the term. In this course we also examined class videos that showed examples of FoK and held small group discussions about its implications for classroom instruction.

Also, I mentored the study group or weekly meetings with the cohort. At first these meetings had taken place formally at the university or Genesis site, however, these meetings shifted to take place at restaurants, the researchers’ home, or the teachers’ house. Therefore, the researcher built strong connections with the teachers as we often would share stories about our families or everyday experiences. The meetings allowed us to grow together as more than just LsciMAcT participants, but as friends. In these weekly study groups I mentor the teacher on various levels. I mentor the teachers logistically about the program requirements. I also provide mentorship on how to conduct action
research in the classrooms, such as how to collect data, how to take field notes, how to write journals, how to code their videos, how to transcribe their videos, how to frame a research question, how to analyze data, and how to write a thesis. The study groups were collaborative where the teachers can add agenda items that are important to them to discuss for the week as well. Explicitly we engage in conversations about how the teachers will go about planning their integrated math and science units. We discuss the types of math-science funds learned as well as how these funds were learned and why they were chosen as being math and science. We also discuss how and why teachers’ select certain funds to use and create math and science activities. We also discuss specific teacher practices based on the teacher’s field notes, my field notes, and teacher’s videos. These practices include explicit conversations about how FoK is mediating the learning of math and science. Lastly, the teachers share their analysis of how they are making sense of FoK as it relates to themselves, their students, their school, and their community. Much of my data is pertinent to what is said and shown during these important study group weekly meetings.

As I define my role as a participant-observer, I participate in the weekly meetings by actively giving feedback and ideas for teachers to create lesson plans and units. I also participate with the teacher in helping set up for lessons before class begins and looking at student work together. I also am an observer video recording the classroom activities and writing field notes on the teacher’s practices.

D. **Data Collection**

In this section, I highlight areas where the researcher collected data. The data collected is derived from the work teachers do in project LsciMAct, which I term “teacher artifacts,” as well as from my own researcher journal/field notes, audio recorded study groups, focus group interviews, and additional classroom videotaping. In the table below, I summarize the following sources for data collection:
TABLE 1. DATA COLLECTION SOURCES

<table>
<thead>
<tr>
<th>Types of Data</th>
<th>Observational Data</th>
<th>Interview Data</th>
<th>Teacher Artifacts</th>
</tr>
</thead>
</table>
| **Sources of Data** | Study group meeting  
Researcher journal  
Researcher field notes  
Classroom videotaping | Focus group interview | Teacher journal  
Teacher individual reports  
Teacher field notes  
Teacher lesson plans  
Teacher collected student work  
Inventory table  
Activity triangle  
Action report |

The data that is collected is categorized by organizing it into either: observational, interview, and teacher artifacts. The observational data is data that the researcher gathered from observing study group weekly meetings, classrooms, and other interactions with the teachers such as out of school settings that are recorded in my researcher journal, like phone calls. Interview data is collected via focus group interviews. Finally, teacher artifacts are those data collection that the teacher has completed that will also be used for the data analysis.

1. **Teacher artifacts**

   This section discusses the various teacher artifacts that are used for data collection. They include the activity triangle, inventory table, teacher journal, individual reports, lesson plans, and student work.

   a. **Activity Triangle**

   Drawing on CHAT framework, the teachers completed Engeström’s (1999) “activity triangle.” The activity triangle is a tool the teachers used for situating learning as interactions through subjects, community, division of labor, rules, tools, artifacts, objects, and outcomes. It provides teachers with a planning tool sheet to holistically design activities that are sociocultural mediated.
Teachers complete an activity triangle during the planning phase before each unit, thus, totaling in three activity triangle sheets.

b. **Inventory Table**

This graphic organizer supports teachers in planning curriculum as it aligns math, literacy, and science standards to appropriate FoK learned by the teachers. The inventory table is completed during the planning period prior to each unit implementation. It is completed three times through the course of the year by teachers.

c. **Teacher Journal**

Separate from field notes, teachers have their own personal journals from which they document observations, experiences, or new learned information that occur separate from implementing classroom activities. Such examples may include informal conversations with students eliciting funds of knowledge at recess, home visits etc. These journals are written in an online database, known as “blackboard,” so teachers and researchers may access them freely.

d. **Individual Reports**

Individual reports is a synthesis of each unit providing a description of a unit, video self-reflections, and future planning/modifications. It supports teachers to frame their action research question. This is completed at the end of each unit.

d. **Lesson Plans**

Teachers create lessons plans highlighting content and language objectives for ELs for each lesson they implement for the units.

e. **Student Work**

Teachers collect student work of the activities they implement to monitor student academic performance. Student work is electronically downloaded to be placed in teacher portfolios.

f. **Action report**
The action report is the teacher’s written report on their action-research project. The report is completed by each teacher. The action report is a part of the teacher’s course work to complete a thesis for their Master’s degree.

2. **Observational data collection**

This section includes the observational data that was collected. It consists of classroom video tapes, field notes, researcher journal, and study groups.

a. **Classroom videotaping**

Videotaping was done in the classrooms on the days the teachers implements the unit. There are three units in total, with each unit consisting of ten lessons in duration. During the first unit, I only came to the classrooms when the teacher requested, and thus I recorded only four videos ranging from the beginning, middle, and end of the unit. However, for the following second and third units I recorded all ten lessons. The total amount of videotaping concludes 24 hours worth of footage.

b. **Field notes**

Field notes are taken during each unit lesson implementation. The teacher conducts her own field notes (see “teacher artifacts”) and separately the researcher writes their own field notes that are observe in the classroom. Field notes are divided into three sections: descriptive, interpretative, and reflexive. Descriptive explanation provides a visual representation of what occurs in the classroom. Interpretative aims to describe the observer’s perspectives of what they are viewing. Finally, the reflexive portion highlights an introspective analysis for questions or items to follow up with.

c. **Researcher journal**

The researcher keeps a personal journal to document their own self reflections throughout the process and their personal perspectives that she discovers along the way. In addition, any miscellaneous memos or informal conversations with the teachers are recorded. This includes the
observations that I recorded during the first year the teacher took courses. The researcher journal differs from field notes in that they include any settings in which I encounter shared spaces with the teacher.

d. **Weekly study group meeting**

The weekly meetings with teachers are similar to that of Moll’s (1990) concept of “study groups.” During these meetings, teachers collaborate in their school cohorts with a researcher to theorize their pedagogical practices and explore alternative methods. In addition, it functions as a source of support to express innovative ideas, express concerns, and provide resources to aid teaching and learning. The weekly study group meetings become the primary spaces for where intervention occurs in the professional development program.

Importantly, weekly meetings are co-developed with researchers and teachers, and it’s important that researchers work alongside with teachers and not coercively impose practices upon teachers. Both teachers and researcher correspond to raise topics for their weekly meeting agendas. Weekly meetings allow for an interactive space through which researchers acknowledge that teachers enter into the study groups learning environment with valuable information, resources, and their own FoK that can contribute to the collective goal of theorizing funds of knowledge practices in the classrooms. FoK become both the *object* of study and a *meditational tool* through which the “spaces” of weekly meetings provide teacher assistance.

The weekly meetings meet once a week for an hour throughout the course of the school year, and additional meetings are arranged on an ‘at needs’ bases. There are at total of 27 weekly meetings arranged. I kept a running record of the agendas with notes at the meeting and audio record the meetings to provide a transcription.

3. **Interview data collection**

a. **Focus group interviews**
The researcher conducted three focus group interviews each at the end of every unit analysis with the school cohort. The interviews lasted for about an hour and were transcribed.

E. **Data Analysis**

The study draws on Creswell's (2007) categories to analyze data: (a) managing data (b) coding and developing themes, (c) description of cases, (d) interpreting the results, and (e) representation. These data analysis steps were completed using the computer generated qualitative software, NVIVO 9, and I attended a training course to learn how to use the program. Analyzing the data required me to transcribe all weekly study group meetings, focus group interviews, and classroom videos. For these sources, I took memos while transcribing documents. Next, I managed the data by creating folders for each of the data collection sources: weekly study group, classroom videos, interviews, action report, teacher journal, teacher and researcher field notes, individual and group reports, and lesson plans. Then, I read all the data sources to make sense of the whole before analyzing specific pieces of data, and to familiarize the data further. Then, I read for a third time adding more memos, short phrases or key concepts that related to the research question. These memos were useful for me to target key concepts and make sense of the ‘whole’ teachers’ FoK development in teaching practices, FoK conceptual understanding, and (language)learning.

Then, I used NVIVO to open code and develop analytical themes and subthemes. The process of open coding allowed me to compare and contrast ideas or create or delete codes as new awareness emerges to situate the codes in a hierarchical order. NVIVO was beneficial to merge codes into larger themes, or to cut themes into smaller codes, or insert themes into sub-themes etc. Hesse-Biber and Leavy (2011) recognize the emerging process of codes and the analysis as a way to evaluate and re-evaluate data to discover what the data collected means. Furthermore, codes are an organizational tool to develop themes and implications for descriptive reporting and theory building (Basit, 2003). In appendix B.4, is a sample on how I was able to view the text, based on a code, from various sources through
triangulating the data to assist the researcher to focus on similar concepts appearing in different sources, thereby establishing a credible substantiation of the constructs. As a result, appendix B.5, shows the finite codes created for this study and themes such as: identify EL FoK, access EL FoK, constraints to FoK curriculum, mediating lesson plans, mediating classroom interactions and discourse, conceptualize FoK, conceptualize content areas, and EL perspective and learning. Furthermore, appendix B.5 also shows the number of references indicated per code. These references were important for me to ensure that I was not simply indicating “change” in the teachers’ FoK conceptual shifts if, for instance, the teachers’ narrative spoke about a different FoK view in only one incident. To reflect a true conceptual change in the teachers’ views, I had transcribed all 21 weekly study group meeting, three focus group interviews, and three FoK interviews. Collectively, these interviews accumulated approximately 31 hours of transcription, resulting in 78 references for the weekly study group meetings, 32 references in my researcher journal, 40 references in the interviews, 14 references in the individual report, and 21 references in the action report of the teachers explicitly defining FoK. Therefore, these large amounts of references could speak to the themes in the teachers’ conceptual change, in not just one moment but several moments in a given unit in order to provide an accurate account of their FoK perspectives. Additionally, I could compare the teachers’ FoK talk to show conceptual shifts because of the triangulation of data sources.

Additionally, to organize data into codes and develop themes is an interpretive process. The interpretive process involved the use of NVIVO’s feature of *queries*. Query is a tool to ask questions and dive deeper into the data to not only understand what is observable, but explore data that may appear to be unobservable. Consulting with the trainers of NVIVO, I was able to create individual codes for each participant, including the researcher. This was useful since participant codes and conceptual codes could be run as matrix codes, which allowed the manipulation to examine intersecting codes or be viewed jointly. For instance, I could matrix code “Abby” as a participant and codes on “tension” and
“third space” overlapping with FoK to gain insight into her meaning-making of FoK. I could also run
text queries to search for nuances in the terminology of FoK or multiple terms like “learning” and
“FoK” or “EL” across data sets. These queries expanded how I would make sense of the teachers’
meaning making as well as the researchers’ own perspectives. I could establish credibility of the codes
when she discovered no new information was emerging by running queries. These queries gave insight
to the teacher cases looking at within cases or cross-case analysis. The within-cases overlap through
sources of study group meetings, group reports, and focus group interviews, since these were done
collectively with the teachers and researcher. However, the description of the cases could also be
examined across cases, from their action report sources, as is shown in Chapter VIII on the teachers’
separate ways to mediate FoK. The themes emerged could provide salience in one instance or show
similar repetition across cases.

Furthermore, I could capture the teachers’ shift in practice by analyzing their classroom videos
as well as contextualizing their practice in the study group meetings. Since the teachers’ are situated in a
larger study, Project LSciMAct had the teachers use an observation protocol, shown in appendix B.6 to
examine their practices. The observation protocol is divided into two minute increments allowing the
teacher to mark the frequency when they see an occurrence of FoK multiple languages, questions,
tension, third space, role shifts, and participation shifts. The teacher has read articles, watched video
examples, and engaged in discussions about these terms with me and the other researchers and
practioners of LSciMAct when they took the action research course of which I was a teacher assistant
for. From this observation protocol, the teacher selects a two-minute episode from three videos per unit,
that they would like to transcribe to critically examine their practice. For my study, I could examine the
teachers’ FoK practice in the classroom videos, while also cross referencing what the teachers say about
their practice during the study group meetings where we explicitly refer to the observation protocol. In
doing so, I was able to create a thick, rich, descriptive case for the teachers’ FoK development in their practices and conceptual shifts.

F. **Credibility**

Marshall and Rossman (1995) describe credibility as the attempt to “demonstrate that the inquiry was conducted in such a manner as to ensure that the subject was accurately identified and described” (p. 143). There are many different ways in my study that the teacher is accurately identified and described. The methods of triangulation allows for a more diverse analysis. Using the multiple data sources from observational data, interview data, and teacher artifacts allows me to explain more fully the richness and complexity of the teacher by studying her from more than one standpoint. Besides using multiple data sources, I ensure credibility by engaging in the research for a prolonged duration. My study consists of collecting data over a two year long period allowing me to look at the process from a clear beginning, middle, and end. The first year engaged as a student and teaching aid as the teacher took courses and the second year via weekly meetings and classroom implementations. In addition, I involve in persistent observation throughout the study by observing in my researcher journal weekly courses with the teacher the first year and the second year observing the teacher in weekly meetings and daily classroom observations. Readers of this study will also be able to accurately identify and describe the teacher through the use of actual transcriptions based on quotes from the teacher in interviews, weekly meeting discussions, and video transcripts. I intend to provide a thick and rich description of these in my findings.
VI. FINDINGS

The purpose of this study was to understand how a cohort of mainstream teachers learns to use and make meaning of FoK as they design curriculum and engage in teaching ELs math and science. In this chapter, I explain the findings from the study for each question below to respond to the larger question of how teachers learn FoK:

1. How does a cohort of mainstream teachers learn about ELs scientific and mathematical funds of knowledge?

2. How does a cohort of mainstream teachers use ELs scientific and mathematical funds of knowledge to mediate science and math learning?

3. How does a cohort of mainstream teachers (re)conceptualize their understanding of funds of knowledge?

In order to ground my findings, I address three themes while concentrating on teachers as the unit of analysis. These themes include the researcher’s role, the teachers learning, and students learning.

![Figure 4. THEMES IN THE FINDING CHAPTERS](image)

Situated in a teacher development perspective, I discuss my role as the researcher by explaining how I mediate how teachers learn to use FoK. I also look at teachers learning in two areas. First, teachers learn
about FoK as a theory and practice for teaching math and science. I also explore teachers’ learning through learning theory. In other words, I focus on how learning to use FoK informs how teachers understand what counts as learning. Lastly, I chose to examine student learning outcomes to represent what the students end up producing based on the teachers’ FoK practices. Moreover, student learning captures what teachers learned in the process of using FoK for curriculum development and, in addition, sheds light on how students and teachers engage at the discourse level in science and math literacy and content.

A. **Privileging Science**

Although Abby and Karen exhibit a math and science identity, I found in our weekly meetings they spoke greater to their science identity. Privileging scientific FoK discussions limited my data references for how the teachers speak to theorizing mathematical FoK. In few incidents where math is referred to, it is in conjunction with science or spoken generally as an “academic subject.” Hence, throughout my findings, compared to math, there are greater examples of the teachers’ identifying scientific funds, further mediation of funds for science objectives, and reflections on theorizing FoK for ELs science learning.

I contribute a few factors to why the teachers speak math infrequently compared to science. First, the teachers don’t refer to themselves as being math educators, even though they teach all core subjects, including math. On August 31, 2010, Karen refers to herself as a “lead K-2nd grade reading and writing representative teacher,” whereas Abby continuously reminds the cohort she is “the lead science teacher in K-2 grade.” Furthermore, administration reinforces a single academic subject identity by creating a culture of teaching where each grade level chooses one master representative for each core subject (i.e. language arts, math, science, or social studies). In addition, both teachers’ had limited exposure to math in their pre-service teaching programs. For instance, Abby completed her bachelor’s degree in elementary science education, and Karen held a bachelor’s degree focusing on language arts in
elementary education. In addition, Karen’s exposure to science continued throughout her life as she informally learned science at home from her dad who was a biology teacher. Finally, both teachers privileged the Playground Curriculum as a science curriculum. For instance, Karen asserts, “I teach [the Playground Curriculum] during the science block, even though math is integrated, I think of it as science” (April 12, 2011). Since Abby is the lead science teacher, she went into the designing the curriculum with the forefront of implementing science objectives. Therefore, when working in a cohort, the teacher’s brought their expertise of reading, writing, and science in our conversations and limited math discussions. However, I aim to represent how the teachers conceptualize math and science funds, but I can only go so far since the teachers’ privileged science practices and speaking about science in rich ways.

B. Overview of Finding Chapters

The following forthcoming chapters are comprised of the findings in this study. Chapter VII, “Accessing ELs’ Math-Science Funds,” explores the multiple activities the teachers designed to gather their students’ FoK. It addresses the teachers’ struggle to foster confianza with parents and students based on the types of activities their relationships fostered. Also, the chapter describes how the teachers can recognize or misrecognize their ELs math-science funds, and the nuances between how I identified math-science funds versus the teachers. Next, Chapter VIII, “Mediating Math and Science,” describes how the teachers mediated math-science funds in their lesson plans. This chapter examines the teachers’ agency to develop a FoK curriculum despite resistance from the administration. Working as agents of change, the teachers shift from instructors of scripted curricula to curriculum designers and learn how to balance multiple curricular components. Chapter VIII, “Mediating Math and Science in the Classroom Interactions,” discusses how the teachers use FoK to foster participation and content development in math and science by socially organizing the classroom interactions. The final finding Chapter X,
“(Re)conceptualizing FoK,” explores the ways the teachers theorize FoK for accessing and mediating ELs’ funds.
VII. ACCESSING ELs’ MATH-SCIENCE FUNDS

Opening a package of basketball cards is suspenseful. You never know if you are going to get lucky and receive a card that is worth more than the deck you paid for. I remember one of the first basketball card my siblings collected was a signed autograph of Kareem Abdul Jabbar that we still have in a sealed glass container. We packaged our cards in binders and I would help to read the price guides and determine the value of the profits.

The purpose of this section is to explore the teachers’, Abby and Karen’s, meaning making as they learn to access students’ math-science funds. Accessing students’ math-science funds was necessary because the teachers’ current math and science curriculum did not build on cultural-linguistic strengths, or funds, as tools accessible for (language)learning. The teachers were looking for ways to help ELs in the content areas of math and science by leveraging their familiar funds to teach unfamiliar math and science content.

Traditionally, FoK are captured through home visits (Gonzalez et al, 2005), however, the teachers’ ideological resistance (i.e. safety concerns) and inadequate resources (i.e. access to translators and time constraints) restricted them from visiting students’ homes. As an alternative, Abby and Karen modified traditional FoK approaches to (re)design their own methods, drawing on students’ life-worlds to gather math-science funds. Gonzalez and Moll (2002) speak to such modifications explaining that FoK is theoretical and transitory “it evolves through each new iteration, and that it must be renewed, that is, modified, and adapted to local conditions” (p. 277). Also, the researchers explain the importance for teachers to establish confianza, mutual trust, between themselves and families. Confianza is necessary because families require prior established trust to share their personal funds. Therefore, the significance of this section addresses how teachers make meaning as they struggle to move towards gathering students’ math-science funds.

How the teachers’ access students’ math-science funds is explained in four sections. The first finding section examines the teachers’ (re)design of FoK activities and attempt to establish confianza by fostering relationships with students and parents. In the next section, the findings explain how the teachers can potentially recognize or misrecognize accessing math-science funds. The third section
reveals how the teachers moved towards gathering math-science funds. The last section provides ways the researcher and the teachers identify math-science funds, since the researchers interventions informed the teachers gathering of students’ funds. However, prior to addressing these sections, is information on how the teachers’ synthesized the FoK activities, and global findings to the number of funds gathered.

A. **Synthesis of FoK activity inquiry**

Abby, Karen, and I collaborated to create FoK activities designed to access students’ math-science funds. The teachers’ planning for the FoK activities evolved from one activity to the next. I capture the evolving nature, as well as the teachers’ struggle, to designing these activities by drawing on a “FoK activity inquiry” model. A FoK activity inquiry model demonstrates the teachers’ cyclical process of planning, implementation, and analysis on students’ funds. Importantly, this model reflects the complex process the teachers’ undergone to elicit math-science funds. In other words, the teachers’ had to experiment with designing and re-designing several FoK activities as they moved toward gathering students’ math-science funds.

![Figure 5. FoK ACTIVITY INQUIRY](image)

As the teachers engaged in the FoK activity inquiry process, they hypothesized what format the activity should be (i.e. survey, community walk). In addition, they pondered the types of questions they
would ask based upon their evolving understanding of FoK (i.e. interests, experiences). Next, the teachers implemented the activity to identify and document what funds were gathered. Then, the teachers filtered non-math-science funds from math-science funds. Also, the teachers reflected upon the potential of these funds for creating a curriculum topic that could mediate math and science learning. Additionally, the teachers would examine the activities’ intended objectives versus actual outcomes to address gaps in order to re-design a new activity. Finally, the teachers negotiated, throughout the process, what counts as FoK for math and science (language)learning.

The role of the researcher, as a facilitator, was significant to the teachers’ FoK activity inquiry process for designing the activities. The researcher’s intervention contributed to how the teachers would access math-science funds. For instance, I asserted my expertise on FoK, in particular what counts as math-science funds, with the teachers as we collectively evolved to design FoK activities. Therefore, it is imperative to understand, in addition to the teachers’ perspective, how the researcher viewed what counts as FoK, and how these perspectives were similar or different between participants. Throughout this chapter, the FoK activity inquiry process will be explained through the teachers’ design of the activity, the types of funds they acquired, a discussion on the results, and then a researcher led intervention to re-design the activity.

B. Global Findings

I observed the frequency of students’ funds collected during the school year. I cross examined the researcher’s field notes and classroom videos to determine the number of funds. I then identified students’ math and science funds verses non-math and science funds learned by Abby and Karen. The graph below illustrates how the teachers varied in the frequency on students’ FoK examples in each unit.

The teachers have agency to make any students’ funds into something math and science. The researcher recognizes math and science funds as students’ funds that the teachers aligned to the standards or to the mandated curricular objectives. For instance, if a student explains how they stepped
in dog poop at the park, then the fund would appear to be a non-math and science fund. However, if I saw the teacher aligned and mediated the dog poop fund to a learning standard, such as cause and effect of organism’s relationship to their environment, then I identified the fund as math or science.

Figure 6. TEACHERS’ GATHERING STUDENTS’ FUNDS

The Initial Planning Period (IPP) consisted of a four week duration that had a different purpose from the other units. The IPP served as a period where the teachers designed FoK activities and were in search of learning students’ funds to develop a FoK curriculum theme. Therefore, the IPP displays the highest frequency of non-math-science funds collected because the teachers were unable to recognize math-science funds and had not mediated students’ funds towards math and science.

Although Project LsciMAct requested teachers to gather students’ funds only during the IPP, I discovered the teachers continue to gather funds for the remaining units. However, there is a decrease in non-math and science funds from the IPP to the first unit. I attribute the decrease because in the first unit the teachers did not plan a purpose for needing to learn new FoK examples. In addition, both
teachers scripted their lessons to teach to the FoK curriculum theme of playgrounds, which fostered a dominant teacher discourse and limited students’ new FoK examples to emerge. However, I identify both teachers collecting the topic of playground funds as being a math-science fund because playgrounds were used for achieving learning standards.

From the first to second unit, the teachers increase in gathering math and science funds because the researcher’s intervention allowed them to develop meaning for how students FoK examples could mediate their lesson plans through the use of surveys. The third unit contains the highest math and science FoK examples because the teachers became skillful at recognizing math-science funds and engaged in impromptu questioning for obtaining funds as they emerged and mediated in class academic discussions.

C. **Activity Selection**

The teachers had flexibility for how they could go about accessing students’ funds. Abby and Karen intended to find math and science in students’ homes and also to find problems that could be investigated to develop curriculum. However, they became resistant to home visits because of time restrictions and discomfort to be in an unfamiliar environment, like student’s homes. Instead the teachers found alternative activities to access funds.\footnote{See appendix C.1}

In my findings, I selected certain activities because they indicated key turning point moments as the teachers learned how to access mathematical and scientific funds and included the following activities: All About Me, Lunch Talk, Poster Survey, Community Walk, Playground Survey, Student Content Survey, and Parent Content Survey. Upon further analysis, I found teacher questioning as an additional activity used to elicit funds. In my analysis on the teachers’ activities of My Stripes, Playground Pictures, and Map of Favorite Place, there were no FoK shifts identified. The results in those
activities confirmed previous types of funds teachers already had learned. Therefore, I chose to not focus on these activities because it did not produce shifts in teachers’ gathering students’ funds.

D. **Fostering Relationships: Creating FoK Activities to Access ELs’ Math-Science Funds for Developing a Curriculum Theme**

This section explores the teachers’ meaning making as they learn to (re)design FoK activities for eliciting students’ math-science funds. Pertinent to this section, is exploring activities designed during the first four weeks of the school year, otherwise referred to as the Initial Planning Period (IPP). The purpose of the IPP for the teachers is to draw on these activities to select students’ math-science funds that could serve as their year-long curriculum theme. The FoK activities that will be explored in the IPP include the All About Me survey, the Lunch Talk, the Poster Survey, and the Community Walk.

The findings in this section reveal the importance of designing FoK activities that foster *confianza*, mutual trust, relationships between the teachers and the students, as well as the teachers and the parents. I reference CHAT tools to show the interactional patterns within each FoK activity between the teacher-student and the teacher-parent to demonstrate how the teachers struggled working towards establishing confianza. Also, the findings explore how the teachers’ learned to move towards ethnographic tools for accessing math-science funds. Additionally, the teachers’ views on what counts as FoK and the types of funds they gather are examined, since these aspects informed how the teachers’ designed FoK activities. Lastly, I explain the types of relationships that are fostered by each FoK activity to provide perspectives on establishing confianza.

1. **Play funds in the All About Me survey**

The teachers began the search for math-science funds by attempting to establish confianza with their students through implementing an All About Me activity on August 19, 2010. In
reference to CHAT, the activity’s tool[^8] to elicit funds was a survey. The teachers decided on a survey because it would allow them with a profile snapshot of each student and draw on a range of what FoK topics existed. However, the activity fostered a division of labor whereby the relationship between the teachers and students is teacher-directed. For instance, the teachers pre-selected FoK topics that were important to them, without knowing what mattered to the students. The FoK topics the teachers selected were food, academic subjects, music, movies, songs, and books. The teachers selected these topics because their understanding on FoK was viewed as their perception of students’ interests. Therefore, in the All About Me survey shown in the figure below, the teachers oriented their FoK questions around students’ favorites, likes, and interests.

![Figure 7. KAREN’S ALL ABOUT ME](image1.png)

![Figure 8. ABBY’S ALL ABOUT ME](image2.png)

[^8]: In this section, I will be referring to CHAT components as tools to describe, compare, and contrast the different FoK activities the teachers created to gather students’ funds. Using CHAT, I will analyze how the teachers’ construct and modify the various subjects, rules, division of labor, mediation, and object to demonstrate the types of outcomes produced.
As opposed to conducting ethnographic visits in students’ life-worlds, the teachers tried to access students’ interest funds in the areas of community, home, and school in the survey. The way they accessed interest funds was by asking questions regarding what students like to do in community, home, and school. Abby slightly deviated from Karen’s survey since her initial understanding of FoK also includes funds as form of student expertise, which prompts her to ask an additional question: what are students good at? In contrast to the traditional FoK theory, the teachers extended learning students’ funds in the geographical space of the school. The teachers considered school knowledge and school space as a part of FoK when they mention wanting to know more about the students’ favorite book, academic subjects, and what they like to do in school. I looked at how the teachers identified FoK to categorize the All About Me activity’s outcome of student funds. When teachers read the student responses, they identified that play funds were common practices found across home, school, and community spaces. Additionally, Abby found that students identified “sports” as a play fund of expertise, viewing sports as an important part of their everyday lives.

As the teachers developed activities to obtain math and science funds, they realized the All About Me survey did not capture nor identify any math and science. The teachers did not connect how play funds could contribute to the larger curriculum objective of a problem worth exploring for teaching math and science. Therefore, the teachers decided to dismiss the concept of play funds and re-negotiate how they would design their next activity.

2. **Limitations to the All About Me survey**

The teachers reconsidered how to prepare for their next FoK activity so they may access math-science funds. In our weekly meeting on August 21, 2010, the teachers provided a critique to the All About Me activity:

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9 See appendix C.2
Abby: I just feel like they didn’t go deep. They are little first graders it seemed hard to take my students any deeper than “I cook at home with my mom.” Like to get them to really go deep with it, I was disappointed.

Karen: I agree with that it happened a bit with me.

The teachers claimed that students didn’t go “deep” with their funds, implying that students didn’t share detailed information. Upon further analysis of the activity, I saw that the teachers’ questioning, or rules of the activity, were closed-ended. For the All About Me activity, I defined closed-ended questions that asked students to list what they do, instead of asking students to share their FoK experiences in a narrative. For example, rather than ask “something you do at home” the teachers could question students to “tell a story about a special memory at home.” In other words, the teachers’ questions didn’t ask students to describe a detailed narrative. The questions were also considered closed because they limited student responses by only providing narrow spaces to write responses in small boxes or lists in lines. I mediated the teachers to think about how they could access student FoK narratives in order to foster funds that were elaborate.

Ambareen: We have to be careful how we are asking questions because I will give you an example. You could ask what did you do over the weekend and students would say they watch TV. So you need to find out how to ask the question so you can get what you want out of them. Maybe even think about watching or questioning in the lunchroom or at the playground. I’m just throwing out ideas.

I asked teachers to be aware of the type of questioning they ask students and to be prepared for how to respond to students when they answer with only a few words so that they can obtain students narrative experiences. I had suggested for Karen and Abby to make observations of students in informal settings. Informal settings consist of school activities that are non-academic such as recess or lunch. The teachers could use informal settings as a way to observe or discuss narratives in a student-led conversation. I also hypothesized that because teachers were pre-selecting topics of funds to ask, they limited the funds to which students could share.

Although the survey was useful for identifying FoK topics, it lacked how these funds were meaningful in students’ life-worlds. Additionally, confianza wasn’t mutually established and students
weren’t able to provide detailed information because the survey questions were teacher-directed. In contrast, observations of students in informal settings (i.e. lunch, recess) allow for the emergence of FoK topics that are student-led to which the teachers may not have otherwise been privy. Therefore, Karen modified my suggestion to establish a new activity: Lunch Talks.

3. **FoK narratives for the Lunch Talk activity**

The Lunch Talks expanded upon the FoK topics derived from the All About Me survey and were executed for two days from August 23-24, 2010. In an effort to acquire FoK narratives from the students, the Lunch Talks would provide an informal environment where students could speak with the teacher about their lives. However, Abby was unable to conduct Lunch Talks because as the lead science teacher she needed her lunch time to prepare the science labs. Due to time restrictions, Karen included only six EL subjects as part of the activity based on those students who she was considering to be a part of her action research study. She arranged for two separate twenty-minute group lunches consisting of three students, each session to be held in the classroom.

Karen planned to change the activity’s *rules* from pre-scripted teacher questions to facilitating questions that emerged from student-initiated conversations. Abby’s perspective of FoK as student expertise was adopted by Karen in our meeting on August 21, 2010. Karen saw the value in funds as expertise and decided to ask, “what are students good at.” She extended expertise to include practices and knowledge, and questioned “what students know a lot about.” Karen wanted to explore these questions during Lunch Talks because she did not ask them previously during the All About Me activity. To Karen’s surprise she recalls the following:

“The students expected the experience to be very IRE oriented. This is me admitting that my students are used to IRE- something I need to improve upon for sure. The kids kept looking at me to ask them a question that would lead to a response. When I asked a few students what they felt they were good at, or what they knew a lot about, two or three just kind of shrugged. I’m not sure if they were being modest, if they didn’t understand what I meant, or if they weren’t self aware enough to know what they were good at” (Karen’s journal, August 18, 2010).
In the passage above, Karen described limitations to the Initiate Response Evaluation (IRE) discourse. In IRE, the teacher initiates a question, a student responds with a closed answer, and the teacher evaluates the student response. Karen views the IRE discourse as being centered on the teacher’s talk and restricting students’ voice and is a discourse structure students expect. Karen builds an awareness of Genesis’ culture of schooling privileging IRE discussions and contributes IRE as a rationale for why a majority of students are having difficulty to share information with teachers on their own.

Although Karen attempts to establish confianza by giving her students a voice, she misrecognizes the privileging of her discourse in a school setting. I observed that IRE’s restrictive discourse makes it difficult for students to expand their FoK. In other words, students were not used to a classroom culture of initiating discussions by themselves about what is worthwhile in their lives. For a teacher to ask what a student is good at or what a student knows a lot about, changes the status of what knowledge is significant to be spoken about with teachers. Karen modified the *rules* to the classroom discourse to shift from IRE to conversational discourse for when students interact with teachers. However, Karen was unable to provide the mediational tools to assist students toward this new type of conversational discourse. Even though it appears that students were partaking in an informal activity of lunch, Karen was unaware that holding the lunch in the official space of the classroom would lead a majority of students to appropriate the official rules of school, which fostered IRE discourse.

a. **Personality and family funds in the Lunch Talks**

Given the dominant culture of IRE discourse, Karen conformed back into the traditional teacher role and initiated questions in the Lunch Talks activity. She asked students questions about who their family members are, what their parents’ jobs are, and students’ in-school and out-of-school interests. I read Karen’s journal entry dated August 25, 2010, to create categories for the types of funds she documents learning. Karen learned similar funds, as found in the previous activity, such as

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10 See appendix C.3
students’ interests, academic subjects, and home life. Karen also attributes funds to include student
personalities. I see this based on Karen’s conversations as documenting students being “imaginative,”
“cheerful,” “talkative,” “bright,” and “quiet.”

In the Lunch Talks activity, Karen learned about parents’ career funds through the perspective of
students. In one incident, Karen journals on August 25, 2010, Yamali’s view toward her father’s career,
as she mentions, “my mom works at Subway and my dad is a delivery man, delivering couches and
other heavy things. My dad didn’t go to school, so he doesn’t know anything, so he doesn’t have a good
job” (p.1) Based on Yamali’s perspective of her father’s career, Karen infers that “it’s likely her dad has
said something about the importance of education and has used himself as an example of what happens
when you don’t go to school” (p.1) Karen’s understanding of Yamali’s funds captured what her parents
value through their work funds. Thus, Karen discovered learning about family members’ funds as a new
space in capturing students’ funds.

In summary, Karen struggles to establish confianza through a conversational discourse in a
Lunch Talk. The limitation in the Lunch Talk was that the traditional in-school interactions between
teacher and student privileged the teacher’s discourse. A benefit to the Lunch Talk was that Karen
accessed meaningful funds from one particular student’s knowledge which she learned from her parents.
Based on expanding student funds to parent funds, Karen created a new activity that explores parents’
funds further: Poster Survey.

4. **Accessing parents’ funds in a Poster Survey**

   The Lunch Talk activity informed Karen that parents’ funds were beneficial to learning
students’ funds. Collectively, we arranged to implement the Poster Survey on August 27, 2010, which
would ask parents to write what they know about various topics. The FoK topics that the teachers
wanted to inquire further were: jobs, community, food, and free time. Therefore, the **community** of the
activity extended to include students and parents. I had suggested that the upcoming school’s Open
House was a venue where Abby and Karen could interact with the parents. However, Abby did not conduct the Poster Survey because she felt there was not adequate time during Open House for the activity. In contrast, Karen was willing to try out the activity.

Our collective goal was for the distribution of labor to move toward a parent-directed activity. We attempted this by arranging the tools and rules for the Poster Survey to wean away from traditional inventory surveys, like the All About Me activity, and to use large poster sheets instead. My rationale was that some of the families at Genesis could come from illegal or undocumented backgrounds, and the paper and pen mode of eliciting funds can be associated with legal paperwork. In my reflection of CHAT theory, I suggested for Karen to design the rules of the activity to not include written questionnaires but to select specific topics that were of interest to her, and to label these topics on a poster sheet. As opposed to pre-selected questions, topics could have the potential to be open-ended where parents can write anything they want regarding that topic. In the activity, the parents used tools such as markers or crayons which provided the activity with an art or craft orientation.

Despite our careful planning, Karen struggled to foster confianza with parents because few parents attended the Open House. The teachers and I overlooked the pre-existing relationships, or confianza, between parents and the school which reflected the tenuous relationships Genesis school established with parents.

“Unfortunately, I didn’t have a ton of parents come, and I didn’t have time to find someone to translate the words on posters. I think parents didn’t really get it…For jobs, only one parent walked over and she wrote that her son does chores for an allowance. Not quite the information that I was looking for! Also, the free time poster became one of repetition. One parent wrote swimming and roller skating but the rest all said they like to play with their kids” (Karen’s journal, Aug. 23, 2010).

In her journal, Karen mentions when few parents did arrive, the Poster Survey did not make sense to them, and part of this was due to not having a Spanish translator accessible throughout the entire event. The outcome of the Poster Survey provided few parents’ funds. Karen did not learn new information about parents’ funds, but she was able to see the repetition of play practices in home and community
spaces as parents shared playing with their kids. Although Karen identifies parents as a source to obtain students’ funds, the Poster Survey shows that maintaining close relationships with parents is important to access students’ funds. Furthermore, when establishing confianza with parents (and students) it’s imperative to consider the spaces where participants belong to, as opposed to expecting them to share funds in spaces that the teachers adhere to, like school.

5. The Community Walk: Negotiating out-of-school observations

After reflecting on all the different funds learned, Karen and Abby did not identify a connection to math-science funds. I decided to go back to the original drawing board, and ask the teachers to re-consider finding math and science in students’ homes. My rationale was that privileging students’ and parents’ every day environments, the home, would help contextualize students’ funds. In addition, teachers venturing into students’ households could allow ELs and their parents a familiar space that was personal to them to be willing to foster confianza that shares meaningful funds with the teacher. Furthermore, I thought home visits would lend themselves for the teachers to identify math and science funds since they could point to math and science that the students may be unable to identify themselves. However, Karen and Abby resisted again, claiming that they did not feel comfortable conducting ethnographic visits in students’ houses.

I decided to negotiate with the teachers and present an alternative in our weekly meeting on August 18, 2010:

Ambareen: You can do observations from the community, like a community walk. As you go on the walk kids can describe experiences they had in different locations and can spark a conversation that we are not aware of. Really you are thinking about what it means to be an ethnographer, you want to get into your students’ culture - so the everyday mundane practices about your students.

Karen: I like the idea of the community walk and I wonder if I can have them use it for mapping. That would be neat having them walk together.

Since I couldn’t convince teachers to visit homes, I wanted teachers to construct a new activity that mediated the use of an ethnographic tool and extended the community of the activity to include the students’ life-worlds, like their neighborhoods. At the time, I pictured learning math and science funds
through the methodology of being an ethnographer. Being a teacher-ethnographer would require teachers to go outside of their comfort zones (ie. School space), and dive into spaces that were part of the students’ life-worlds (ie: out of school space). To my surprise, Karen agrees to conduct a Community Walk on August 20, 2010. Unfortunately, the school’s policy on uniform lessons within grade levels, prevented Abby from executing the activity because her grade refused to do the walk.

6. **Playground funds for the FoK curriculum theme**

Karen’s academic background led her to draw a connection from the Community Walk activity to the social studies standards of mapping, not toward science or math objectives. She creates a Community Walk activity, where the *rules* are for students to give directions and identify landmarks, street names, and houses where students lived. In addition, Karen successfully is able to persuade her grade level team to join her, and so the *subjects* in the activity extend to include the entire second grade roster of teachers and students.

![COMMUNITY WALK MAP](image_url)

*Figure 9. COMMUNITY WALK MAP*
As students walked in their community, they engaged in academic discussions on mapping skills and shared with peers their community funds. The activity reflected a *division of labor* where students became facilitators in sharing their FoK and teachers’ became learners of students’ FoK. Karen describes the conversation further:

> As we were walking, students pointed out Soya Park and began sharing experiences that they had had there. Since the park is next to a school, the students connected the two to each other and began inquiring why Genesis did not have access to a playground. They expressed great interest in having recess and a place to play, just as the other school had. As we reflected on this interaction later that day, we realized that this interaction was a critical moment between ourselves and our students. Their modality in speaking about the need and desire for a playground was stronger than any other topic we had explored in the classroom; we wanted to learn more (Group report, Dec. 28, 2010).

As many students share their experiences in Soya Park, it is evident that they have been in this area of the neighborhood multiple times. However, what made this walk different from previous walks is students were asked to look at their community in a different perspective as geographers mapping landmarks and learning to use directions. A critical awareness emerged of where parks are located and not located in their neighborhoods leading students to wonder why Genesis did not have a playground. This was more than just a question of why Genesis did not have a playground, but rather an analysis on students exploring their own funds. Thus, in the social studies academic framework, students began connecting their own funds about playground experiences to critically cross-examine their practices in school. Students saw a conflict in their funds and school practices contributing to an injustice that certain schools can foster play, that are meaningful to them, but their school could not.

Later that day on the car ride back from school, Karen shares the outcome of her students funds with Abby who immediately saw a connection with her students concerns about recess. She explains in her report on December, 25, 2010, how her students “are wondering why they don’t have recess. So I started to look more into it. Nearly every day students asked if they would regain their recess privileges and even asked if they lost recess because they were bad children” (p. 4). Karen and Abby saw how the students’ need for a playground and recess time was a common denominator and could be the foci to the curriculum theme around students play funds. Teachers initially overlooked how playground funds
could relate to math and science funds. However, advocating for a playground was a uniting cause for teachers and students, and therefore Karen and Abby decided to go forth with playgrounds as the curriculum theme.

The Community Walk is a turning point activity for the teachers’ working towards fostering confianza with their students. The activity leveraged students’ environments, the community and the playground, instead of privileging the in-school setting. In doing so, the students’ became the experts of their life-worlds and the distribution of labor shifted from teacher-directed to teacher-student facilitated. Engaging conversations in students’ life-worlds afforded the students with an opportunity to share what they know about their practices and to identify a meaningful problem, the lack of a playground at Genesis.

7. **Summary of fostering relationships**

In this chapter, confianza is a mutual trust exchanged between the teacher and the participants (i.e. students or parents). A participant may not readily share personal information if trust is not established with the teacher. Therefore, fostering relationships based upon mutual trust is necessary to access math-science funds. Here, mutual trust is exhibited by the participant to distribute their funds to the teachers. Also, the teachers trust is reciprocated in that they must create a meaningful curriculum, from the perspective of their students. The challenge for the teachers lay in fostering confianza that would allow them to access funds that connected to math and science. In addition, the teachers shifted to select funds, from the students’ point of view, that were both relevant AND meaningful to their students’ lives.

The teachers engaged in FoK activities that held benefits and limitations towards gathering students’ math-science funds. A question to ask when reflecting upon FoK activities is *whose meaning do the teachers’ capture and from whose perspectives?* This question can be explored by drawing on
Table 2 below which synthesizes the teachers’ struggle to foster confianza and access math-science funds.

**TABLE 2. THE TEACHERS’ STRUGGLE TO FOSTER CONFIANZA AND ACCESS MATH-SCIENCE FUNDS**

<table>
<thead>
<tr>
<th>FoK Activity</th>
<th>FoK View</th>
<th>Types of Funds</th>
<th>Relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td>All About Me</td>
<td>Interests</td>
<td>Play funds</td>
<td>Teacher-dominant; Student-focus</td>
</tr>
<tr>
<td>Lunch Talk</td>
<td>Expertise</td>
<td>Personality and family funds</td>
<td>Teacher-privileged; Student-focus</td>
</tr>
<tr>
<td>Poster Survey</td>
<td>Interests</td>
<td>Parent funds</td>
<td>School/teacher-dominant; Parent-focus</td>
</tr>
<tr>
<td>Community Walk</td>
<td>Experiences</td>
<td>Community funds</td>
<td>Teacher facilitated; Student facilitated</td>
</tr>
</tbody>
</table>

The All About Me survey functioned as a starting point for the teachers to obtain a scope of funds, from the teachers’ perspectives, interested to students. However, the interactions between teacher and student rested on the teacher pre-selecting questions and the students providing written responses with few words. Thus, the activity is teacher-dominant but with a student-focus on their funds. The surveys were useful for “big picture” topics and access relevant funds that occurred in students’ everyday life, such as food and play, but the teachers were unable to know how these funds were meaningful to students in a survey.

Karen wanted to embody more student input in knowledge and learn more information about their students than just a list of topics. So she created further activities to bridge her relationships not from surveys, but then from informal conversations, such as the Lunch Talks. Although Karen learned meaningful familial funds from Yasmin, majority of the students were constrained from speaking because of the school’s dominant culture of IRE discourse that leveraged the teacher’s voice. Hence, the Lunch Talk established a relationship that privileged the teacher, even
though the conversations were intended to focus on the student. Therefore, it is important when designing FoK activities to become aware of how conversations held in-school may privilege the teacher, versus ways students talk in conversations out-of-school may maintain a shared discourse. The potential conflict of talk in-school versus out-of-school may make it difficult for teachers to re-establish the culture of ‘shared talk’ they want to maintain to access students’ funds.

The Poster Survey shifted from the traditional All About Me survey because it attempted to draw on pre-selected topics that could be built further by sharing and extending the topics to where parents would chose for it to go. Although the teachers attempted to learn from the parents’ perspectives, the drawback to the survey is that it took place in-school, a place where parents already lacked confianza. In addition, not having a Spanish translator made it difficult to communicate with parents and reflects on the school’s lack of resource to bridge relationships with parents. Thus, the activity situated the school and teacher in a dominant position in relation to withdraw access to the parents’ language choice.

Finally, the teachers moved towards ethnographic tools to access students’ funds. Learning about funds situated in students’ life-worlds, such as the community, engaged the teachers to understand students’ meaning and perspectives on their funds, opposed to contexts in-school that were removed from their life-worlds. Also, gathering funds in students’ life-worlds, allowed the students to share experiences that the teachers’ may not have thought to ask about. For instance, the teachers attempted the Community Walk to learn about the geographical place of the neighborhood, but the students shared collective and relevant playground experiences. Therefore, ethnographic measures provided the teachers with learning about students’ funds that were meaningful to their life and where the students’ were experts to reveal information. Thus, the teachers were able to select playground funds, grounded in the problem of Genesis not having a playground as the curriculum theme.

E. **(Mis)Recognizing Students’ Math-Science Funds**
I found that although the teachers could engage in accessing students’ funds through FoK activities, it didn’t mean that the teachers could recognize students’ math-science funds. In the IPP, the teachers selected playground funds for the curriculum theme because they were relevant, meaningful, and a problem worthwhile to explore for their students and themselves. However, at the end of the IPP, the teachers did not conceptualize playground funds as a student math-science fund. This section elaborates further how the teachers continued to access students’ math-science funds in the first, second, and third unit. My findings show in the units how the teachers’ recognized and misrecognized students’ math-science funds. The first unit demonstrates the teachers’ misrecognition of math-science funds when implementing a Playground Survey to access students’ funds. Additionally, the teachers misrecognized the differences between students and parents playground funds. The researcher’s intervention in the second unit reveals the teacher’s shift to recognize math-science funds when distributing another survey to gather funds, the Content Survey. However, the teachers misrecognize the possibility to explore parents’ math-science funds in this survey. For the second and third unit, I examine how the teachers accessed and recognized math-science funds through asking FoK questions.

1. **Misrecognizing math-science funds in the Playground Survey**

   In the first unit, the teachers decided to create a Playground Survey with the students to represent the need and advocate for a playground at Genesis. The survey was distributed to the Genesis school community including students and teachers across all grade levels, and parents in Abby and Karen’s classrooms on October 17, 2010. The teachers asked survey questions that were of interest to learning about school and playground funds. Figure 10 is a sample survey illustrating the different survey questions. Based on the survey questions the teachers collected school funds when asking “what’s wrong with the current school play lot.” The teachers also were obtaining playground funds when asking “how often students went to a playground”, and “what playground structures they know and would like
to have”. The survey question asking “why should or shouldn’t we have a playground” resulted in findings that the teachers saw as both school and playground funds.

![Student Playground Survey Image](image)

**Figure 10. STUDENT PLAYGROUND SURVEY**

The teachers misrecognized the potential of the Playground Survey to access math-science funds. From the teachers’ perspective, the Playground Survey was not intended to gather students’ math-science funds. However, I view math-science funds as those funds that teachers align to state standards, mandated curriculum objectives, or to math and science Discourse practices. In the survey, the teachers use the topic of a playground fund to connect the survey to math and science learning standards. In doing so, the teachers use playground funds as an outcome of a math-science fund, but themselves are
not aware of playground funds as being a math-science fund. However, if the teachers had awareness of playground funds being math-science funds, then they could have the potential, through the survey, for gathering more math and science (language) learning. For instance, I saw potential for a math fund in the math standard of number sense math when asking the frequency of playground visits. I also viewed potential science inquiry funds when students identify “what’s wrong with the play lot” as possible science problem to research. Therefore, the teachers misrecognized gathering potential math-science funds in students’ playground funds.

a. **Misrecognizing playground funds between students and parents**

I examined the outcomes of math-science funds in the Playground Survey to show how the teachers misrecognized playground funds between students and parents. When Karen and Abby reflected on students and parents’ funds from the Playground Survey they were able to confirm their general knowledge on the safety conditions of the play lot. The teachers collectively document in their report on December 28, 2010, their survey result findings. They write that “recess has been indefinitely cancelled for safety reasons, as our current play space has caused relatively serious injuries and parent outrage. Our students and parents expressed that the Genesis lot was unsafe” (p. 4). Here the teachers gathered their students’ school funds as it related to their play lot practices. Their findings indicate similar results on “safety” for parents and students. The teachers represented and synthesized how they defined playground safety in a video on October 25, 2010, as a way to fundraise for a playground.

Karen: Do you think we need a new playground? *(Karen’s second graders scream “yes”).*

Principal: Currently uh our playground at Genesis uh I would probably categorize as a hazard↑ to the particular students here.

Mark: I don’t like it because I fell on the rocks and scrape my knees.

Jose: *(Jose is walking and slips in a pot hole). I just slipped look!*

Claudia: I fell down and got cut.

The teachers refer to safety, through the voices of their students, as a concern to “falling,” “scraping,” “slipping,” and “cuts” when being on the play lot. The principal also concurs that the play lot is
“hazardous.” Therefore, the teachers identify these safety funds as being similar for students’ and parents’ playground funds.

Although the teachers identified learning students and parents’ school funds, which brought about safety concerns, I explored my own findings on the survey results. The teachers knew that parental support would be necessary to advocate for a playground, so they created a Parent Playground Survey shown in figure 11.

![Parent Playground Survey](image)

**Figure 11. PARENT PLAYGROUND SURVEY**

The teachers viewed the Parent Playground Survey as a way to learn parents’ funds, particularly why parents think Genesis does not have a playground, and what concerns they have with kids playing on a
playground. In my analysis, I identified funds, from the teacher perspectives, found in the Parent Playground Survey\textsuperscript{11} and in the Student Playground Survey\textsuperscript{12} to create categories that emerged and examples of each fund. A limitation in the teachers’ analysis of the survey results was that they skinned reading through each survey response and inferred the theme of playground safety emerging for both parents and students.

The survey data revealed a difference in how parents and students identified safety as it related to their playground funds. When it came to knowledge about playground structures, parents mention benches where they would sit and communicate with other parents, which is unique to the practices of parents and not students. When it came to describing playground safety, parents shared community funds about their knowledge of gangs, bullies, drugs, and rapists. In contrast, students expressed their experiences playing in school by comparing their playground funds in a park nearby. The students’ playground practices revealed knowledge on having an appropriate floor space that was large enough and carried a soft ground, like at the park, so they would not get hurt on the pavement. Another difference in playground practices between parents and students was rooted in playground attendance. Students attended playgrounds more often, about 2-3 times a week, in comparison to parents who attended 1-2 times a week.

Therefore, my findings on the survey results suggest that although teachers saw comparisons in student and parents’ funds around school concern and safety, they misrecognized the nuances in parents versus students’ practices on their playgrounds funds. Although parents and students may refer to what appears similar playground funds, their meaning behind their funds differed from one another. Thus, it’s important for teachers when gathering funds to dig deeper into their analysis and search for meanings, from the perspectives of the participants to avoid misrecognizing funds.

2. **Recognizing math-science funds in the Content Survey**

\textsuperscript{11} See appendix C.4
\textsuperscript{12} See appendix C.5
During the IPP and the first unit, the researcher recognized math-science funds, but in the second unit the teachers’ began to recognize math-science funds because of the researcher’s intervention. For instance, I found that in the first unit, the teachers did not gather math-science funds in the Playground Survey because they were unaware how to identify math and science concepts from students’ lives. In the first unit, the teachers conceptualized math and science as topics from textbooks found in the mandated curriculum. For instance, the teachers recognized concepts of math in counting money from a Eurocentric perspective, so they aligned students’ math funds that similarly resembled counting money at a restaurant as being a math fund. However, the topic of playgrounds was not in their mandated curriculum, so it was difficult for the teachers to count playgrounds as being “math” and “science.” Therefore, the teachers struggled to identify math-science funds and connect math and science concepts from books to students’ life-worlds.

I assisted the teachers to recognize math-science funds from students’ playground funds in a meeting on February 8, 2011. I worked with the teachers to see math and science, the way they did, through mandated curriculum objectives. Collectively, we identify the second unit’s objectives on “Balance and Motion” to categorize these math and science concepts: gravity, engineering, impact, and speed. Whereas in the previous activities I had teachers develop questions on their own, I shifted the division of labor to collaborate with the teachers to facilitate questioning math-science funds. I proposed an alternative activity, Student Content Survey, to elicit math-science funds from students’ lives as it relates to math and science mandated curriculum objectives. Figure 12 highlights the FoK questions we designed.

The purpose of the first question was to target students’ funds about gravity. Teachers chose this question because describing a time when a student fell would serve as an example of how a student would have experienced gravity. The second question was focused on impact and how teachers could teach the relationship between height and impact. Students’ funds about speed were looked at by asking
students to list what items they have been on that made them go fast. Finally, the teachers asked what have students built before to learn their engineering practices. It was important to the teachers to ask who the students built with because they wanted to tap into funds from potential household members. This knowledge could be useful for teachers because they wanted to invite a guest participant to help in the unit, since the teachers felt they were novices in engineering.

![Student Content Survey](image)

*Figure 12. STUDENT CONTENT SURVEY*

The teachers analyzed their survey results by reading aloud together and only recording those funds which they heard repeated across both classrooms. Collectively, we categorized each fund according to gravity, impact, speed, and engineering to find the following examples: slides, bikes, stairs, cars, bus, legos, and blocks. The survey responses allowed teachers to identify math and science funds from students’ lives as they emerged in the context of the survey’s question on “Balance and Motion.”
For instance, hearing a students’ fund on “stairs” may not have triggered the teachers to think about “stairs” as a math or science concept. However, framing a question on impact and the student results of stairs appearing, allowed the teachers to see “stairs” as a science fund relating to physics.

Next, we had to select the second unit’s curriculum topic based on the survey result. We then brainstormed how the categories of gravity, impact, speed, and engineering related to our understanding of a playground informed by students’ math and science funds from the Student Content Survey. Both teachers were able to identify a playground object that they saw had the potential to teach the mandated objective. For instance, Abby suggested swings and Karen referred to slides. However, based on the resources available in the science kits, the teachers chose to examine students’ slide funds.

The teachers’ movement to recognize math-science funds emerged through the researcher’s intervention in creating the Student Content Survey. The survey questions asked topics that were found in the mandated curriculum in order to link a possible math or science connection to students’ life-worlds. Unlike the Playground Survey the teachers used the Content Survey to gather students’ math-science funds. Therefore, the survey results helped the teachers to recognize and access potential math-science funds.

3. **Misrecognizing parents’ math-science funds**

The teachers recognize that parents have math funds on construction, but they misrecognize their funds in the following survey. In the previous Student Content Survey, the teachers read that students listed family members, particular siblings and parents, helping them construct items. Drawing on this new information, the teachers distributed a Parent Content Survey on February 23, 2011\(^\text{13}\). The purpose of the Parent Content Survey is to learn parents’ engineering funds because the teachers felt limited in their knowledge on engineering. The teachers’ hoped to select those parents that exhibited a wealth of funds about engineering to come to the classroom and teach them and the students

\(^{13}\)See appendix C.7 and C.8
how to construct slides. Unlike the Poster Survey, the tools of this survey were mediated for parents to read and write in either Spanish or English.

However, Abby and Karen were astonished to find that together they received only three parent survey responses. They describe the limited parent participation collectively in a report on April 5, 2011.

“A disappointment with our community relations that we experienced during Unit 2 was the level of parental involvement. We sent home a survey (in English and Spanish) in an attempt to invite parent volunteers into the room to share their funds of knowledge on building things. Only one of Mrs. Anderson’s students’ parents responded that they’d be willing to help, but nothing came of it because the parent worked during the day.”

The teachers described their survey results as a disappointment in parents’ lack of involvement. However, the mode to which teachers established parent relationships was unfavorable to parents scheduling as school hours overlapped with their work hours. In addition, another parent who did request to come to Abby’s classroom, as shown in the survey sample above, self-identified as having no engineering funds and thus Abby didn’t view any benefit to having the parent come to school.

The teachers were operating FoK as being concrete when parents claimed they either had funds or did not. Additionally, the teachers misrecognize math funds because of the way they see engineering as being limited to blueprints and building skills. Therefore, when a parent was willing to come to the class and speak Spanish, Abby overlooked the adult having any math-science knowledge. Yet, even if a parent could not self-identify their own math funds, they could have contributed to the classroom and this was a missed opportunity. Furthermore, the limited survey responses show the continuing lack of collaboration between Genesis and parents.

4. **FoK questioning to recognize and access math-science funds**

A method I observed the teachers use to recognize and access math-science funds was asking impromptu questions during classroom discussions. I transcribed the classroom videos and marked where I saw students sharing math-science funds. I then went back and documented what prompted a student to share a fund and found that every fund was traced back to a larger teacher
question. I grouped each teacher question and created the following categories with examples of each question as shown in Table 3.

**TABLE 3. TYPES OF FoK QUESTIONS**

<table>
<thead>
<tr>
<th>Question Type</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experience Question (EQ)</strong></td>
<td>Teacher asks student to share a life experience.</td>
<td>Abby: Talk to your partner about a time they have been on a slide. What did it look like, where was it?</td>
</tr>
<tr>
<td><strong>Student Connection Question (SCQ)</strong></td>
<td>Teacher asks a question and student self connects their funds to the question.</td>
<td>Karen: You are going to tell me how tall, long, draw, and label your slides. <em>(on board is a sample blueprint of a car).</em> Tom? Tom: That’s a muscle car. Karen: You know a lot about cars.</td>
</tr>
<tr>
<td><strong>Content Funds Question (CFQ)</strong></td>
<td>Teacher inserts a prior identified student fund into a mathematic or scientific question.</td>
<td>Brock: You can go green. Karen: How can we make slides that are green to help make slides help the environment? Brock: Use solar panels to have(.) to have water come down the slide to to make it faster and fun(.) and like the fish like clam fish.</td>
</tr>
<tr>
<td><strong>Expansion of Students' Funds Question (ESFQ)</strong></td>
<td>Student shares a fund and teacher questions to learn additional information about student’s fund.</td>
<td>Abby: How do you get them [bats] to stay away? Alex: When it’s sunlight they get melt because they are like vampires. Abby: Are you talking about vampires or Bats? Alex: Bats. But vampires and bats are the same thing. Vampires can melt like bats.</td>
</tr>
</tbody>
</table>

FoK questions were important because in these examples, it shows how the teachers could access a students’ fund, through questioning, and recognize these funds to be a math-science fund because the teachers connected it a larger math and science standard. For instance, experience questions arose when teachers asked students about their life experiences. For example, Abby asks students to describe a time
students have been on a slide and what the slide attributes were. Multiple students responded sharing different types of slides they have been on such as curvy slides, double sided slides, roof covered slides, and water slides. These slide experiences were then used by the students to identify a problem with a slide that they would fix, fulfilling science standards on technological design. Thus, slide funds were transformed into recognizing a science-fund.

Student connection questions are when a teacher is unaware that the question posed relates to students funds. However, as a result of the questioning, students draw a connection to the question and their funds. In the example given above, Karen was asking students to design blueprints of their slides. To show students what blueprints looked like, she placed an example of a car blueprint on the overhead. As the teacher asks students to tell them how tall and long their slides are, Tomas self identifies a math fund on engineering to share his car funds and provide context to the blueprint design. This prompts the teacher to affirm that she has learned Tomas’ knowledge about cars.

Content fund questions addressed teachers framing a scientific or mathematic question while using students’ prior identified funds. I found that when teachers used students’ FoK to question, students would extend their responses by providing additional funds. For instance, Brock introduces his science funds on “going green,” and Karen uses Brock’s funds to ask a science question on how he plans to build a slide that’s beneficial to the environment.

Expansion of students’ funds requires teachers to have identified a student fund, either through the use of an experience, student connection, or content questioning. Teachers extend upon students’ funds by asking additional questions to further their understanding. In the example above, Abby learns Alex’s misconception on bat’s melting. She extends on Alex’s funds by collecting further information on what he knows about vampires and bats. Alex’s knowledge on bats is then used by Abby to draw connections to science standards on organisms, thereby transforming vampire funds into science funds.
Based on these FoK questions, I listed the teacher identified math and science funds from their field notes and references to classroom transcripts in the second and third unit, since the teachers did not identify math and science funds in the first unit. In the second unit, the teachers viewed students’ funds in terms of engineering (math) or science funds. The teachers learned students’ experiences with building, gravity, and speed. In addition, Karen and Abby also learned that students had a wealth of information about different types of slide structures. Teachers learned about the slide structures as they taught through variables that can affect the speed of going down a slide. Thus, teachers begin to recognize what counts as funds as intersecting with math and science. Teachers wean away from previous topics in IPP such as personality and interests, and merge with science and math concepts of construction and science experiments.

In the third unit, the teachers used FoK questions to identify science funds around organisms in the playground. Teachers also learn about family funds such as parents careers as they recruit people to help advocate for a playground. They also gather funds from the community when referring to ways to keep the playground safe. Due to the teachers third unit objectives to focus on organisms, teachers neglect to pay attention to ways math can be incorporated when learning about organisms. Thus, mathematical funds are not identified by teachers.

5. **Summary of (mis)recognizing math-science funds**

The teachers in this study implemented several activities to access funds, such as surveys and asking FoK questions. However, accessing funds meant the teachers had to recognize where math-science funds existed in students’ life-worlds. Throughout each FoK activity, the teachers accessed, recognized, and/or misrecognized students’ math-science funds as summarized in Table 4.
In the first unit, the teachers recognized students’ funds such as playgrounds or in-school play lot experiences, but misrecognized students’ math-science funds in the Playground Survey. The Playground Survey was used to teach math and science standards, and was a missed opportunity to gather math-science funds. In the researcher’s view, the teachers took something that appeared to not be a math-science fund, like playgrounds, and created it into a math-science fund because it was used for math and science (language)learning. I identify math-science funds as those funds the teachers align to state standard, mandated curriculum objectives, or to math and science Discourse practices. The outcome of the Playground Survey is a math-science fund, but the teachers’ conceptualizing of math and science, from a mandated curriculum perspective, did not lend them to view playground experiences as a math-science fund. In contrast, the teachers recognized math-science funds in the Student Content Survey because it forged them to draw parallels between mandated topics (i.e. gravity, speed) and student self-
identified funds in their life-worlds. For instance, the teachers saw how a student survey response on a science fund, like stairs, can be integrated with the science mandated curriculum topic of impact.

Additionally, asking FoK questions is a tool the teachers used to access students’ math-science funds during classroom conversations. These questions facilitated how the teachers could recognize and transform students’ funds to mediate math and science (language)learning. Therefore, pertinent to recognizing students’ math-science funds, is teachers own conceptualization of what counts as math and science. In this section, the data shows how teachers recognize math-science funds when they see a connection to students’ funds and the mandated curriculum topics or misrecognize these funds when they cannot draw links between students’ funds and mandates.

The teachers misrecognized accessing parent’s math-science funds. The teachers’ limitation in their analysis of the Playground Survey revealed similar funds between parents’ and students on the topic of playground safety. However, the teachers misrecognized the difference in sense making of safety between the parents and the students. The teacher’s misrecognition provides implications for how funds are accessed and recognized when teachers analyze students’ funds through making meaning from the perspective of the participants. Furthermore, the Parent Content Survey suggests how teachers cannot expect parents’ to self-identify their own math-science funds because parents may misrecognize where math and science exists in their life-worlds.

F. **The Teachers’ Movement Toward Math-Science Funds**

The previous section acknowledges the teachers can recognize and misrecognize students’ math-science funds. However, this section elaborates the movement to how the recognition of math-science funds was possible. Overall, Abby and Karen were able to identify and engage in math-science funds in the second and third units, but they could not in the IPP and the first unit.

My findings reveal that the teachers undergo three critical shifts that guided them to recognize and gather toward math and science funds. First, the teachers are able to gather math-science funds...
because they transformed their interactions with students’ funds from interest to investigating funds as social problems. Secondly, the teachers modify the purposes for gathering FoK for a curriculum theme to socially organize learning in the classroom discourse. Thirdly, the teachers’ shift from pre-selecting students’ FoK topics to leveraging the students’ participation by allowing their funds to organically emerge in conversations. In the following, I show how these three changes accounted for the teachers moving towards math-science funds.

1. **Expanding funds from interests to social problems**

   FoK questions can mediate the types of student funds produced. When the teachers stayed in their comfort zone, which consisted of non-problem posing questions based on students’ interests, they were unable to include math and science. For instance, when the teachers asked students what they ate or what their favorite movies were they were engaging in learning FoK, but the teachers didn’t see how it related to creating math and science objectives. The teachers were interacting with students’ funds by avoiding any tense conversations, thereby remaining in their comfort zones.

   One of the activities the teachers’ engaged in based on student and teacher interest was the Community Walk. The Community Walk was a unique event because there were two competing activity systems: school and community. School activities foster student behavior that requires students to adhere to the rules of the school. In contrast, the Community Walk activity made students aware of their roles as playground members who adhere to the rules of a playground. When both the community activity and school activity intersected, the students were able to articulate the social tension by problem-posing why Genesis did not have a playground. By asking problem-based questions, the teachers were then able to incorporate math and science in a learning experience that was outside of the class: the playground.

   As a result, there was a shift from learning about funds through a conflict-free and more traditional school based lens to now learning about funds that were rooted in conflict, or are problem
based. The implication of this is that the teachers began to incorporate ways to solve the playground using potential solutions from math and science. Moreover, by engaging in this problem-based process, the teachers had the opportunity to see where FoK could exist. So the teachers could take a fund, like playgrounds, and make it mathematical and scientific. The topic of playgrounds in and of itself didn’t appear mathematical or scientific, but when the teachers situated playgrounds as a problem with solutions that involved using math and science, the end result was science and math funds. The result of the Community Walk provided an initial direction to the teachers’ understanding of how students’ interests could be applied to math and science funds. The Community Walk was important because this was the first teacher awareness that students’ funds can lead to math and science standards. The teachers were able to include content that went beyond mandated textbooks, and build math and science practices around students’ funds. Furthermore, the Community Walk activity, in conjunction with learning about problematic playground funds, opened the door for teachers to continue to learn further those types of funds that were rooted in problem-based funds which were masked under the larger problem of Genesis needing a playground.

2. **Establishing FoK purposes for classroom interactions**

In order to move toward gathering math and science funds, the teachers had to reevaluate the purposes for collecting students’ funds. In the IPP, the teachers’ purpose for collecting funds was to create a curriculum theme. However, at the end of the first unit, the teachers did not elicit further math-science funds in playground funds. The lack of awareness occurred because playground funds did not align to math and science topics found in mandated curriculums, where the teachers saw “official” math and science. Therefore, the teachers did not develop a purpose for needing to gather students math and science funds in the first unit. As a result, the teachers write in a collective report on December, 28, 2010, how they did not actively seek collecting additional funds because they planned to foster “a teacher-dominant script, giving students very little to voice FoK in the direction of their learning” (p. 2).
In other words, the teachers didn’t see how gathering additional funds would aid in student learning, since they mediated learning by connecting playground funds to the curriculum theme.

The researcher’s intervention on the findings from the Content Survey allowed the teachers to reconsider and discover their own purposes for how students’ FoK could mediate student learning beyond a curricular theme. The Content Survey became important because it transformed the teachers to view students’ funds as math-science funds. When the teachers were able to connect students’ funds to math and science funds in mandated objectives, they were able to negotiate a purpose for how FoK could assist in students learning to make meaning in the classroom discourse, as opposed to just in the curricular theme. For instance, in the second unit, the teachers found a purpose to learning students’ math and science funds found in playgrounds, such as Lego, because they saw how building slides out of Lego could teach math measurement skills and science concepts of balance and motion. Therefore, playground funds, like slides, were important to connect the curricular theme to students’ funds, and learning additional math and science funds, such as Legos, was important to further mediate math and science during class discussions.

The teachers reflected on how using math and science funds for the purpose of socially organize learning could mediate math and science concepts. Therefore, identifying FoK for the purpose of socially organizing learning provided the teachers with a new objective to seek math and science funds. As a result, the teachers were now using students’ FoK to teach to a curriculum topic of playgrounds and through the discourse which contributed to a need for further gathering math-science funds.

3. **Pre-selecting to emerging FoK**

The teachers allowed their students funds to emerge in classroom discussions which contributed to the movement towards accessing math-science funds. Specifically, the teachers changed their approach to gathering students’ funds through pre-selecting FoK questions to asking emerging FoK questions. The teachers had pre-scripted FoK questions in the IPP activities, the first unit’s survey
questions, and in the second unit’s survey questions. However, the teachers access math-science funds by asking unplanned questions in the third unit. The shift from the teachers’ pre-selecting funds to emerging funds demonstrates how the teachers had to share the classroom discourse with their students.

For instance, when pre-selecting questions, the teachers controlled the questions asked and the discourse rested on teacher authority in the class. I examined the different FoK questions asked in each unit. I searched through the teachers’ surveys and classroom transcripts to collect FoK questions asked by both teachers for each unit. I then synthesized a thematic question each unit had in common. For instance, during the IPP the common question asked was, “What do you like?” This question resulted in a broad spectrum of types of non-math and non-science funds collected. In the first unit, Karen and Abby’s common question asked, “What do you know about Genesis’s play lot?” This question began to narrow the types of funds produced to playground funds, but privileged school knowledge. As a result, teachers were teaching to the idea of a playground, but still didn’t view gaining math and science funds. For the second unit, the central question was grounded in asking experiences students had with specific math and science objectives from the mandated curriculum’s chapter on “Balance and Motion.” Although this allowed for the teachers to learn math-science funds, Karen and Abby controlled the topics of funds students could share to teacher-created objectives such as funds on stairs, Legos, and slides. If the teachers fostered emerging FoK questions derived from students discourse to develop conversations open-endedly, students may have provided alternative FoK topics to connect to the “Balance and Motion” objectives.

When allowing funds to emerge in the discourse, the teachers shared the classroom discourse with their students, and positioned them as experts in their funds. In the third unit, a common question the teachers asked was “How do you know?” The teachers had used the four types of questioning in order to change the status of what knowledge in math and science counts. In emerging funds, students can make connections and sense-making out of math and science because teachers privileged student
funds on topics students selected. The questions asked during the third unit were unplanned and unscripted. By doing this type of questioning, the teachers navigated students’ funds in the discourse in the moment to moment interactions. Because funds were emerging from students, and were not always initiated by the teacher, Karen and Abby could probe the students about how they knew the funds, which is a higher order level of questioning. I define higher order questions where the answers are not predetermined but rather have multiple solutions. Higher order questions also engage in reason and abstract thinking and create a conversational discourse.

As a result, what I saw in the classroom is that FoK were not treated as a phase just for designing a curriculum theme, but it became the norm in Karen and Abby’s classroom practice. The improved interactions of questioning and responses between students and teachers created a classroom dynamic that resulted in continuous FoK conversations, with the teacher as learner and student as expert in their funds. What’s learned here is that the teachers had to navigate and learn how to share their voice with students in the classroom (for further discussion see chapter x). As their understanding of math, science, state standards, and FoK grew, they were able to manipulate interactions with students and learn how to ask the types of questions and develop shared-talk with students that they needed to teach math and science through gathering math-science funds.

4. **Summary of teachers’ movement toward math-science funds**

The findings explain how the teachers shifted in their FoK practices to gather students’ math-science funds. Figure 5 summarizes changes in the teachers’ FoK practices. The timeline indicates the starting date of the former practice and the ending date to when the change of the new practice began and continued. Importantly, on April 12, 2011, in the third unit, is where we find the teachers adopting all the changes and moving toward math-science funds. In summary, the teachers first shifted from gathering funds that were of interest to funds that were rooted in social problems. The teachers accessed math-science funds because they engaged with students problem-posing their life-worlds. So the
teachers could take a fund, like playgrounds, and transform it to be mathematical and scientific. The topic of playgrounds in and of itself didn’t appear mathematical or scientific, but when the teachers situated playgrounds as a problem with solutions that involved using math and science, the end result was math-science funds. In contrast to the teachers accessing students’ interests, problem-posing funds required the teachers to dive into unfamiliar and uncomfortable spaces, like the community.

Furthermore, it may require the teachers to engage in a curriculum, where the teacher may not be the expert or have the answers, and such is the case for Abby and Karen when they were uncertain to why Genesis did not have a playground. However, the tension of problem-posing funds enacts a curriculum where attempting to uncover social problems, grounded in students’ funds, enables the use of math and science to learn in a meaningful context that create math-science funds out of students’ every day funds. Therefore, the teachers could access math-science funds.

In addition, the teachers modified the objective for eliciting funds for thematic curriculum to making student connections to content in the classroom discourse. The teachers had to create their own purposes, with the assistance of the researcher, to find new meaning for accessing math-science funds.

**Figure 13. TEACHERS’ MOVEMENT TOWARD MATH-SCIENCE FUNDS**
The Content Survey allowed the teachers to become aware that additional topics of math-science funds can be used to mediate math and science objectives, beyond the topic of playground funds. If the teachers’ had not developed new FoK purposes, then the teachers may not have found a reason to further access math-science funds. Also, the potential to mediate beyond a curriculum theme would have been limited the resources students could use their funds for, such as funds to socially organizing learning (i.e. student participation, role shifts). As a result, new purposes led to the continuation of gathering math-science funds.

Finally, the teachers also progressed in shifting from pre-selecting students’ funds to emerging funds. As the teachers allowed students funds to emerge, the topics of funds that students saw connections to the content with expanded into domains the teachers may not have been privy too. Funds that emerge from students require the teachers to give students a shared voice in the classroom and to engage in conversational topics that the teachers may either not be familiar with or to be flexible in their lesson plans to accommodate such topics. However, leveraging the discourse of the students provided the teachers with gathering additional math-science funds that positioned the students as experts in their funds.

G. Perspectives on Identifying FoK

The previous sections explored different FoK activities that teachers created to elicit math-science funds, the ways teachers (mis)recognize math-science funds, and the movement towards gathering these funds. However, knowing how the teachers access and recognize students’ math-science funds involves studying the researchers’ perspectives because the researcher provided interventions to the teachers’ development in how they accessed and recognized math-science funds. Referencing appendix A-F reveals the teachers identified math-science funds, whereas appendixes G-I demonstrate the researchers varied identified math-science funds. Therefore, this section explains the nuances between my identification of students’ funds in the units versus the teachers. In addition, I also refer
how working with the teachers expanded my own view on whose funds and what spaces, ideational or geographical, counts as FoK.

1. **Nuances in identifying funds**

In understanding how the teachers identify funds, I have also developed my own understanding on what counts as students’ funds. My own understanding of funds emerged from observing the teachers’ development toward math and science funds from the IPP to the third unit. I examined what counts as FoK as being any knowledge or skills (including culture and native language) essential for the students’ lifeworld(s). In this section, I describe the nuances between the teachers’ identification of math-science funds and my own based on our differing perspectives on (a) cultural funds, (b) in-school versus out-of-school, (c) multi-layering funds and (d) math-science funds.

a. **Nuances to cultural funds**

The teachers and I differed in how we saw culture in students’ funds. I refer to ‘culture’ as students’ everyday living practices. However, when the teachers began to gather student’s funds in the IPP, they were also paying attention to the cultural practices of school. In other words, the teachers were concerned about who their students were, as students, so in the IPP they included academic abilities as important to gathering funds. In contrast, I excluded including academic abilities because I considered FoK to be leveraging out-of-school practices—e.g. playing soccer at a park. I wanted to look at FoK as bridging those out-of-school practices with in-school practices (e.g. playing in Genesis’ play lot) for (language)learning.

Additionally, in the IPP, the teachers accessed cultural funds by selecting tangible surface markers like favorite foods and movies. Here, culture is reduced to interests. I separated culture from interests. I did not include all student interests as being a type of FoK. If I couldn’t differentiate the interest as an everyday practice or if it was just simply a student wanting to know more about something, then I did not include interest as being FoK. It should be noted that there can be intersecting
interests where students’ practices reflect their interests (e.g. student speaks to liking football and plays in their backyard with friends after school). However, cultural interests funds didn’t capture a deeper meaning of culture embedded in the *practices* of the students’ lives. Furthermore, the teachers considered personalities as characteristics of culture that were important to a student identity. I excluded considering personalities as being a type of FoK, because I was concerned with the practices students exhibited in their life-worlds and not how the teachers identified a student’s character. In summary, when the teachers began to access funds, they engaged in funds that viewed their children through a student identity, and had to progress, with my intervention on the Community Walk, to view their students as memberships in their life-worlds (i.e. community member, playground member).

**b. In-school versus out-of-school funds**

Another difference between my identification of funds and the teachers occurred during the first unit. For the first unit, the teachers had targeted learning about students’ in-school funds. They wanted to research more about what experiences students had with the play lot in Genesis in order to identify a school problem. Although I valued students sharing their in-school experiences, I discarded knowledge that students had about their school as counting toward FoK\(^\text{17}\). Knowledge that was found in playgrounds, like observing playground pavement that students referred to as “squares,” or knowledge students and parents had about their community, I identified as funds, because these practices took place in an out of school location which was important to my understanding of privileging funds. In addition, I witnessed playground funds, presented as a curricular topic, being a math and science fund since the topic connected to learning standards.

**b. Awareness on multilayered funds**

I began to see funds as multilayered in the second and third unit, which differed from Abby and Karen. Previously, I had compartmentalized students’ funds into the categories showing

\(^{17}\) See appendix C.12 and C.12a
an isolated direction of funds\textsuperscript{18}. However, after the teachers and I shifted our second unit’s objectives, I began to view funds as complex in nature and overlapping with other funds. For instance, Moje et. Al (2004) isolates funds into compartments like popular culture, peer group, and community. In contrast, when I identified funds for the second unit I saw the fund of play overlapping with the types of engineering and science funds produced. I shifted in my way of thinking about funds, not in isolation, but how funds act upon each other in a complementary manner. For instance, learning about play funds allowed students to share further funds about their experiences on a slide, which led to science funds on speed. In addition, I began to identify students’ knowledge of Spanish cognates and the students’ skill in speaking Spanish as being a fund. My realization occurred even though the teachers were not aware of the place of Spanish in an academic classroom. Additionally, I began to see funds complement one another, such as Spanish, science, and play funds. In other words, one fund can contribute to multiple categories. For example, play funds are nested both within science and Spanish funds; and I also found science was nested in Spanish funds. I discovered evidence that multilayering of funds was important to the students’ ability to share funds and mediate math and science learning, and not situated in only one fund (ie: playground). This was a new awareness for me for how teachers can mediate learning through multiple ways of contextualizing content that is derived from multiple spaces of students’ funds – the intersection of teacher and student funds.

d. Nuances to identifying math-science funds

In addition the teachers and I differed in what we counted as a math-science fund, based on our understanding of math and science concepts. For instance, in the second unit, I saw math and science funds connecting to the IL science learning standards of “technological design.” Therefore, math and science funds in Karen’s classroom on “solar energy” I included as a math and science standard, whereas Karen did not see “solar energy” funds being mediated toward a math and science

\textsuperscript{18} See appendix C.13 and C.13a
learning standard. In contrast, for the second unit, Abby and I both agree that students funds on observing females building items in their community is a FoK, but I differ in that I count this as a math and science fund because I saw a connection to the fund fulfilling a science standard on defining organism and Abby did not. Abby viewed this fund as a way to bridge student interest instead.

In comparison to the third unit\textsuperscript{19}, the emergence of a science read-aloud event in Spanish allowed for Spanish academic conversation to spark in Karen’s classroom. I saw Karen in unit three during this read-aloud activity begin to search for Spanish funds. She had viewed Spanish funds in terms of what academic knowledge students could share in Spanish. In addition to Spanish as student’s knowledge on what students can share about academic content, I looked at Spanish funds as also being a \textit{skill} – practice students can do. Because Karen and Abby did not understand Spanish, they chose to not place ELs native language at the forefront of how they identified funds. On the other hand, I valued identifying native language funds because there are two types of mediation – content and language. In addition, Karen viewed the read aloud as being a science fund because she viewed students were learning a science standard on organism survival. In contrast, I did not identify the Spanish in the read aloud as a science fund because I viewed the Spanish as translations, not science learning.

Abby and I also differed in the third unit how we identified math and science funds. Abby viewed all of students’ counterexamples as being science funds, because students could select from their funds any example to mediate defining an organism. In contrast, I did not count every counterexample as math and science funds if it was unknown if the fund occurred in school or out of school.

2. \textbf{Whose funds and what spaces}

Initially the teachers began their FoK inquiry paying attention to students’ funds. However the Lunch Talk activity guided the way for teachers’ redefining whose funds mattered to include parents. As the’ teachers went searching for parents’ funds, I began to reflect on the purpose of

\textsuperscript{19} See appendix C.14 and C.14a
collecting parents’ funds. Based on my analysis of the Parent Playground Surveys, I saw that if teachers were teaching curriculum through parents’ funds, then their funds would be different from students. Funds that are not derived from students’ life-worlds would not be as meaningful for students, because the knowledge is not situated from their perspectives. I realized that although parents may have funds that differ from students, there are still spaces where parents and students funds intersect. For instance, during the Lunch Talk activity, Yamali’s father’s work funds informed her knowledge on the importance of learning. Rather than dismiss parents’ funds, I shifted in my view so that if the teachers target those spaces where parents’ funds inform students’ funds, then knowing parents’ funds is beneficial. Rather than ask the question of whose funds matter, I now asked the question of whose funds matter for what purpose? I imposed this type of questioning because I found that students’ funds can be situated in non-geographical spaces, such as families. In doing so, I saw learning about FoK as asking the question of who are my students, and then focusing on what spaces will assist the teachers’ understanding of students.

Spaces refer to the sources where students’ funds exist (i.e. life-worlds). I saw that students’ life-worlds consist of both physical spaces and ideational spaces (i.e. community memberships). I listed all the physical spaces and ideational spaces of funds that had been tapped during the school year. The physical spaces represent geographical place, such as parks and houses. Even if teachers did not observe students in the geographical space, students made references to where their funds took place. The ideational spaces, such as families and friends, represent sources where students’ funds emerge. Here, the common area of funds emerged from family, where parents’ funds were tapped, as well as a description of playing with friends. Thus, when gathering FoK on who and how the teachers gathered funds reflect a holistic approach of knowing the student as a person in all their spaces, rather than just knowing the student as an individual in school.

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20 See appendix C.15
3. **Summary of Perspectives on Identifying FoK**

The researcher and the teacher differed in how they identified math-science funds. Exploring these differences is important because the researcher’s stance differed from the teachers which resulted in the interventions to access and recognize funds. This section summarizes the nuances between the researcher and the teachers’ identification of math-science funds elicited by the teachers.

Table 5 summarizes these nuances. It should be noted that the table does not account for the development of the teachers’ within each category. For instance, the teachers view of culture changes from the IPP. However, important to this section is how the researcher differed from the teacher’s identified math-science funds within the particular units.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Teachers</th>
<th>Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPP</td>
<td>Cultural practices of school</td>
<td>Cultural practices in students’ life-world memberships</td>
</tr>
<tr>
<td>Unit One</td>
<td>In-school and out-of-school practices</td>
<td>Out-of-school practices</td>
</tr>
<tr>
<td>Unit Two</td>
<td>Awareness single stranded funds</td>
<td>Awareness multilayered funds</td>
</tr>
<tr>
<td></td>
<td>Funds include interests or student counter-examples (Abby)</td>
<td>Funds as knowledge or skills</td>
</tr>
<tr>
<td>Unit Three</td>
<td>Linguistic funds as knowledge (Karen)</td>
<td>Linguistic funds as knowledge and skills</td>
</tr>
<tr>
<td>*All Units</td>
<td>Math and science as state standards and mandated curriculum topics</td>
<td>Math and science as state standards, mandated curriculum topics, Discourse practices</td>
</tr>
</tbody>
</table>

The researcher and the teacher differed, in the IPP, on their views of culture. The teachers’ saw culture as tangible surface markers, such as food and movies. The researcher provided an intervention for the teachers to do the Community Walk in order for the teachers to view culture in an ethnographic
lens. For instance, the teachers could view the students as more than students, and from the perspective of their life-world memberships like being a playground member or a community member. Here, culture shifted to count as students’ everyday living practices. Therefore, there are differences in the nuances to how the researcher identified math-science funds with respect to culture as everyday living practices.

Furthermore, the teachers differed from the researcher in their math-science funds on native language, Spanish. Specifically, Karen viewed linguistic funds as any knowledge a student would share in Spanish. However, the researcher viewed linguistic funds as knowledge and a skill, such as speaking Spanish as a practice that students could do. The gap between Karen and the researchers’ view on language, furthered the researcher to provide intervention on language choice and language discourse. The researcher intervened Lunch Talks in an attempt to leverage students’ voice, through conversational discourses, in the classroom. In addition, the researcher encouraged the teachers to foster a FoK discourse, where the language of the classroom is one where emerging funds could exist and students could speak to and through their funds, as a language skill.

Additionally, the teachers were enacting funds that privileged their familiarity and comfort of knowledge in-school. Although the teachers did also ask students about their out-of-school playground experiences, the first unit namely captured students’ in-school play lot funds. The researcher became aware of a missed opportunity and misrecognition of math-science in the Playground Survey to reveal the importance of out-of-school funds. In doing so, the researcher differed from the teachers to privilege out-of-school funds so that students home or life-world practices could be bridged with in-school practices.

Throughout all the units the teachers struggled to identify math-science funds because of their perspectives on what counts as math and science. However, when gathering math-science funds, the teachers, in the second unit, counted those topics derived from mandated curriculum topics as the ‘official’ math and science domains. The researcher provided an intervention to expand where the
teachers could recognize math and science from mandated textbook objectives into students’ life-worlds by designing the Content Survey with the teachers. As identified in appendices a-g and f-a, the researcher and the teachers would often differ in how they conceptualized math and science, such as if a fund could relate to a state standard or a mandated topic (see Chapter X). In summary, understanding the differences between the teachers and researchers identification of math-science funds is critical for knowing how the teachers access and recognize these funds.

H. **Summary of Accessing ELs’ Math-Science Funds**

The teachers, Abby and Karen, explored various methods to access ELs’ math-science funds. Gathering these funds was critical for the teachers to leverage students’ cultural and linguistic resources for mediating their math and science (language)learning. However, the findings in figure 14, reveal that the teachers struggled to gather these funds on multiple levels such as establishing confianza, (mis)recognizing funds, and moving towards math-science funds. Also, the findings reflect how the researcher and the teachers differ in perspectives on FoK which resulted in the need for interventions.

First, developing FoK activities to elicit funds required establishing confianza and building strong relationships with students and their parents. The teachers struggled to foster these relationships because they chose to stay in their comfort zone, the in-school space, where they held the authority in the classroom, not students. Additionally, collecting funds in-school marginalized parents who already lacked confianza with the school.
However, when the teachers ventured into unfamiliar student life-worlds, the community and the playground, they could access funds from where they are acquired, the out-of-school space. In doing so, they were able to gather funds that were meaningful and relevant to students’ lives. Furthermore, the teachers needed to consider the nature of conversations with their students to access funds when designing FoK activities. For instance, who gets to select the questions or topics for which funds are spoken about, the teacher or student? Whose meaning are the teachers gathering, their own or the students perspectives? Also, teachers should considerations whose authority is privileged in conversations and how can they create shared talk with their students to access funds.

Secondly, there are potential for teachers to recognize and misrecognize students’ math-science funds. The teachers have agency to create any student fund and transform it into something mathematical and scientific if they could mediate its connection to a state standard, mandated curriculum topic, or a math and science Discourse practice. However, the teachers missed these opportunities in their lack of awareness to create math-science funds in the first unit. The researcher’s
intervention on creating a Content Survey helped the teachers recognize students’ funds can be linked to mandated curriculum topics and be counted as a math-science fund. Implications suggest for teachers to avoid the misrecognition of funds by analyzing students’ funds through the meaning making perspectives of the participants, in addition to conceptualizing what counts as math and science. Furthermore, teachers should not expect for students or parents to self-recognize math and science in their own life-worlds.

The teachers filtered the types of funds they were gathering to focus on math-science funds. Engaging in students’ math-science funds was possible because the teachers embraced tension. They merged into uncomfortable spaces, like the community, forging them to problem-posing with their students and reveal real-life issues that required math and science to solve. In doing so, funds that are typically not viewed as math or science topics, like playgrounds, became a math-science fund. Furthermore, the teachers continued to gather math-science funds because they created new purposes for FoK beyond developing a curriculum theme on students’ funds. Implications suggest teachers to be researchers of their own classrooms and explore alternative purposes for FoK that can mediate ELs (language)learning. Also, the teachers’ shifted from preselecting funds to privileging students’ discourse that allowed FoK to emerge in the classroom and position them as experts. The study recommends teachers to gather math-science funds in a learning environment where students can be positioned as experts in their funds, and teachers as learners.

In understanding how the teachers gather math-science funds, it’s important to consider the factors that informed the teachers. The researcher’s perspectives on gathering funds pushed the teachers to use ethnographic tools and recognize cultural funds as being everyday practices, not just tangible surface markers on food or movies. Furthermore, differences in identifying math-science funds between the researcher and the teachers lay in their evolving interpretations of what counts as math and science. The researcher informed teachers to recognize math and science content as state standards, mandated
curriculum topics, and Discourse practices. Implications suggest enacting a place in school where teachers and researchers can theorize FoK practices and learn from one another.
VIII. MEDIATING MATH AND SCIENCE: PLANNING A FoK CURRICULUM USING ELs’ MATH-SCIENCE FUNDS

My best friend and I had a secret hang out spot that we called “The Booster.” The Booster was a forest that we made into our second home. Being adventurous, we spent endless hours climbing tall trees, watching bugs, and hanging out by the lake.

One of the purposes of FoK is for teachers to design their own curriculum by capitalizing on students’ funds. Subsequently, teachers designing their own curriculum is not unique to the theory of FoK, but has historically been researched in the field of curriculum studies. In my findings, Abby and Karen negotiated questions that are raised in curriculum studies to overlap when considering creating a FoK curriculum. For instance, Schubert (1997) addresses a fundamental question to ask what’s worthwhile knowing, experiencing, doing, needing, being, becoming, overcoming, sharing, and contributing as all essential components to consider in a curriculum. In a FoK curriculum, the students’ funds become central to the curriculum to recognize their experiences as mathematical and scientific. In doing so, the students’ knowledge is what counts and is used to leverage their meaning making to teach math and science. Additionally, Dewey’s (1929) philosophical view of education suggests “there is no way to discover what is ‘truly educational’ except by the continuation of the educational act itself. This discovery is never made; it is always making” (p. 47). Hence, similar to Dewey’s view of curriculum, a FoK curriculum is in constant motion, in the making, of examining, reflecting, and theorizing an engaging process of what knowledge is of most importance. In this perspective, curriculum is not pre-determined, but in FoK, the curriculum is evolving with the students’ funds. As teachers explore with students about their funds, new questions develop to allow the curriculum to emerge and expand in other FoK sources.

Furthermore, Dewey (1902) criticizes the inappropriate focus of curriculum being “its passivity of attitude…its uniformity of curriculum and method. It may be summed up by stating that the center of gravity is outside the child. It is in the teacher, textbook, anywhere and everywhere you please except in
the immediate instincts and activities of the child himself” (p. 34). The idea of turning toward students' experiences for curriculum development is expanded by Hopkins (1976) who distinguishes between the ‘was’ curriculum and ‘is’ curriculum by explaining “the WAS curriculum is centered around book learning or acquiring from books the now dead knowledge of formerly lived people…the IS curriculum is centered in or is the study of firsthand experiences of pupils…the IS curriculum is what the teacher causes pupils to do to themselves while they are associated together…it deal with the whole pupil who develops through internal control of the learnings that he or she self selects to recreate into the self for personal growth (p. 213).

Here, Dewey (1902) and Hopkins (1976) recognize that the student is the living curriculum, which intersects with FoK to situate students’ social networks as places for teachers to co-construct curriculum with students. Designing a curriculum drawn from students’ lives aligns with aspects of sociocultural theory since Vygotsky (1978) argued that learning is fundamentally interpersonal and it proceeds from the interpersonal to the intrapersonal. Therefore, what constitutes the learning context is expanded into the larger institutional, cultural, and social contexts, which these contexts are exhibited from students’ FoK practices. Teachers attempt to theorize the everyday practices of their students, practices “that are at times emergent perhaps counterintuitive, and sometimes opaque. Formed and transformed within sociohistorical circumstances. Practices are constructed by and through discourses, the ways of knowing that populate our streams of talk. The lives of ordinary people, their everyday activities, and what has led them to the place they find themselves are the bases for our theorizing practices…and the power of social relationships in the construction of knowledge…emergent nature of negotiating the process (Gonzalez, Moll, & Amanti, 2005, p. 1).

In FoK, teachers focus constructing curriculum on the process of practices of life and how their students’ lived experiences provide resources of all kinds to engage in life. Teachers are not simply putting FoK theory into practice, but rather the two go hand in hand: the practice is the theory and the
theory is the practice. Teachers are theorizing as they learn of students everyday lived practices. Thus, curriculum has no beginning and no end; rather it’s a pursuit towards the meaning of what is worthwhile? For whom is it worthwhile? And for what purpose is it worthwhile? It is in this perspective, the finding chapter seeks to understand teachers meaning making of theorizing their own curriculum practices of what is worthwhile with respect to FoK. Hence, drawing on curriculum studies, my study asks similar questions for a FoK curriculum: What FoK are worthwhile knowing, experiencing, doing, needing, being, becoming, overcoming, sharing, contributing? How do the FoK selected in curriculum expand, restrict, benefit, and marginalize certain members in community of practices? An attempt to discover these questions are common themes found in the findings of this chapter.

Expanding on the argument against a uniformed curriculum, current researchers, Meidl and Meidl (2011), describe how given the pressures of accountability, and educational policy implementing standard-based reforms, many school districts with large populations of ELs and underachieving test scores, are mandating scripted curriculums. Scripted curriculum posits a uniformed approach to instruction, which may seem like equity, but concerns on equity are being raised on the use of standards for diverse populations, including ELs. Also, scripted curriculums further enhances disconnect “between the needs of children from diverse cultures and the system of instructional delivery, including curriculum, planning, and materials, in public education” (Meidl & Meidl, 2011, p. 4).

Working within a scripted curriculum, the teachers, Abby and Karen, struggled to re-mediate the (language) learning context, so that ELs can make meaning in familiar environments that connect their cultural frame of references and everyday experiences to math and science. Realizing that their current scripted curriculum did not consider ELs funds, the teachers developed their own FoK curriculum, with the intent to privilege students’ cultural-linguistic resources for math and science. In this study, a FoK curriculum explores a social problem, grounded in students’ funds, which becomes the curriculum theme. Additionally, a FoK curriculum aims to create fluid boundaries between ELs’ language and
cultural practices with math and science. In doing so, ELs contextualize and make meaning of math and science derived from their familiar everyday practices. Therefore, this chapter explains how the teachers learn to mediate students’ math-science funds to develop a FoK curriculum.

This chapter first discusses the obstacles the teachers face in creating a FoK curriculum based on the funds gathered from the previous chapter. Then, I describe how the teachers’ agency allowed for students’ funds to be lesson planned for math and science content from funds that might not traditionally be seen as math and science, such as playgrounds. Next, the section describes how the teachers’ lesson planned curriculum to align math-science funds to state standards and mandated curriculum. Additionally, the researcher explores how the teachers’ lesson planned to build language opportunities while fostering student participation.

A. Complexities in Designing a FoK Curriculum

Karen and Abby faced challenges when creating a FoK curriculum. The teachers advocated for a curriculum that addressed their students’ needs for a playground learned from the Community Walk activity. Karen and Abby wanted to incorporate students’ funds and playground activism, but the idea was not accepted by administration and district area officers who expected all teachers to adhere to a scripted curriculum. This section explores, the teachers tension with the administration on what (language)learning for ELs should look like. Furthermore, findings reveal that the teachers encountered a larger problem; there was a restrictive “space” for the creation of a modified curriculum (i.e. Playground Curriculum). I refer to the space restrictions as two types of constraints (a) pacing guide constraints and (b) relational constraints. Karen and Abby had to work through these restrictions of space before they could mediate students’ funds for math and science (language)learning.

1. Pacing guide constraints

a. Content constraints and FoK as supplements
The chief officers and the administration mandated scripted curricular pacing guides to the teachers, which limited the content and time allotted to talk about students’ funds. Abby describes the restrictive curricula in her journal entry on September 10, 2010.

“We’re not allowed to really deviate much from the curriculums unless it’s necessarily supplemental…and we are supposed to stick to it as much as possible, though supplemental lessons are important and accepted. This year, we’ve begun using FOSS for science…we’re expected to follow the four units for science.”

Based on Abby’s journal, the teachers could only instruct within the mandated curricular units, however they may deviate from the scripted curriculum if they provide necessary supplements to the mandated topics. Originally, I suggested the Playground Curriculum could be implemented through the back door of supplements in our meeting on September 23, 2010.

Karen: I remember when we were meeting that our theme was the focus but then you said no it should be the supplement.
Ambareen: It is an extension activity out of it (mandated curriculum).
Abby: So? (sarcastic) I still have to do FOSS.

I define supplements as the “activity extensions” to mandated curriculum. I had thought the teachers could embed opportunities for supplements until they achieved their playground objectives. However, Abby responds sarcastically with “so,” implying that supplementing doesn’t change that all FOSS activities must still be taught. The problem with supplementing is that we wanted funds integrated, not merely inserted in mandated curriculum topics. Developing playground funds that were central to the curriculum required the teachers and me to explore additional constraints and teacher risks involved so we may negotiate our options.

b. Policed environments and time constraints inhibiting a FoK discourse

Abby and Karen faced disciplinary measures if they did not stay within the minutes allotted to each subject. The “culture of timing” is displayed through daily timed schedules that are required to be posted in each teachers’ classroom. Abby elaborates on the policing of strict time measures by providing an example of what happened to a fellow teacher, Jack, during an unannounced observation by administration in our meeting on March 22, 2011.
“It is very common for administration to make unannounced observations...That’s where the teacher who got in trouble for doing the question of the day too long. That’s why I was saying if I go off into funds of knowledge...there going to walk in and be like what’s this mumbo jumbo!”

Jack received a poor evaluation for exceeding the time limit on the question of the day by seven minutes. At any given moment the teachers could be evaluated by unannounced administration observations. The implication of policing the restrictive timing concerned Abby because engaging in students’ funds would require extra time that the district did not allow.

The time constraints limited the opportunities for student talk. The teachers explain the implications of time for ELs in their group report on April 5, 2011.

“Students have also picked up on the tight daily schedule. They often remind the teacher when she falls behind schedule. This has been a deterrent...rather than students feeling the freedom to continue their discourse, they have...awareness of the schedule.”

The teachers recognized that their ELs refrain from oral participation because they too are pacing themselves with the schedule. Detrimental for ELs, who need multiple opportunities for speaking English, time constraints can deter ELs language development. National Literacy Panel (2006) found that extensive oral English development must be incorporated into successful instruction (p. 4). Thus, the punitive time measures limited the ability for both students and teachers to engage in a FoK discourse.

c. **Implications of time and content constraints on a FoK discourse**

Providing flexibility in time and content for a FoK discourse was critical for Karen and Abby to even use students’ funds for learning. Recalling from the previous chapter, students would not readily share their math and science funds. The teachers needed to explore students’ non-math and non-science funds so they could find the math and science funds. However, venturing into students’ non-math and non-science funds required engaging in content that is outside the boundaries of mandated curricular topics. In addition, exploring these funds also requires the flexibility in time. As a result, Karen and Abby lived in constant fear that they, like Jack, could be reprimanded.

d. **Grade level pacing constraints**
Genesis administration mandated grade level teachers to implement the same curricular pacing guides across every content area. Genesis teachers executed the grade level pacing rule, by having each grade level teacher in charge of a different subject. Abby planned first grade lessons for science and Karen planned second grade lessons for reading. Karen and Abby envisioned implementing the Playground Curriculum during social studies because it did not have a mandated curriculum. However, all grade level teachers would have to agree on the Playground Curriculum for social studies. Unfortunately, Karen and Abby were unable to convince their grade levels because the other teachers interpreted they would be violating the grade level pace rule if both the first grade and the second grade teachers were implementing the same topic of playgrounds. The grade level pacing rule applied to within not across grade levels. In addition, the grade level teachers didn’t find value in students’ funds and called it “frivolous.” Karen and Abby explain in their group report the challenge to working with their co-workers.

“Trying to “sell” our curriculum became a fight that we realized we wouldn’t win, and so we taught it in secret during our social studies block. We missed the solidarity that we had with our grade level peers; the risk that we took in teaching our unit (as the administration expected that we all follow a uniform lesson plan) was one that the other teachers didn’t want to take.”

Karen and Abby lost solidarity with their teachers by choosing to teach the Playground Curriculum independently during their own social studies block. The teachers realized that their peers were unwilling to join forces and take the risks (i.e. poor evaluations) associated with undermining the grade level pacing rules. Karen and Abby’s students also lost solidarity because they wouldn’t be learning similar content as their peers. However, the teachers were determined that the Playground Curriculum was worth fighting for.

e. **Extending FoK beyond supplements**

I revisited my position on using funds as supplements. I discovered that what is considered supplemental material is contested. Ultimately the power to identify supplements during unannounced observations and to define it is given to administrators and chief officers, not the teachers.
I no longer viewed the playground activities as supplements. Integrating students’ funds would mean developing a new curriculum, given the constraints of content, time, and grade level pacing. I saw the Playground Curriculum being different than the mandated curriculum in that it had its own sequence and content that was grounded in students’ funds. For the teachers to make funds central to students learning, they would have to develop a new curriculum where the funds were at the core of the curriculum. Therefore, Karen and Abby were not in favor of supplementing because if they were accepting the risks of receiving violations, they may as well push for funds to be beyond supplements.

2. **Relational constraints**

   The teachers worked with many different people in the Genesis community. However, the teachers’ relationships with these people, in particular their third cohort member, Lorena, created a relational constraint in the development of a Playground Curriculum. It was a risk for Karen and Abby to work with Lorena because she was a part of the former administration and lost her job when the incoming principal, Rodrigo, was hired. This created conflict because Rodrigo expected Lorena to have no role at Genesis. The teachers needed Rodrigo’s support to implement the Playground Curriculum at Genesis. However, Karen and Abby needed Lorena’s assistance in developing curriculum and advocating for a playground. Lorena had knowledge of Genesis’ history, was friends with members in the local school council, established close ties with community members and families, could communicate in Spanish, and collaborated in co-teaching with Karen. Therefore, the teachers needed to have a relational space to work with both Lorena and Rodrigo.

   During our cohort meetings at Genesis, I became aware of the political tensions. Karen and Abby had the seemingly impossible task of balancing loyalty with Lorena and Rodrigo. The teachers’ maintained positive relationships with Lorena by establishing a comfortable experience for her at Genesis. For instance, the teachers would sneak her into their classrooms to avoid her from having to see Rodrigo for our cohort meetings and would provide a welcoming environment by publicly greeting
her when other teachers ignored her. However, Karen mentions in a journal on April 4, 2010 confronting Lorena about the political tension.

“I saw you as part of the previous administration. It was nothing personal, but I wanted to please the new administration and be in good standing with them.”

Karen rectifies the situation by acknowledging to Lorena that she needs to establish loyalty with the new administration. She interjects to add that “it was nothing personal” in the context of reiterating her support for Lorena as well. As a result, Lorena respects Karen’s honesty and accepts continuing a supportive relationship. However, the teachers would have to continue to be strategic in how they interact with Rodrigo and Lorena for the rest of the school year. Thus, relational constraints were also an inhibiting factor for the teachers to design a Playground Curriculum.

3. **Teacher strategies to override the FoK curriculum constraints**

Karen and Abby accepted the risks in developing the Playground Curriculum because they valued solidarity with their students in what they count as learning. For both teachers, learning counts as elevating the status of students’ funds in the curriculum. Student’s funds were integrated in the Playground Curriculum because the teachers were able to develop strategies around the constraints. Therefore, the Playground Curriculum could be developed and implemented because of these teacher strategies: forming the Genesis Playground Committee, intervention meetings, extracurricular roles, deceptive lesson planning, and resolutions in social studies.

a. **Forming the Genesis Playground Committee**

The teachers wanted to include playground activism as part of the Playground Curriculum. The teachers created the Genesis Playground Committee (GPC) as an organization that would work for a new playground and could advertise for their curriculum to receive support from Rodrigo. The initiatives of GPC included building awareness for a new playground, hosting monthly fundraising events, and writing playground grants.

The teachers describe the formation of the GPC as a change in site at Genesis on December 28, 2010.
“Some teachers would apply individually for grants for their personal classroom, but there was not anything where teachers, administration, students, parents, and community members were working together.”

The GPC extended collaboration outside school to unite parents, teachers, students, and community members who supported the organization. The teachers popularized the playground initiative to create a school and community climate that fostered playground activism. In doing so, the teachers could gain leverage from the community and other staff members at Genesis to encourage Rodrigo to join the cause.

b. **Intervention meeting with the principal**

The teachers needed administration clearance to develop and implement the Playground Curriculum. Therefore, I suggested that the teachers along with myself and Dr. Razfar, a professor and principal investigator of Project LsciMAct, host an intervention meeting with the principal on September 27, 2010. I framed the argument for a teacher developed curriculum as a Master’s degree and bilingual endorsement requirement at the university. Dr. Razfar described that the teachers would be working with the university as professional development to learn how to build academic language proficiency for ELs in the content areas of math and science. Dr. Razfar reassured Rodrigo that the Playground Curriculum would align to state standards. However, the curriculum would also integrate students’ interests and community knowledge. Karen and Abby emphasized their plan to research playgrounds which would require collaboration in different grade levels (i.e. first and second grade). After persuading Rodrigo, he responded by stating that he supports a collaboration between the university and Genesis. He advocates for teachers to become researchers of their own classrooms and continue pursuing their educational degrees and endorsements. In addition, he praised the idea of a Playground Curriculum because he agrees that the school does need a playground. Surprisingly, he avoided the topic of adapting the mandated curriculum or the school rules of content, time, or grade level pacing.
I followed up with the teachers to ask their reflections on the talk with Rodrigo. Karen feels it was a success to have the chance to ask the unmentionable—modifying the curriculum.

“We were able to create a space where our voices weren’t only heard, but we were afforded the opportunity to engage in a conversation about our curricular changes.”

Although Rodrigo was supportive of Karen and Abby’s determination for a new playground, it was unclear what his stance was towards the Playground Curriculum. Abby describes her complexities to make sense of our meeting with Rodrigo.

“Our principal appeared indifferent toward our initiative. Yet, soon after the meeting, our principal asked us to present our goal of getting a playground at Genesis to the staff as well as the LSC. He supported our desire to get a playground at our school, but we were unclear as to whether he approved of our curriculum.”

Abby and Karen knew that Rodrigo supported playground activism, but were unclear if he approved their Playground Curriculum. Because the teachers made Rodrigo aware of the situation, they interpreted his silence as acceptance. They continued preparing the playground units with due caution.

c. **Accepting extracurricular roles**

Accepting extracurricular roles would further the cause for a Playground Curriculum because it showed Rodrigo that the teachers were committed to his administration. In an interview on April 12, 2011, Abby explains that if “we wanted to have a little freedom with our lessons, we had to do a lot of extra things to get on our principal’s good side.” Getting on the principal’s “good side” meant being there when the principal needed them. For instance, Rodrigo needed teachers take on lead volunteer positions to maintain the existence of several after school programs that he supported. Therefore, Abby became the science club coordinator and Karen volunteered as the drama club coach. Also, Rodrigo recognized both teachers taking on positions as the lead organizers of the GPC. By taking on extra positions in the school and working late hours, Karen and Abby strategically showed their allegiance to the new administration which would grant them some flexibility in implementing their playground lesson plans.

d. **Sneaky teachers and deceptive lesson planning**
The teachers took precautions to minimize the chance of getting caught for violations when developing the Playground Curriculum. The teachers refer to themselves as “sneaky teachers” because of the lesson plan strategies they adopted. Karen and Abby explain the lesson plans strategy in their shared report on June 15, 2011.

We decided to print and display the “regular” grade level lesson plans on our desks for the administration, but teach the units that we had created…We felt we were the “sneaky teacher” because [we] would plan with [our] grade levels, but not necessarily teach what was planned.

All lesson plans are filed for administration documentation and auditing purposes. Therefore the teachers minimized the risk of being caught with the Playground Curriculum by deceiving administration and other teachers. The teachers would submit the expected grade level pacing plans. However, in actuality, the teachers were secretly implementing different lesson plans using plans from the Playground Curriculum.

Additionally, the teachers would attend required grade level meetings where they planned and paced what they were supposed to teach from mandated curriculum. However, these grade level meetings were not beneficial for the Playground Curriculum, so Karen and Abby would attend their own meetings to collaborate and design the Playground Curriculum. Thus, deceptive lesson plans and planning attributed to the identity of sneaky teachers.

e. Using social studies for a resolution

–Karen and Abby did Social studies was the only subject with non-mandated curricula and so the teachers saw the most flexibility to implement the Playground Curriculum during this hour. In addition, social studies had the least chance of a district or school administrator conducting an observation because the subject is not on the state test for first or second grade. In our weekly meetings on March 22, 2011, the teachers speak to sacrificing the social studies block.

Abby: I had a hard time teaching this [Playground Curriculum] and the FOSS. I can’t get rid of FOSS because I am the science lead teacher…I just don’t do social studies.
Karen: They [administration] don’t care. It’s [social studies] is not on the test. It’s not a big deal.
As the lead science teacher, Abby finds it’s challenging to develop two science plans. She creates science plans according to FOSS for her grade level, and science in the Playground Curriculum. Therefore, Abby chooses to use the social studies block to integrate Playground Curriculum. The logistics to implement the playground curriculum had its limitations which consisted of sacrificing social studies content.

4. **Summary of complexities in designing a FoK curriculum**

In order to develop the Playground Curriculum, Karen and Abby had to overcome the tension between them and the administration on their different stances on what counts as (language)learning. For schools, like Genesis, with a large population of ELs that fail to meet adequate yearly progress, (AYP), district officials may enforce teachers to instruct from scripted mandated curricula that are sequentially aligned to standards and are believed to meet achievement in test scores. Figure 15 depicts
From the perspective of the administration, their expectation of (language)learning is for all grade level teachers to work with the same curriculum that was pre-chosen for them. These predetermined lessons were transferred to students through a time sensitive script for instruction, turning both the teachers and students into passive actors in the culture of schooling. When engaged in (language)learning from the administration’s perspective, Abby referred to her role relinquishing as a teacher on January 9, 2011.

“I feel like I have to strictly follow the plans, because that has been drilled into me by my principal this year who seems to believe we should teach like robots.”

The traditional (language)learning approach asks teachers to engage in mechanical practices, and operate as Abby describes as “robots.” Here, what counts as learning is *uniformity* in the name of equity. However, equal does not mean fair. The teachers viewed (language)learning by addressing the needs of their students’, which encompassed advocating for a playground and their knowledge grounded in playground funds. Furthermore, the teachers recognize that every student varies in the types of resources needed to mediate their (language)learning. Therefore, the teachers wanted to re-mediate the scripted curriculum to make it student-centered. This would mean the creation of a shared student-teacher curriculum, with a focus on the students’ need for a playground and leveraging their funds. In contrast, the administration’s rules of (language)learning provided a deficit view of students’ ability by ignoring the rich knowledge that lies in their FoK.

The difference in how students can (language)learn became the driving force for the teachers to enact change. The teachers’ agency led them to take risks in order to create a space for implementing FoK curriculum. They marketed the need for a playground and vouched for community and school members to join the Genesis Playground Committee. Working with the research team, the teachers
hosted an intervention meeting with the principal to advocate their intended curriculum. Also, the teachers volunteered in after-school programs to show they supported their principal’s programs. Finally, as ‘sneaky teachers,’ Abby and Karen turned in deceptive lesson plans that made it seem they were uniformly in compliance with other grade level teachers lesson plans.

Although the teachers’ agency gained benefits to create a space for a FoK curriculum, it also had its limitations. For instance, Abby and Karen could receive poor teacher evaluations because their (language)learning philosophy was not in compliance to the administrations perspectives. Also, to create a time for implementing the FoK curriculum required the sacrifice of the social studies hour, since this was the only content that was not under mandated pressures. Finally, the teachers built solidarity with their students, but lost solidarity with other teachers in the learning community because they deviated from their intended roles as instructors of scripted curriculum. In summary, the teachers’ agency was necessary in order to enact a space for a FoK curriculum and mediate ELs math-science funds to plan curriculum.

B.  **Becoming Curriculum Designers: Integrating FoK with Mandated Curriculum and Standards**

In the climate of high-stakes assessment and standards-reform, there is a pressing issue on how to apply standards *equitably* to ELs with varying levels of English proficiency. As the previous section demonstrated, Genesis administration, along with district policy, believed maintaining uniformed scripted curriculum would provide equal opportunities for all students, since the scripted curriculum addresses the standards. However, missing from the conversation is equity in *access* to the resources made available to ELs that ensure achieving these standards. In contrast to ELs schooling, mainstream students who represent the dominant culture have funds that align closer to the Eurocentric practices of school and tools used for math and science learning. However, given the language needs and potential for cultural conflict between their home-school practices, ELs, like mainstream students, deserve equity
in the opportunity to access their funds in the learning environment. Thus, Abby and Karen sought to develop a new curriculum that integrated students’ funds with math and science.

Abby and Karen were learning to design a new curriculum that would integrate playground activism and students’ funds with mandated curriculum and state standards. In developing the Playground Curriculum, the teachers struggled to balance these multiple curricular components. Karen elaborates on this struggle in an interview on February 1, 2011.

“Really what we are doing is we are networking. We are networking standards. We are networking what we are expected to do with our mandatory curriculum, and networking with what the kids know and their funds of knowledge are. We are trying to make our grade levels happy. I feel like it’s a huge balancing act and I think it’s especially hard.”

The teachers faced challenges to ‘network’ and ‘balance’ curriculum that extended beyond standards to include the needs of students’ funds, grade level teachers, mandated curricula, administration requirements, and their own expectations (i.e. playground activism). The overarching findings in this section reveal, the teachers navigating through these struggles in order to transform from scripted curriculum instructors to becoming *curriculum designers*.

I draw on data from the teachers’ lesson plans to explore the different units in the Playground Curriculum as the teachers work towards integrating students’ funds, playground activism, mandated curriculum, and standards. The first unit excludes incorporating mandated curriculum, the second unit dismisses playground activism, and the third unit embeds all curricular components. Collectively the progression in developing these units demonstrates the teachers learning of seeing students’ funds “mathematically” and “scientifically” to integrate with standards and the mandated curricula. Importantly, the findings show how teachers’ lesson planned towards mediating students’ *multiple funds* as they move towards becoming curriculum designers.

1. **Perceived disconnect between funds and scripted curricular topics**

   The teachers found it complex to design lessons that integrated math and science standards, playground activism, student playground funds, and mandated curriculum. I assisted the
teachers by having them examine the science mandated curriculum, FOSS, for ideas that could speak to playgrounds. In our meeting on September 23, 2010, Abby brings to attention the mandate of the curriculum to address plants.

Abby: We are talking like right now in science, I have to be doing plants. They are cutting down all the trees so I have to talk about it even though it’s not “136units.”

Abby identified a problem where, in her view, playgrounds were not relevant when trying to teach about plants objectives as outlined by FOSS. I suggested an alternative for the teachers to consider. Identify the problems and goals of the playground curriculum in isolation, and then think about how the standards and mandated curriculum can be integrated.

I redirected Karen and Abby to focus on what problem posing question they could ask for the first unit. My rationale was that if the teachers designed a curricular problem that they were answering, then math and science standards, such as plant objectives could be used as problem solving tools. I also aided the teachers with their reflection on what was the core purpose of the curriculum. In other words what would the teachers position in the center of the curriculum, plants or playgrounds. Karen responded by explaining her goals for the unit.

Karen: Researching the playgrounds. It should be the pros and cons to having or not having a playground and do you think we should have one and why.

Karen connected the students’ original question of why Genesis did not have a playground as the problem statement for the first unit. Her curriculum goals were for all students to research the playground, determine the positive and negative aspects to having a playground, and evaluate if Genesis should have a playground. I then guide the teachers for how math and science could be conveyed through the playground goals.

Ambareen: So that can be the goal, and we would want to do like some kind of survey and have a data chart with the pros and cons of the playground. We could maybe see where that view comes from like parents or administrators. What are some questions you are thinking to ask, you can make the questions mathematical like how often do you go to a playground.

Abby: So like first start off with the kids

Karen: I would do the parents, but I think it’s good to start with the kids.
I offer the design of surveys to build upon Karen’s curricular goals of learning the positive and negatives of a playground. The surveys would also serve as a tool to teach the scientific method which comprises of asking questions, collecting data, analyzing data, and reporting results. In an effort to show the teachers how mathematical standards can be incorporated, I suggest that the teachers ask mathematical questions in the surveys with their students, such as how often students go to playgrounds. In addition, I recommend taking the responses from these surveys and graphing the results in order to achieve the math standards on graphing. Karen and Abby avoid responding to math or science standards and instead redirect the conversation towards who should be included in the surveys.

Ambareen: Who are the individuals involved? Introduce who is at stake in having a playground.
Abby: They [students] can come up with these are all the people who are important and who we should interview. You know so they feel like they are picking people.
Ambareen: Who is an actor in the environment- and plants. So if you wanted science this would be important. Yeah we are not forgetting the plants.

Abby viewed the students as important agents for choosing who should be interviewed for the survey. In contrast, I expand the teachers thinking to consider other factors that would be affected by the playground, not only people, but environmental factors as well. If Abby were to explore how the environment, including plants, is affected by a new playground, then students can engage in the original FOSS mandated curriculum topic. Abby disagreed with me and did not see the connection between the plant objectives in FOSS and the playground.

Abby: I feel like I just threw everything out the window. No I hundred percent I mean it. This is hell for me! I hate it! I hate it! I hate trying to force this!

Abby erupts into anger because she feels that students’ playground funds do not belong in the FOSS curriculum. Her view of FOSS is that it is a mandated curriculum leaving her powerless to bring in supplemental ideas such as playgrounds. In addition, her limited view of science restricts her from examining playgrounds as a scientific topic on plants. Instead she sees integrating playgrounds with plants as “forcing” science into the curriculum. The teachers conclude on planning the playground curriculum without using FOSS. Rejecting FOSS was a drastic pedagogical change for the teachers
since they were deviating from their normative practices of lesson planning to the mandated curriculum. The teachers had to find alternative ways to plan for the first unit by integrating playground activism, students’ playground funds, and math and science standards.

2. **Researching playgrounds: Integrating FoK, playground activism, and standards**

Although the teachers could not find connections between students’ playground funds and the scripted curricular topics on plants, they were successful in bridging the standards. The teachers were able to draw upon standards because they were used to solve the problem on if Genesis should have a playground. In the following, I explain how the students’ shared universal fund on playgrounds is lesson planed to mediate math and science learning.

The teachers began lesson planning by problem-posing the first unit’s question, based on students’ funds. They designed a research question asking “Should we have a playground at Genesis?” The purpose of this question is for students, as community activists, to research with data and proof of need for a playground. Using the research question, the teachers found connections to related science and math standards. For instance, the teachers’ decided to use their research question to fulfill the ISBE standard 11.A.1a, *developed questions on a scientific topic*\(^\text{21}\)

The teachers also lesson planned for the students to conduct a survey to show if there is a need for a playground. In doing so, the teachers were planning to engage students in the scientific process, conducting an experiment, which is identified below in their plans.

“(Do an experiment.)…guide students to understanding that we’d probably need some data to back up our claim…Tell students that one way to get data from these people is to do a survey …they will also be doing interviews to get more information.”

The teachers’ lesson planned for students to *collect data for investigations using measuring instruments and technologies* (ISBE standard 11.A.1c) such as surveys and interviews to support their claim for or against a playground. The teachers planned for the survey to have the following questions that draw on

\(^{21}\text{Throughout this chapter references to state standards will be italicized.}\)
playground funds: should Genesis have a playground, why should or shouldn’t Genesis have a playground, what playground structures participants wanted, what’s wrong with the current play lot, and how often participants went to a playground in a given week. However, in the Playground Survey activity, the teachers planned for the students to follow up with participants and design their own interview questions based on student knowledge of playgrounds. Therefore, in addition to the scientific method, the teachers were able to plan for a mediation using playground funds for the ISBE math standard 10.B.1a on *formulating questions of interests and design surveys or experiments to gather data.*

Additional math and science standards were also targeted by using data from the surveys, grounded in playground funds. The teachers drew connections to the ISBE math standard of 10.A.1a to *collect, organize, and display data using pictures, tallies, tables, charts, or bar graphs,* and the ISBE science standard of 11.A.1d *recording and storing data using available technology and standard 11.A.1e arranging data into logical patterns.* The Survey Data Chart in appendix D.1, was used by students to organize data from the Playground Surveys. The students used separate Survey Data Charts to distinguish the results by each grade-level students, Genesis staff members, or parent participants. The teachers included the survey responses of yes or no for the question if Genesis should have a playground. The teachers also inserted tables for the last question of how many times participants attend a playground with survey responses 0-1, 2-3, or more than four. For the second research question of what playground structures participants wanted, the students were able to have the opportunity to write and organize the survey responses.

Next, the teachers planned for student to *analyze data, drew conclusions, and communicated the results* (ISBE math standard 10.B.1c) to the survey. The students would analyze these results by counting and recording the total number of tally responses. They planned for students to graph each survey result to display the conclusions of how many participants wanted a playground, which structures, and how often they attended a playground. The students then selected one quote from the
survey response that demonstrated either a reason why Genesis should or should not have a playground or what was wrong with the current play lot. Also, a drawing of their observation of the current play lot was included. They displayed these findings into a poster to share their conclusions as can be seen in appendix D.2. Additionally, the teachers’ lesson planned for students to share their findings, and saw the standard compare observations from individual and group results (ISBE science standard 11.A.1f) as a requirement they could meet.

In summary, the first unit demonstrated how Abby and Karen were able to develop lessons that align math and science standards with students’ knowledge on playgrounds using the scientific method and mathematical data analysis. In addition, the topic of playground funds is lesson planned to mediate these standards. The teachers also achieve the curricular component of ‘playground activism’ because the teachers planned for students to collect data, show claims, evidences, and produce findings in support for a new playground at Genesis.

3. **Engineering slides: Leveraging scripted curricula**

This section describes the teachers’ awareness to mediate students’ funds with scripted curricular topics that may appear to not be related to playgrounds in their lesson plans. In addition, it reveals how the teachers mediated multiple funds, instead of a universal playground fund, in the lesson plans.

The teachers learned to connect scripted curricular topics to students’ funds. As the schools’ unannounced observations intensified, the teachers could no longer wait out the risk of avoiding the scripted curriculum. In planning the second unit, the teachers leveraged FOSS too much, and as a result, sacrificed the playground activism initiative. Karen describes this shift when she planned for the second unit.

> “In the beginning I was about it [playground activism] but second unit isn’t as concerned about social justice more on physical science…now it’s just the rigor of the daily stuff.”
The teachers were not aware that the science mandated curriculum could also be a form of playground activism because the science mandated curriculum does not address activism. Instead, the teachers and I collaborate to expand on the science mandated curriculum through the lens of students’ playground funds because the teachers saw a connection to playgrounds and the mandated curriculum topic on “Balance and Motion.”

The connection to playground funds and the scripted curricular topic emerged when Abby and Karen rummaged through the FOSS kits in search for a second unit topic. According to FOSS, the unit’s objective was to explore stable (balanced) and unstable systems, use counterweighing to manipulate center of gravity, and investigate two classes of motion—spinning and rolling (FOSS, 2012). The kits in the FOSS activities included a u-shape Styrofoam tube that Karen thought looked like slides. Karen elaborates further on March 22, 2011, the emergence of students’ slide funds connecting to FOSS mandates. “we began to brainstorm what we were already studying in science to see if connections could be made. we had…a…mini-unit on “rolling” with the FOSS curriculum. We had investigated objects that roll as well as how the slope of a ramp can affect the rolling motion of an object. We quickly realized that this science content connected well with slides, which would merge our school-mandated science topic with our previous unit.”

The connection to FOSS emerged because Karen and Abby adopted viewing the curriculum as their students would make sense of their environments. The teachers saw the potential of meaning making from the student perspective as playground players, particularly the interactions students have with slides.

The teachers also indicated changes they wanted to make based on their reflections from the first unit. For instance, the teachers wrote together on December 28, 2010 that they felt in the first unit the students engaged in math calculations and science inquiry, but only “some science content [so] in our next unit…we would like to integrate more science content.” Because the teachers were aware that the first unit did not contain significant science content, I decided to ask Abby and Karen to make a list of
what science topics they would be covering for FOSS in order for us to be mindful to integrate science content further. The teachers came up with a list of four major physics concepts derived from FOSS: balance, motion, gravity, and force. Using the FOSS science concepts, we planned curriculum accordingly to see where the FOSS objectives, science math standards, and students’ slides funds intersected. We planned curriculum taking into account these multiple layers and began brainstorming how the pieces fit together.

I facilitated the planning by having Abby and Karen learn more about students’ science and math funds around the physics concepts they identified. Recalling from the previous chapter, the teachers and I created the Student Content Funds Survey. The survey was an opportunity for the teachers to learn about balance and motion through asking questions about students experiences with falling (i.e. gravity, balance, and impact), speed (i.e. motion), and building (i.e. engineering and balance). The findings of the survey revealed students’ funds: building, slides, stairs, and Lego. The teachers used the identified funds from the Student Content Survey to then strategically plan aligning these funds to the math and science standards and FOSS objectives. Therefore, the teachers integrated balance and motion with playgrounds by problem-posing the second unit’s question, *how can we engineer model slides that are fun and safe?*

**a. Mediating building funds, FOSS, and standards**

The teachers used students’ building funds that they learned from the survey response to create Content Funds Questions (CFQ). The CFQs are questions where the teacher inserts a prior identified student fund into a mathematic or scientific question to mediate (language)learning. The teachers’ wanted to expand further on students’ building funds by asking in the lesson plans: *Pretend that you are the engineers for our playground slide. If you were designing a slide for our playground, what would you need to do to create the slide?* Although this question was introduced in the first day lesson, it actually foregrounds a continuous question for the rest of the unit. Students were to be mindful
of this question because the science experiments they do and the new concepts they learn are to be used towards the final assessment of designing and engineering their own model slides that are fun and safe. The planned question builds on students’ funds on their knowledge of building and experiences on slides to teach the science concepts, principles, and processes of technological design (ISBE standard 11.B). The teachers additionally planned to ask Experience Funds Questions (EFQ) in their day one lesson plan shown below.

Revisit playground structures that students’ brainstormed from the Playground unit... Ask students about their experiences with slides- what slides do you like? Different kinds? Ever gotten hurt on a slide?

The teachers planned to draw on students to share their funds on experiences they had being hurt on a slide so that students could be mindful of identifying current problems with slides. The teachers were integrating the ISBE standard 11.B.1a by making students aware of a technological design problem (i.e. based on student experiences with slides what are problems with slides) and to formulate possible solutions (i.e. how can students design and build model slides that would solve the design problem with current slide structures). In addition to fulfilling the science state standards, the teachers planned to include the FOSS objective on how the design of an object (i.e. slides) affects its’ (i.e. marble) ability to rotate. The way students would build and re-build slides through trial and error would assist students in understanding the FOSS objectives on how slide designs affect the motions of a rolling spherical object.

b. Mediating slide funds, FOSS, and standards

The teachers used students’ knowledge of slides, to plan their own science experiments that were beyond the FOSS experiments outlined. For instance, data from the Student Content Funds survey revealed that slides were the largest item response where many students explained falling from. Teachers used slide funds to teach the concept of gravity by generating a CFQ: When we get on a slide, why do we go down? This question introduces and merges the science concept of gravity, as the force that pulls objects down, with students’ funds on slides.
Students thought about gravity by doing an experience where they would drop two objects such as a plastic egg and a paper airplane, to compare examples of gravitational pull on earth (ISBE performance descriptor standard 12.D1b). Next, students would make predictions which object would fall to the ground first and make comparisons to how when they are on a slide why they go down, just like the objects. This experiment allowed teachers to embed in their lesson planning students’ experiences on slides with FOSS objective of acquiring the vocabulary associated with balance and motion (i.e. gravity) as well as the ISBE standard on gravitational pull.

c. Mediating stair funds, FOSS, and standards

Another response from the Content Funds Survey revealed the largest item response where students fell from the highest location were stairs. Therefore, the teachers created a CFQ examining the relationship between heights affecting the speed at which gravity pulls to the earth. The teachers asked the following question using students’ stair funds: Why is it okay for us to jump from the bottom stair to the ground, but not from the roof of our house? Thus, the teachers planned to teach the concept of impact through heights that the students were familiar with, like stairs.

The teachers created the Egg Drop Experiment where students would drop hard boiled eggs from three different heights: six inches, twenty-four inches, and sixty inches. The teachers planned for students to fulfill the ISBE learning standard of 12.D1b, as the performance descriptor suggests that students should describe how gravity affects motion and demonstrate the rate, time, and distance factors. The student work, in appendix D.3 from Abby’s classroom shows that the students would measure the heights, draw observations of what happened to the egg, and write a conclusion on how height affects the impact of a fall. Students would use what they learned from the experiment to consider how high their slides will be and think about safety since a higher height will result in a dangerous impact for a fall. After completing the experiment, students would revisit the CFQ to think about their

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22 See appendix D.3
own experiences with stairs and different slide heights to describe relationships between role of height, impact, and gravity.

d. **Mediating Lego funds, FOSS, and standards**

The teachers learned from the survey that a majority of students built items for play using Lego. The teachers mediated the technological design by having students use Lego, which were objects that the students were already familiar with, to explore new concepts in building slides through knowledge of balance and motion. The teachers planned FOSS objectives of exploring and describing variables that influence the motion of objects (i.e. slope). For instance, they asked the following CFQ: *How can we engineer a slide to make it go faster? How will the slope of a slide change how fast we’ll go down?* Teachers draw on students’ funds of slides to have students reflect on what independent variables students experienced with slides that caused certain slides to go faster than others.

The teachers designed the Marble Experiment where students are to build a slide at three different heights: six inches, twelve inches, and sixty inches. Students make predictions which height will result in the shortest time for the marble to roll down. In appendix D.4, the students conducted their experiment twice to show reliability in the data, thereby completing the standard of 13.A.1b *explain why similar results are expected when procedures are done the same way.* Students would compare data results and propose reasons for differences in observations. In addition students would partake in math standards of 1.MD.3 by *being able to tell time* using common scientific instruments (i.e. digital stop watch). The tables from the experiment also demonstrate students being able to *organize, represent, and interpret data with up to three categories* (1.MD.4). The teachers planned for students to realize that the greater the slope creates a greater speed. Therefore, as students design their model slides using Lego, they need to be aware of how high their slope is to ensure safety in the speed of the person going down the slide.

4. **Emergence of the Organism Unit**
For the third unit, Abby and Karen also mediated students’ multiple funds in their lesson plans. The teachers were able to successfully lesson plan all curricular components of students’ math-science funds, playground activism, FOSS, and standards for the third unit. The teachers revisited the initial purpose of the playground curriculum which was to advocate for a new playground at Genesis. To do so, meant to return to the scripted curriculum for selecting a unit three topic.

Seeing the potential for integrating FoK and mandated curriculum, motivated Abby to include her science mandates for the third unit planning. Coincidently, Abby’s final science mandated curriculum, Science and Technology Concepts Program (STC) and Karen’s FOSS curriculum, shared the same unit topic of living creatures. STC addressed organisms, specifically observing plants (i.e. freshwater and woodland plants), woodland animals (i.e. squirrel), and bugs (i.e. snails and millipedes) to understand the interdependence between organisms and their environments. FOSS introduced insects (i.e. worms, ants) to study the diversity of forms in insects and observe and compare the differences in the life cycles and behaviors of insects (FOSS website).

Although the teachers were able to find a unifying factor, organisms, to merge their mandated curriculums together, the teachers still faced the complexity in tying organisms with the topic of playgrounds. On June 27, 2011, Abby and Karen write in their report how they planned for the third unit to blend playgrounds with organisms. Abby Karen elaborates in her June 27, 2011 report how she was able to make a connection between playgrounds and organisms.

The students had become invested in our playground initiative, so we knew we wanted to stick with that theme and wrap it up somehow. At the same time, our FOSS (i.e. STC) science curriculum demanded attention to organisms. To tie in organisms, we decided to focus on how a playground at Genesis would affect the environment. This became our guiding question.

Karen, like Abby, places the playground initiative at the forefront of her planning. She knew that they would “stick with that theme and wrap it up somehow.” She reads further into the objectives of STC and FOSS and notices that FOSS primarily looks at insects lifecycle and behaviors, whereas the STC curriculum focuses more on organisms relationships with their environments. The teachers problem-
pose a question that integrates learning goals of STC and students’ funds to pose *how a playground at Genesis would affect the environment*. The teachers defined environment as the surroundings of an organism, thereby having students hypothesize the causes and effects of a playground on a particular organism they studied.

The teachers contemplated how their own needs of integrating playground activism could be incorporated in the third unit since it was missing in the second unit. I asked the teachers what the goal is in the final activity, and if it’s activism, what does an activist do? I wanted the I begin by questioning teachers to think about the goal in the unit as an activity system within the CHAT framework. If the goal is for the teachers to plan towards students becoming playground activists, then what practices or tools would students need in order to complete the goal? Karen responds to my question with the following:

Karen: Social activism and writing a letter. What if we did something where the content as far as science as organism and learning what kind of things could possibly come like pros and cons. In order to do the writing you have to have facts and that’s where content comes in and they can walk away feeling they made a change or make their voice heard. We should do a culminating activity where we can write to the alderman and say hey we need help.

Karen extends on the actions of a community activist to do practices that “make their voice heard” and that can potentially “make a change.” One action item she suggests is writing a letter to the alderman to ask for financial help in building a playground. Karen draws connections to the science content by having students write a persuasive letter about the pros and addressing the cons to having a playground in the environment. Karen is able to build on her and Abby’s desire to address playground activism in a context that takes action towards a playground and concentrates on the science content.

5. **Mediating funds in the Organism Unit**

The teachers sought to mediate students’ funds in their lesson plans for the third unit. In contrast, to the second unit, the teachers did not pre-select students’ funds to mediate. Instead, the teachers’ lesson planned with the intent to allow students’ funds to emerge in student talk. In doing so,
the teachers could expand on student talk as students made connections to the content, or when the teachers saw potential in students’ funds with the content.

The teachers began their lesson plans with the overarching theme on playground funds, to ask how building a playground will affect the environment. Playground funds were mediated with the concept of environment, because students engaged in scientific inquiry by conducting observations of the current play space environment (ISBE 11.A.1a). Students drew, recorded, and collected what items they saw on the play lot. In appendix D.5, the student work example from Karen’s classroom, reveals an EL finding rocks, a garden, flowers, bumps, trash, leaves, and dead flowers in the play lot. After recording and storing data (ISBE science standard 11.A.1d), the students arranged the data into logical patterns (ISBE science 11.A.1e) by classifying organisms versus non-organism categories. Then, in appendix D.6, the student displayed the results on a chart to organize, represent, interpret data (Common Core math standard 1.MD.4). The teachers used the above chart to address Abby’s mandated objective of identifying characteristics of organisms. By drawing on playground experiences, the students were able to identify which organisms exist in a playground and features that make something an organism.

Because the teachers’ lesson planned through larger playground fund, students could share their playground experiences and demonstrate additional funds with non-playground funds, like organisms. Also, by the third unit, the teachers could recognize students’ funds in scripted mandated topics, so the teachers opted to create questions where they could connect students’ funds to science and math topics. For instance, the teachers’ lesson planned to ask “how can we keep plants alive on the playground?” The teachers’ intent is to mediate any experiences or funds students have with plants by activating the familiar playground environment. The teachers’ lesson plan to fulfill ISBE science standards 12.A.1a identify and describe the component parts of living things and standard 12.B.1b describe how living things depend on one another for survival. They broke down their lessons further to first address Abby’s
curriculum on the needs of a plant, and later Karen’s mandated objective on the life cycle and characteristic structures of mealworms. To teach the needs of organisms, the teachers explored external text materials and decided to engage in scientific read-alouds. The first book *It’s Alive* explained the needs of a plant. In the second book *Garden Wigglers*, Karen requested Lorena to read the book using students’ linguistic funds, Spanish, to make the reading comprehensible for ELs, and also re-read the book in English to explain the needs of a worm. [appendix insert student work on plants and worms examples]

The teachers also lesson planned for students to integrate their experiences, or funds, with organisms. For instance, both classrooms had their students work in groups and research an organism to learn the organisms’ needs, what habitat it lives in, and how it can affect the environment. However, the teachers chose each organism based on what organisms they knew could potentially exist in a playground and was in their mandated curriculum. The teachers selected butterflies, ants, worms, birds, and plants, but were open to organisms that students’ bring up or have brought up in the past like poison ivy. Unlike the second unit, they recognized that students’ may have potential funds with these organisms in playgrounds and write about building awareness for when these funds emerge. In their lesson plans, the teachers acknowledge that students may have,

> “Informal observations when students play outside at home or on playgrounds, parks, etc.; Positive and negative experiences with different organisms (getting stung by a bee, poison ivy)”

Planning for organisms that intersected with playgrounds, mediated the opportunity for students to speak to their potential experiences with these organisms while learning the standards. As the students would share their research with the class, the students would compare living things in relation to the environment (ISBE 12.B.1a). The teachers planned for students to identify what the cause and effects would be of that organism if it were to reside in the playground.

In creating the final assessment, the teachers planned to draw upon students’ playground funds, non-playground funds, and prior knowledge on organisms, to write a letter to the alderman asking
sponsorship for a playground at their school. The students, as community activists, used their observations and data collected from the year to write a persuasive response for why Genesis deserved a playground. The teachers’ lesson planned, in appendix d.7, to activate and mediate students’ funds in the letter by addressing the following starter sentences. The first starter sentence, we would like a playground because, asks students to connect their playground funds from the Playground Survey to address the need for a playground. The second starter sentence, we should have a playground because we know how to keep it safe, mediates students slide funds and results from the slide experiment to argue for the importance of playground safety. The third starter sentence, we should have a playground because we know how to keep good organisms in and bad organisms out, mediates students experiences with organisms and the research done in the third unit to advocate what a playground environment should look like.

The teachers also lesson planned for the letter to fulfill math and science standards. In math, the students were able to make meaning of a problem (i.e. not having a playground) and look for entry points to it solution quantitatively (i.e. survey data, slide data). Teachers expanded on the first unit for unit three to have students justify and provide quantitative reasoning for what the surveys meant. In other words, students were not just creating graphs, but making meaning of the quantities in the graph to prove that there is a demand for a playground. In writing the letter, students had to construct arguments for why they deserve a playground which fulfills a Common Core mathematical practice of the logical progression of statements to explore the truth of their conjectures. Although in unit two the students conducted slide experiments, in unit three, students had to examine claims and formulate quantitative explanations for what makes a safe slide. As students referred to wanting safe slides, they transitioned to make convincing arguments of needing a safe community too.

6. **Summary section of becoming curriculum designers**

This section provides a summary on the teachers’ development towards becoming
curriculum designers. First, an overview on how the Playground Curriculum can be conceptualized as a third space is provided because it marks the tension the teachers faced in creating a FoK curriculum that fulfills their curricular objectives. Second, a synthesis on how the teachers developed to integrate FoK with standards and mandated curricula is reviewed. Third, this section summarizes and gives implications to the teachers’ mediation of students’ multiple funds in their lesson plans.

a. **Playground curriculum as a third space**

In this section the teachers learned how to integrate multiple curricular components on students’ funds, playground activism, standards, and mandated curriculum. The struggle to balance these curricular components emerged because of the teachers learning how to make sense of students’ funds in relation to math and science. Often, the teachers faced difficulty to recognize “funds” in mandated curricula and standards, or vice-versa. From the perspective of activity theory, “third space” can be considered as an expanded activity in which the object of activity is extended and activity is reorganized resulting in new opportunities for learning (Guiterrez, Baquedano-Lopez, Tejeda, 1999). For the teachers, figure 16 reveals how the development of the Playground Curriculum can be thought of as a “third space” curriculum.

The “first space” curriculum consists of the mandated curriculum and its alignment to standards. The “second space” curriculum is the teachers’ focus on students’ funds and playground activism. Initially, the teachers saw conflict between mandated curriculum and standards not addressing students’ funds. The tension between the two curriculum goals resulted in the teachers’ designing a new curriculum, Playground Curriculum, in order to recognize students’ funds “mathematically” and “scientifically.” Drawing on third space theory is important because it shows the teachers expanded their concepts of math and science from a perceived culturally-objective scripted mandated perspective, to view math and science from a language and cultural perspective of ELs, which contributes to the expansion of mediating students’ funds for math and science (language)learning.
As a side note, school-based standards on math and science may appear to be “culturally – objective,” but *doing* math and science is a cultural practice. The point here is that the scripted curricular privileged a culture of school-based math and science practices, and the teachers’ tension furthered when they wanted to integrate ELs out-of-school math and science practices that differed from the official ways of doing and knowing math and science found in playgrounds.

**Figure 16. THIRD SPACE CURRICULUM**

b. Integrating funds
The findings further show how the teachers had to learn how to see students’ funds “mathematically” and “scientifically” in order to integrate students’ funds in the lesson plan. The diagram below, summarizes the teachers’ evolving shift in the units to make sense of integrating funds, playground activism, mandated curricula, and standards collectively.

**Figure 17. TEACHERS’ DEVELOPMENT ON INTEGRATING AND MEDIATING FUNDS IN THE LESSON PLANS**

During the IPP, the teachers recognized that playground funds were important but were unsure how to use it for math and science. In the first unit, the teachers could connect the topic of a playground, as a math-science fund, because standards were used to solve the problem on if Genesis should have a playground. The teachers could not relate math-science funds to mandated curricula because it did not
acknowledge playgrounds as a math or science topic. For the second unit, the researcher’s intervention to design a Student Content Survey informed the teachers to see math-science funds in mandated curricula topics. The teachers preselected funds from the survey’s results to mediate the use of playgrounds, slides, stairs, and Lego funds in their lesson plans. However, the teachers were unable to capitalize these funds for playground activism because they leveraged too much of the scripted curricula mandates. Recognizing the need to balance all curricular components, the teachers learned to incorporate all facets of the curricular components in the third unit.

c. **Mediating multiple funds**

The findings demonstrate the teachers’ shift towards mediating *multiple funds* in their lesson plans. ELs enter classrooms with funds that may be common to other students, like playgrounds, or as the teachers found in the Content Survey, have funds that are unique to their way of making meaning. Nonetheless, students need to be able to tap into their different sources of funds to learn content. The teachers are capable of planning activities that can restrict or expand the ways students can make sense of the (language)learning. Table 6 displays the types of funds the teachers’ outlined in their lesson plans to mediate the science and math standards. In the first unit, the teachers used a universal fund, the topic of playgrounds, to teach through the standards. Although the mediation of playground funds is beneficial, it may restrict students to use one source of fund in comparison to using many of the other infinite sources of funds acquired by students.

In contrast, for the Slide Unit the teachers surveyed the students and preselected which funds they would teach through to use multiple funds (i.e. slides, building, stairs, Lego) to teach math and science. The significance of multiple funds allows for multiple sources for students to make sense of standards. Within the context of a universal fund on slides, students could access multiple funds to make sense of balance and motion. For example, the science concept of balance could be learned by students using their slide, playground, building, and/or Lego funds.
<table>
<thead>
<tr>
<th>Unit</th>
<th>Problem-posed</th>
<th>Mediated FoK</th>
<th>Science Standards</th>
<th>Math Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit One</td>
<td><em>Should Genesis have a playground?</em></td>
<td>Playground Funds</td>
<td>Science Inquiry (11A)</td>
<td>Number Sense (6C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Science, Technology, &amp; Society (13A)</td>
<td>Statistics (10B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slide Funds</td>
<td>Science Inquiry (11A)</td>
<td>Number Sense (6C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Technological Design (11B)</td>
<td>Statistics (1.MD.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Physical Science (12D)</td>
<td>Algebra (7B, 8A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- balance, motion, gravity, force, impact, slope, variables, speed</td>
<td>-slope, variables</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Science, Technology, &amp; Society (13A, 13B)</td>
<td>Measurement (2.MD.9)</td>
</tr>
<tr>
<td>Unit Two</td>
<td><em>How can we engineer a safe and fun slide?</em></td>
<td>Building Funds</td>
<td>Technological Design (11B)</td>
<td>Number Sense (6C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Physical Science (12D)</td>
<td>Algebra (7B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- balance, motion, slope</td>
<td>-slope</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Science, Technology, &amp; Society (13A, 13B)</td>
<td>Measurement (2.MD.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stair Funds</td>
<td>Science Inquiry (11A)</td>
<td>Number Sense (6C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Physical Science (12D)</td>
<td>Algebra (7B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- gravity, force, impact</td>
<td>-slope</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lego Funds</td>
<td>Technological Design (11B)</td>
<td>Algebra (7B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Physical Science (12D)</td>
<td>-slope</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- balance, motion, slope</td>
<td></td>
</tr>
<tr>
<td>Unit Three</td>
<td><em>How will building a playground affect the environment?</em></td>
<td>Playground Funds &amp; Organism Funds</td>
<td>Scientific Inquiry (11A)</td>
<td>Number Sense (1.OA.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Life Science (12A, 12B)</td>
<td>Statistics (1.MD.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- environment, organism, survival, growth, plants, insects, habitat, cause and effect</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Science, Technology, &amp; Society (13A, 13B)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spanish Funds</td>
<td>Life Science (12A, 12B)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- environment, organism, survival, growth, insects, habitat,</td>
<td></td>
</tr>
</tbody>
</table>
The use of multiple funds expands meaning across a diverse group of students who can access standards in their familiar contexts.

Although the second and third unit both mediated multiple funds in lesson plans, the difference lay in that the third unit lesson plans had greater flexibility for students to draw upon their own funds. The teachers decided to create a flexible lesson plan where they “mental planned” for students to deviate from the teachers’ selected funds to make their own connections as it emerged in class talk. As a starting point, the teachers were aware to include multiple funds on playground, organism, and for Karen’s class, Spanish funds. These funds provided a variety of resources that students could draw on for learning life science skills.

Significant to the second and third units planning, is that students are learning to and through their multiple funds. The activities represent a multi-layer approach to funds for (language)learning. As students explore their larger playground funds, they can use further assistance of additional funds that are specific to them to make sense. Therefore, teachers must build activities that allow for students to capitalize on their multiple funds, so that students can comprehend the subject matter that is relevant to their multiple ways of meaning making.

C. The Role of Standards and Mediation in a FoK Curriculum

I explore further how the teachers mediated ELs’ math-science funds in their lesson plans by examining the role of standards between the FoK curriculum and the scripted curricular, FOSS and STC. First, I explain global findings on how the Playground Curriculum exceeded the number of standards compared to the scripted curricula and its’ potential to mediate beyond grade-level standards. Then, I draw on CHAT to explore the role of mediation using funds and standards in the teachers’ lesson plans.

a. Global findings: Mediating beyond grade-level standards

In Table 8, I used the teachers’ lesson plans to show where they identified science and math standards compared to where the researcher identified these standards. The researcher did not include
## Table 7. STANDARDS IN PLAYGROUND VERSUS SCRIPTED CURRICULA

<table>
<thead>
<tr>
<th>Standards</th>
<th>Unit One</th>
<th>Unit Two</th>
<th>Unit Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.A.1a Describe an observed event</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11.A.1b Develop questions on scientific topics</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11.A.1c Collect data for investigations using measuring instruments and technologies</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11.A.1d Record and store data using available technologies</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11.A.1e Arrange data into logical patterns and describe patterns</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11.A.1f Compare observations of individual and group results</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11.B.1a Given a simple design problem, formulate possible solutions</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11.B.1b Design a device that will be useful in solving the problem</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.B.1c Build the device using the materials and tools provided</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.B.1d Test the device and record results using given instruments, techniques, and measurement methods</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.B.1e Report the design of the device, the test process and the results in solving a given problem</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.A.1a Identify and describe the parts of living things</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>12.A.1b Categorize living organisms using a variety of observable features</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>12.B.1a Describe and compare characteristics of living things in relationship to their environment</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>12.B.1b Describe how living things depend on one another for survival</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>12.D.1a Identify examples of motion</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>12.D.1b Identify observable forces in nature</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>13.A.1a Use basic safety practices</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>13.A.1b Explain why similar results are expected when procedures are done the same way</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>13.A.1c Explain how knowledge can be gained by careful observations</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>13.B1a Explain the uses of common scientific instruments</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>13.B.1b Explain how using measuring tools improves the accuracy of estimates</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>13.B.1d Identify and describe ways that science and technology affects people’s everyday lives</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

T= Teacher  
R= Researcher  
C= Scripted Curricula
Table 7. STANDARDS IN PLAYGROUND VERSUS SCRIPTED CURRICULA (continued)

<table>
<thead>
<tr>
<th>Standards</th>
<th>Unit One</th>
<th></th>
<th></th>
<th>Unit Two</th>
<th></th>
<th></th>
<th>Unit Three</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics: ISBE Math Standards</td>
<td>T</td>
<td>R</td>
<td>C</td>
<td>T</td>
<td>R</td>
<td>C</td>
<td>T</td>
<td>R</td>
<td>C</td>
</tr>
<tr>
<td>6.C.1a Select and perform computational procedures to solve problems with whole numbers</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>6.C.1b Show evidence that whole number computational results are correct and/or estimates are reasonable</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>6.D.1 Compare the numbers of objects in groups</td>
<td>X</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>7.B.4 Estimate and measure the magnitude and directions of physical quantities (i.e. slope, force)</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td>8A. Describe numerical relationships using variables and patterns</td>
<td>X</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.A.1a Organize and display data using pictures, tallies, tables, charts, or bar graphs</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.A.1b Answer questions and make predictions based on given data</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.B.1a Formulate questions of interest and design surveys or experiments to gather data</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.B.1b Collect, organize, and describe using pictures, tallies, tables, charts, or bar graphs</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>10.B.1c Analyze data, draw conclusions and communicate the result</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Core Math Standards</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1.MD.3 Tell and write time in hours and half-hours using analog and digital clocks</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.MD.4 Organize and represent data with up to three categories</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.MD.1 Measure and estimate lengths in standard units.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.MD.7 Tell and write time from analog and digital clocks to the nearest five minutes</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.MD.9 Generate measurement data by measuring lengths of several objects to the nearest whole unit</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.MD.10 Draw a picture graph and a bar graph to represent a data set up with up to four categories</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.OA.1 Represent and solve problems involving addition and subtraction</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.OA.5 Add and subtract within twenty</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

T= Teacher  R= Researcher  C= Scripted Curricula
standards that were lesson planned for but not executed in class because those standards were not mediated. In addition, standards written in the scripted curricular lesson plans are also listed. Also, the differences between the researcher’s and the teachers’ standards exist because either the teachers overlooked the standard in their plans or there was a conceptual difference in what counted as math and science between participants. In addition, the teachers’ science standards did not outweigh math standards by chance. I found that teachers identified math standards through the science objectives. For instance, in the second unit, the teachers indicated math standards on time and measurement as it related to various science experiments on slides. Hence, the teachers viewed math as it was embedded in completing a science activity. Furthermore, a limitation in the scripted curricula is that it is not integrated with other content areas, so the standards are reduced to science standards.

The global findings on standards show that the teachers’ Playground Curriculum lesson plans addressed more state standards than the scripted curricula. The teachers and I created the Playground Curriculum centered on problem-posing and problem-solving which required the students to tap into standards that were exceeding their grade-level standards. For instance, the scripted curricula adheres to standards within grade-level state standards and therefore does not fulfill all of 11A scientific inquiry standards. According to ISBE standards primary first and second graders, follow a grade-level standard that should not practice, but rather “distinguish among the following: observing, drawing a conclusion based on observations, forming a hypothesis, conducting an experiment, organizing data, constructing and reading charts and graphs, and comparing data” (Illinois Science Assessment Framework performance descriptors, pg. 8). Another example is found in the science experiments in the scripted curricula that pre-provide a scientific question and data for students to analyze, whereas the playground curriculum asked students to develop their own observations, create their own research question, and collect their own data for analysis. This is why across all the units Table 8 shows 11A standards completed but not for FOSS and STC. Similarly for math, the common core standards also follow a
grade-level model and so algebraic standards of slopes and variables are not found for first and second
grade, even though the teachers are able to introduce the terms, by drawing connections to their
students’ funds since the standard was necessary to solve the slide problem. The Playground Curriculum
demonstrates higher order math and science skills that went beyond first and second grade level
standards, indicating its robust opportunity for ELs’ (language)learning.

2. **Mediation of FoK and standards in CHAT planning**

Both the Playground Curriculum and the scripted curricular align themselves to
standards, but these curriculum differ in the way they use standards. Drawing on a CHAT framework,
can explain how standards are used in a (language)learning activity and implications for how the
teachers planned for ELs math and science mediation.

![Figure 18. SCRIPTED CURRICULA ACTIVITY TRIANGLE](image-url)

**Figure 18. SCRIPTED CURRICULA ACTIVITY TRIANGLE**
In planning each unit, the teachers would create an activity triangle, based on activity theory, to show the interactions of students’ funds and standards in the unit’s activity. The researcher synthesized the teachers’ activity triangles, to compare the nature of their planned activity to scripted curricular activities in order to show how FoK and standards are used. In figure 18, the activity triangle shows how scripted curricular is implemented traditionally in Genesis.

In particular, students’ funds are missing from the learning activity, as the activity shows to be culturally-objective. The tools students can draw on are culturally removed and consist of textbooks and the experiment kits to mediate learning towards the object, which are the scripted curricula’s science objectives. Importantly, standards are designed to be the outcome of learning. Standards are met through rules of a paced scope and sequence, which mean that in a certain month a specific standard should be achieved.

**Figure 19. PLAYGROUND CURRICULUM ACTIVITY TRIANGLE**

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23 See appendix D.8
In contrast, the teachers planned for standards “thematically,” in relation to students’ funds, instead of a pacing timeline as seen in figure 19. At the center of the Playground Curriculum activity, is a problem-grounded in students’ funds, to solve. For instance, each unit integrated students’ funds on playgrounds to “problem- pose” the activity’s playgrounds with a science concept, such as the environment, engineering, or research skills. By lesson planning to problem- posing students’ funds with science topics, the teachers could integrate the use of students cultural tools for mediating (language)learning. In other words, students’ funds had a purpose for the activity. In the Playground Curriculum, students’ funds served as the mediational tool to move towards the object, standards. In scripted curricula, students are learning the standard (outcome), as opposed to the Playground Curriculum where students are using the standards for learning (object). The teachers’ planned in their activity triangle, for standards, along with funds, to be a tool for the learning goal of becoming community activists, engineers, environmentalists, and researchers. In doing so, the standards became an instrument for understanding the activity, rather than the outcome.

3. **Summary of role of standards and mediation in a FoK curriculum**

In summary, although both the Playground Curriculum and scripted curricula address standards, they both use standards differently in the learning activity. The scripted curricula teaches in a scheduled pace, where it maintained within grade-level standards. In contrast, the teachers ventured outside grade-level standards because such standards (i.e. algebraic reasoning) were required to complete the problem of the activity. In doing so, the teachers created higher order and rigorous (language)learning that was accessible for ELs using their funds. Also, the teachers planned to leverage students’ cultural and linguistic strengths, or multiple funds, as cultural tools towards mediating the object, standards. The standards became necessary to know in order to solve playground problems, relevant to students’ lives. The implications suggest that ELs FoK can be legitimate tools for math and science (language)learning. Furthermore, teachers need to be aware of how they are using standards to
create authentic, relevant, and familiar learning contexts for ELs from which they can draw their own cultural frame of references.

D. **Language of Power: Mediating to Communicate Mathematically and Scientifically in a FoK Discourse**

Reformed math and science policy indicates that all students should be able to communicate mathematically and scientifically. Specific to ELs are WIDA standards that also indicate English proficiency standards. In WIDA, math and science communication is defined by WIDA standards for communicating mathematically and scientifically within the domains of listening, speaking, reading, and writing (WIDA, 2007). To fulfill these objectives, the teachers sought out ways to mediate funds in their lesson plans for their ELs to communicatively participate. This section shows the teachers development to plan multiple activities using funds for ELs to communicate math and science through listening, speaking, reading, and writing. Findings show how the teachers’ planned for a language of power in the class that privileged a FoK Discourse, where students could communicate to and through their funds, thereby, making math and science communication accessible.

1. **Teacher awareness of limited reading and oral communication**

   In the first unit, the teachers’ lesson planned using the official district lesson plans. In the district lesson plans, the teachers are to check and list the WIDA standards they would be addressing. I teachers identify all standards, except building reading skills (see appendix X). At the end of the unit, I pointed out the lack of reading opportunities to the teachers in a meeting on September 23, 2010, and asked them to explain how they think they introduced the WIDA standards for the first unit.

Karen: I feel like a lot of science is the data collection. Reading because they are reading their data, we want them to read it.

Abby: Interviewing classes could be the speaking, and asking what is really good about this and kind of brainstorm and do reflections.

Karen: I really like the multimodal thing where they have to write. It’s in the writing center too, for writing for different media.
Even though the teachers didn’t check completing reading, Karen re-evaluates her stance. She captures scientific reading through numerical sense making as students would read the data collection in charts and graphs. Abby explains meeting the speaking standards because students would use their funds on playgrounds to ask interview questions and have conversations with participants on their survey. Karen follows up with the interviews responses to connect writing in the genre of interviews, as meeting the writing for different media standard. Listening was not explicitly spoken about, but in my inference I draw that teacher instruction was the space for students to listen.

I follow up with the teachers on thinking and planning for communicating scientifically and mathematically at the end of the first unit on September 27, 2010. Although the teachers felt they targeted each language domain, I wanted to challenge them and push the boundaries further on how scientific and mathematical speaking, listening, writing, and reading could be embedded in the activities they were designing. I explain this in the following:

Ambareen: What are things we are hearing and placing them in categories that would be part of science and math? You want more opportunities for English language learners. So you can see their growth from those students who did not speak to look at. How are opportunities for funds of knowledge allowed in each of these?

In our conversation, the teachers identified students that were not speaking in class. I state that participation is being able to engage in all four WIDA domains, not just speaking. In addition, participation is socializing into a community of practice (Wenger, 1998). However, using the example of speaking, I frame the teachers to build awareness to how they can embed multiple opportunities for engaging in the WIDA domains through students’ funds. To do this, would require the teachers to reflect further on their FoK practices and how they foster students’ to participate communicatively. The teachers address their reflections collectively in their group report on December 28, 2010.

“At cohort meetings we reflected on problems within unit one and identified our major problem as over planning. We also ignored the students’ voice and did not give enough time for student talk.”
As the teachers reflect on the first unit, they identified that over planning lessons created a teacher-center discourse. The teacher’s would rush to get through their objectives, that they “did not give enough time for student talk.” The lack of students’ voice meant fewer opportunities for students to share their funds and for teachers to acquire funds, and embed their funds in the language domains. It also meant fewer opportunities for students to theorize their own funds and draw connections to the content.

2. **Fostering ELs’ oral, listening, reading, and writing participation**

   The teacher’s didn’t take up the needs of all four language domains equally. For the teachers, the problem of speaking mathematically and scientifically was a pressing matter than the others. The teacher prioritized their issues to first, create a student-centered discourse, and then foster opportunities to merge funds across WIDA domains and math-science content. Karen and Abby addressed these two concerns by altering the way they lesson planned. The teachers discontinued the use of the district formatted lesson plans and created their own for the second unit. The teachers used the district lesson plan to create “scripted teacher talk.” For instance, the lesson plans writes, “ask students, explain to students, tell students, guide students, remind students, assign students.” The first unit lesson plan shows how heavy the plans are guided toward what the teacher will say and do, but provides minimal planning to what students will do or have time to talk. In contrast, the second unit modified lesson plans filtering talk time to whole group, small group, partner conversations, and even individual reflection.

   The teachers learned that ELs need additional opportunities to think independently and talk collaboratively with other students before they could engage in whole group discussions. The teachers began to design lessons putting the perspective of what students would be doing which position the teachers to be *facilitators* of students’ activities. This also informed a different perspective to students’

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24 See appendix D.9  
25 See appendix D.10
listening skills. Instead of listening to the teacher during the instructional discourse in unit one, the students have the chance to listen to each other. Students began listening for different purposes. Students were listening not just for teacher directions and teacher explaining science and math concepts, but students were able to listen to one another funds and make sense of how they were similar or different to their viewpoints on playgrounds for understanding math and science learning. In doing so, the teachers were making scientific talk accessible for students because in this example, the students could speak to their slide funds in relation to gravity concepts, and they were given opportunities to speak in groups, than compared to the first unit.

The teacher also changed the opportunities for students to engage in communicating scientific writing. Whereas in the first unit, the students wrote out interview responses from surveys, the teachers decided to create science journals (see appendix X). Incorporating daily science questions rooted in students funds, gave students tools, through their funds, to write about scientific concepts. Now students were writing everyday in their journals as opposed to writing once for a final poster assessment.

In addition, the teachers thought about scientific reading as more than just interpreting data. The teachers wanted students to familiarize themselves with non-fiction texts, so in their tradition language arts block, they planned to teach students the difference between fiction and non-fiction texts. As a follow up for independent reading time, students would read non-fiction books. Reading and learning about non-fiction texts, prepared students for their whole class read aloud in unit two. The teachers relied on materials outside of traditional science and math textbooks, such as read aloud books like Groovy Gravity by Rena Korb, to explain the concept of gravity. The book was passed around throughout the unit for students to read on their own as well. As a result, the teachers planned to fostered reading, listening, oral, and writing communications in math and science.

3. Creating multiple opportunities for reading, oral, and writing participation
For the third unit, the teachers expanded the opportunities students had to engage in listening, reading, oral, and writing participation. The teachers and I began to look closely at ways to capture participation using linguistic funds, Spanish, to engage speaking the language of math and science. Abby was resistant to the use of Spanish in the class because she saw herself being unable to foster Spanish when she no knowledge of the language. Although Karen shared similar reservations, she was willing to experiment with the idea. Karen had Lorena come to the class and foster Spanish by conducting a read a loud on the book Garden Wigglers by Nancy Lowen in both Spanish and English. Lorena would also prompt questions about the survival needs of worms in Spanish so that students could respond using their native language. Afterwards, Karen requested Lorena to provide her with further science texts on organisms in Spanish so she could try on her own. Karen brought in further Spanish reading books such as, Bugs for Lunch and Margaret y Margarita. Even though Karen could not comprehend the Spanish, she could read and gain assistance from students’ who were Spanish proficient on words and phrases she didn’t know.

Further read alouds were done by Karen and Abby both, in English, using the book It’s Alive! By Linda Yoshizawa to teach the needs of plants. The shift in third units reading materials, was the opportunity for students to read in groups non-fiction texts on organisms. Each group would research an organism by reading books on that organism to decipher data on what the needs of the organism was, the habitat it lived in. The teachers planned for students to connect what organism they were reading about by drawing on their playground funds to analyze how each organism would affect a playground.

The teachers revised their science journals from the second to third unit. In the second unit, the students would write to answer a daily prompt (see appendix X). However, in the third unit, the science journals became an activity packet known as “My Playground Organism Packet” (see appendix X). The packet was an organizational tool complete with teacher created graphic organizers for students to write in. For instance, compared to the writing journal, the Organism Packet included a space for students to
draw and write their observations. It also had built in table and graphs for the students to complete their data. Similar to the science journals, each worksheet consisted of a daily journal question, grounded in students funds as well. However, in answering the questions, the graphic organizers\textsuperscript{26} of venn diagrams, T-charts, webs, and letter prompts served as helpful tools for scaffolding students’ writing. Multiple opportunities for scientific and mathematical writing were also provided as students would create an organism poster and write a letter to the alderman. The Organism Packet gave access to students to write to their funds in mathematical and scientific ways because each question linked playgrounds to environments and experiences with organisms.

4. **Summary of language of power: Mediating to communicate mathematically and scientifically in a FoK Discourse**

Abby and Karen were actively seeking ways to transform their planning and make communicating math and science accessible to ELs through their funds. Figure X below highlights the teachers’ shifts and figure 20 builds on the movement to create multiple opportunities for planning ELs math and science communication.

![Figure 20. TEACHERS’ SHIFT IN PLANNING MATH AND SCIENCE COMMUNICATION](image)

\textsuperscript{26} See appendix D.11
At the end of the first unit, the teachers realized based on conversations with the researcher and watching their classroom videos, that they fostered limited opportunities for communicating because of their teacher-dominated discourse. For the second unit, the teachers plan to provide greater exposure for ELs to engage in math and science discourse.

Table 8. PLANNING MULTIPLE OPPORTUNITIES FOR COMMUNICATION

<table>
<thead>
<tr>
<th>Communication Component</th>
<th>Unit One</th>
<th>Unit Two</th>
<th>Unit Three</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading</strong></td>
<td>-Used playground funds from survey to read graphs</td>
<td>- Used slide funds to make connections to reading aloud a book (i.e. Groovy Gravity)</td>
<td>-Used Spanish funds to translate reading Garden Wiggles and Bugs for Lunch (Karen)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Used slide funds to read slide experiment data</td>
<td>-Used organism funds to read It’s Alive (whole class)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-ELs researched specific organism books and made connections to playground funds to the environment (small group)</td>
</tr>
<tr>
<td><strong>Writing</strong></td>
<td>-Use playground funds to write final poster assessment</td>
<td>-Writing data and results in slide experiments</td>
<td>-Writing organism research poster</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Daily science journal writing with a question on funds (i.e. slide, building)</td>
<td>-Daily journal writing in an Organism Packet connected to funds (i.e. playground, organisms)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Writing letter to alderman to advocate for playground</td>
</tr>
<tr>
<td><strong>Speaking</strong></td>
<td>-Limited small group talk</td>
<td>-Daily opportunity for small group talk and whole class</td>
<td>-Daily opportunity for small group talk and whole class (third spaces)</td>
</tr>
<tr>
<td><strong>Listening</strong></td>
<td>-Dominant teacher Listening</td>
<td>-Dominant student listening</td>
<td>-Shared student/teacher listening</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Invited guest speaker</td>
</tr>
</tbody>
</table>
They do this by first developing multiple opportunities for speaking, reading, and writing. Secondly, they plan for math and science discourse to be accessible for students because the content is connected to students’ funds from which they can communicate through. Finally, in the third unit, as the teachers’ awareness on how funds can integrate with math and science became clearer, they were able to develop further activities for communication as shown in Table 8.

The significance here is that as teachers’ moved towards multiple opportunities for ELs to engage in mathematical and scientific communication for ELs, they were also creating a new classroom culture of communication. The “language of power” became communicating to and through FoK in a math and science context, a type of FoK Discourse. The teachers’ did not set a time to talk about students’ funds, rather students’ funds were organic and central to planning the lesson activities. Therefore, math and science communication was not limited to students who held the prior knowledge on academic concepts. Planning towards a FoK Discourse, as the language of power, allowed the communication of math and science to be something that all students could access because it was grounded from something they could connect, such as their everyday knowledge and practices. Implications suggests ways that teachers can address communicating mathematically and scientifically in other ways, such as a math and science Discourse practices, in addition to listening, reading, writing, and speaking.

E. Summary of Mediating Math and Science: Planning a FoK Curriculum Using EL’s Math-Science Funds

Abby and Karen faced challenges when creating a FoK curriculum because they had to negotiate within a larger educational community who have contesting views on what knowledge is worthwhile and how it is learned, resulting in tension on (language)learning ideologies. For educational policy makers, standards are the means for educational equality because all students are held to high-standards and are accountable for knowing the same content. In this climate of standard-based reforms, many
underperforming schools with large population of ELs, like Genesis, have turned toward scripted curricular as the answer to raise academic achievement scores because of its alignment to state standards and tests. Often, the approach to standards through scripted curricular has resulted in teaching students uniformly, in the name of equality. As was shown in this chapter, the teachers struggled to create equity, in terms of ELs access to cultural and linguistic resources, in order to achieve math and science standards. However, the teachers were able to mediate math and science learning by planning a FoK curriculum using ELs math-science funds, and figure 21 summarizes the teachers’ journey.

**Figure 21. SUMMARY OF PLANNING A FoK CURRICULUM**

In the first section, the teachers found at Genesis there was no space for a FoK curriculum because the school enforced a scripted curricula with strict pacing, content, and grade-level uniformity guidelines that constrained them to plan for students’ funds. The teachers responded to these restrictions with *agency* such as arranging a principal meeting, organizing the Genesis Playground Committee,
volunteering after-school, and submitting deceptive lesson plans, in order to create a FoK curriculum that served their ELs’ cultural and linguistic needs. The teachers’ agency was critical, and is an implication for teachers who chose to enact a FoK curriculum in scripted environments, to empower and re-position themselves from instructors of curricula to becoming curriculum designers.

As the teachers designed lessons to mediate math and science using students’ funds, they struggled to integrate curricular components on funds, playground activism, standards, and scripted curricula. Although the teachers could connect math-science funds to standards, they faced tension to integrate these funds with scripted curricula because they had to learn to see school-based math and science topics in students’ life-worlds. The teachers planned to mediate math and science content by moving towards integrating ELs multiple funds in their lesson plans. In the first unit, they used playground funds to teach standards on science inquiry and math statistics. The second unit drew on multiple funds, such as playground, stair, building, and Lego funds to plan a unit on engineering a fun and safe slide. These funds were planned to integrate the scripted curricula topic of “Balance and Motion” with science (i.e. inquiry, technological design, physical science) and math (i.e. number sense, statistics, algebra, measurement) standards. In the third unit, the teachers’ lesson planned to use playground, organism, and Spanish funds, but also “mental planned” for other unknown funds that emerged from students in class talks to mediate math and science. Multiple funds were important to the mediation of math and science because ELs could draw on funds, which are different from their peers, to make meaning, instead of teaching to universal funds. Furthermore, the mediation of multiple funds allowed ELs to make sense of math and science through a multilayered approach. For instance, learning gravity in a universal playground fund and through slide funds and/or stair funds, could enhance alternative ways to make sense of science and math concepts. These implications suggest teachers to plan mediation of math-science funds through various students’ funds, instead of privileging the dominant shared fund in the class.
Also, the teachers became curriculum designers as they planned for students’ to use math-science funds to communicate mathematically and scientifically. As each unit progressed, the teachers’ created multiple opportunities for ELs to communicate through reading, writing, speaking, or listening activities. In doing so, the teachers leveraged a FoK Discourse as the language of power. The language of power was to communicate to and through students funds, thereby, making math and science communication accessible because every student could participate from their life-world knowledge and practices. Implications suggest for teachers to examine their classroom discourse in ways that make math and science discourse accessible to ELs. In addition, teachers should seek other ways, such as how ELs in their life-worlds enact science and math practices in order to communicate mathematically and scientifically apart from reading, writing, listening, and speaking.

Although the scripted curricula and Playground Curriculum both addressed standards, how they used standards differed. The teachers wanted to teach standards, knowing and doing math and science, from out-of-school practices found in students’ playgrounds funds. However, this approach to (language)learning created tension to the scripted curricular that privileged Eurocentric ways of knowing and doing math and science from in school-based practices. These practices included mediation of textbooks and tools in traditional science experiment kits. In contrast, the Playground Curriculum drew on students’ funds as mediational tools. In addition, the teachers developed activities, in a CHAT framework, where ELs learned through the standards because it was needed to solve playground problems, versus learning to do a standard, like in the scripted curricula. In doing so, the researcher found the teachers could mediate standards that were beyond grade-level expectations to create a rigor curriculum compared to scripted curricula centered on a scope and sequence timeline to standards. Implications suggest for teachers to develop problem-posing questions on students’ funds that use standards and scripted curricula topics to solve. Furthermore, teachers should embrace tension as these moments of conflict resulted in a “third space” Playground Curriculum bridging ELs FoK practices with
in-school practices. A major point to consider is what if the teachers opted to avoid tension and not enact a FoK curriculum, what would have been lost?
IX. MEDIATING MATH AND SCIENCE IN THE CLASSROOM INTERACTIONS

Playground Carrom board is a combination of pool and hockey with your fingers. Before you can play you have to powder the board to make it slippery. The goal of the game is to get the most points by hitting coins into a net pocket. An expert player knows how hard and what angle to hit the “puck.”

In the previous section, I described how FoK were integrated for planning curriculum to mediate math and science using ELs multiple funds. In this chapter, the researcher explores how Abby and Karen mediate math and science using ELs math-science funds in classroom interactions and discourse to socially organize (language)learning. This additional layer was necessary to study in order to show how teachers’ mediated (language)learning during classroom discussions where students’ funds would emerge, unplanned. Mediating students’ funds in the classroom discourse was important because it expanded the FoK resources that ELs could participate with to make meaning of science and math content.

My findings show how Karen and Abby differ in their FoK practices, starting as either procedural or resistance identities (Razfar, Troiano, Nasir, and Yang, forthcoming) but both, moving toward a FoK inquiry teacher identity. Recognizing these identities are important because the mediation of math and science (language)learning occurs when teachers’ inquire ways to use FoK, and appropriate the theory to make meaning for it according to their awareness on the needs of their students. In this study, a procedural identity indicated a teacher who completed the FoK tasks asked by Project LsciMAAct (i.e. learn EL’s funds and plan a FoK curriculum). A resistance identity represented a teacher who opposed the ideology that FoK could mediate academic (language)learning. Butler and Schnellert (2012) define teacher inquiry as “building conceptions of teaching as requiring, not application of scripted routines, but rather contextualized decision-making that instantiates pedagogical principles and practices to best meet students’ needs” (p. 1207). Drawing on teacher-inquiry literature (Butler and Schnellert, 2012), a FoK inquiry teacher identity is using FoK for building conceptions of teaching, decision-making, and pedagogical principles and practices.
Karen embraced FoK to organize student learning for participation. She fostered participation by integrating FoK with *higher order questions, role shifts, division of labor, and third spaces*. She transformed her role from a procedural to FoK inquiry teacher. In contrast, Abby ideologically resisted legitimizing FoK as something meaningful for her class, but she procedurally her practices completed the expected FoK curriculum design. However, her role transformed from procedural-resistance to FoK inquiry teacher as she developed awareness for how FoK could organize learning to make meaning. Her mediation of FoK included integrating students’ funds with *tension and third spaces*. Finally, both teachers shifted from a deficit to *additive* view of ELs as a result of reflecting on their FoK practices.

A. **Diversity of Learning Goals**

I identify Karen and Abby’s reference to “learning” through different educational goals. I draw on Bert van Oers (2008) four approaches to learning in cultural contexts to frame how the various goals of learning inform the teachers’ FoK practices. These four learning goals have been categorized as: learning to perform, learning to make-meaning, learning to participate, and learning to be.

1. *Learning to perform:* These learning processes aim at appropriation of specific meaningful actions…motor and perceptual learning are examples of this type of learning process.
2. *Learning to make meaning:* These learning processes aim at the distribution and improvement of the contents (subject matter) of learning. This learning is discursive: meanings are explained, discussed, transformed, and shared.
3. *Learning to participate:* This form of learning focuses on the genres of acting in social contexts; the learner is assisted to appropriate the rules and tools of the community…within the borders of the community’s practices.
4. *Learning to be:* This type of learning addresses the learner’s identity by focusing on the learner’s motives, ambitions, and moral and aesthetical values. The actions to be performed here start out from the learner’s personal sense and are constantly evaluated with the help of personal values and norms” (p. 10-11).

Karen and Abby both demonstrated “learning to perform” which were incidents where students’ funds were used to complete an action or task, but did not transform student learning. Abby’s
primary educational goal rested on “learning to make meaning.” Her FoK practices reflect on how students’ funds could enrich their math and science content knowledge. Karen’s primary educational goal on “learning to participate” examined a case study of one student, Brock, and how FoK could mediate his oral science and math participation. The overall study of this section contributes to the goal of “learning to be” as a way to examine teacher development. Both the teachers theorized their FoK practices in order to learn how to use FoK to socially organizing student learning. It should be noted, that these educational goals are not exclusive, but rather in my findings, I show how indications of each of these goals is embedded throughout the teachers’ development.

In addition, the teachers learned to use FoK in conjunction with Project LsciMAc’t’s “coding tools” that were provided to them. These coding tools consisted of learning theories such as third space, tension, and multiple languages. Other coding tools asked the teachers to observe their classroom practices through questions, participation, rule negotiations, and role shifts. Abby selected examining tension and third space to integrate with FoK. Karen chose multiple tools of merging FoK with third space, questions, participation, and role shifts. These coding tools guided the teachers FoK inquiry to organize learning for ELs.

B. **Global Findings: Duration of FoK Conversations**

I examined FoK conversations that occurred orally in whole group settings between students and the teacher in classroom videos in figure 22. I tallied the number of minutes each teacher engaged in gathering or mediating students’ FoK for each unit. Both the teachers increased in their FoK conversations from the first to third unit. The first unit holds the least amount of FoK conversations because the teachers’ acknowledge being dominant in their teacher voice and providing minimal opportunities for students to share their FoK. An increase from the first to second unit of 24 minutes for Karen, and 13 minutes for Abby, in FoK conversations occur because the teachers’ are aware to explore students’ funds by relinquishing their authority and lesson
planning for students to speak through their funds. In the third unit, both teachers are able to capitalize students’ funds for (language)learning and foster a shared discourse between teacher and student. However, Karen demonstrates an additional 18 minutes more FoK conversations compared to Abby because her learning goal targeted FoK for oral participation and the researcher counted speaking as a FoK conversation. In addition, Abby’s resistance to FoK in the first and the second unit for learning also reflected fewer minutes to engage in students’ funds.

C. **Karen Using FoK for (Language)Learning to Participate**

This section explores the ways that Karen uses ELs’ math-science funds to mediate academic (language)learning. During the IPP, the researcher identified Karen with a procedural identity as she would say in weekly meetings and to the principal “we are doing this work because it’s for our courses and requirements for the ESL endorsement” (researcher journal, September 27, 2010). However, this section shows her movement toward a FoK inquiry teacher, as she recognizes to take ownership on the theory of FoK to change her practices and student participation outcomes. In turn,
she no longer does FoK because it’s for the endorsements, but because she finds meaning in the theory to mediate ELs math and science (language) learning.

Importantly, Karen learns to use FoK for mediation, beyond a curriculum theme. Here, mediation is recognized from a CHAT framework, such as how the teachers socially organized students’ funds with the rules, tools, and division of labor in the activity. I show a case study of a struggling student, Brock, and how Karen mediates EL math and science participation using FoK to socially organize asking FoK questions, creating role shifts in whole-class and small group interactions, and through third spaces. But first, let’s examine her initial views of ELs from a deficit to additive view.

1. **Karen’s Deficit View of ELs**

Karen initially held a deficit perspective regarding the math and science oral participation of ELs. Karen saw a problem in how ELs were quieter than their native-English speaking peers and thought the responsibility rested on the students to change their own speaking habits. In particular, Brock, was an EL whose lack of oral participation raised the greatest concern for Karen. Brock’s situation was unique in that Karen did not pass him in first grade based on his minimal retention of concepts. In addition, Karen contributes Brock’s ADHD as a hindrance to his participation because he’s unable to focus. Furthermore, in the “pacing constraints” context, Karen sees Brock’s speech impediment as a problem to the amount of class time he needs when he speaks. For instance, in our meeting on March 1, 2011, Karen describes how in rare incidents when Brock speaks he “repeats himself…five or six times… the whole class is sitting there and I’m just like okay say it faster…please get it out.” Also, Karen writes on January 9, 2011, the content of Brock’s talk “seems off the wall” since she interprets it to be irrelevant for discussions. Even though Karen had initially perceived Brock’s background as inhibitors to his participation, she was willing to explore his participation practices further.
2. **Attempting higher order questions for participation**

Karen experiments with asking higher order questions to foster math and science oral participation. For instance, during the first unit, Karen compares Brock’s participation practices when he works in a group to when he is presented with higher order questions from the teacher in a whole class setting. Karen writes a field note on her awareness of Brock’s lack of participation on October 27, 2010.

> “Brock is confused about something his peers laugh at him…one of the girls gestures he is ‘crazy’…Brock is trying to share something, but no one is listening…Brock states “That’s not sharing! You’re not sharing the microphone!” I gave him the microphone to ensure his participation…one of the girls took it out of hands putting their backs to him as they worked together.”

In this lesson, students were to work in groups and read aloud the Playground Survey responses to organize data in a table. Karen learns that Brock is not to blame for his lack of group participation. In fact, Brock attempts to orally participate, as he screams “you’re not sharing,” but his group members prevent him from doing so. Karen interprets Brock’s low ‘status’ perceived by his group as a cause for his marginalization, resulting in Brock having the microphone stolen, being laughed at, called crazy, and ignored by his peers. Karen is uncertain how to rectify her new awareness on the problem of shared division of labor in group work. However, she realizes she needs to foster opportunities for Brian to talk, such as volunteering him to speak in whole class settings.

In a lesson on October 27, 2010, Karen selects Brock to present his groups’ graph on how many kindergartners wanted a playground. I notice how Karen attempts to publically elevate Brock’s status by giving him ownership when she called the group “Brock’s group” and provided him leadership when she says, “you’re in charge” of presenting. Brock explains there were 27 kindergartners who wanted a playground. However, when Karen compares Brock’s and Yasmin’s graphs, she questions, “Why is the 27 graph show higher than the 31 graph?” Karen chose to ask the question to teach the purpose of skip counting by fives, rather than by ones, so there is enough space when graphing.
Brock: You know(.) you know(.) you can just start (.) the one you started before.
Karen: What do you mean Brock?
Brock: You know you can(.) you can (2 sec) just start the one you started before.
Charlie: I don’t get it.
Karen: Can you explain what you mean?
Brock: Let me (.). sh:ow you [walks up and points to put paper on top]. You can(.) you can(.) just use(.) the the second one as the as (.) the as the (2 sec) they other one.
Charlie: Oh.
Karen: So you’re saying put it like this? (putting one paper on top of the other).
Brock: Yeah. It will be like (2 sec) be li:ke(.) be li:ke(.) you ha:ve (.). li:ke it’s the same. It’s li:ke(.) it’s like counting by ones. Th:is way th:an counting by fives.

In the transcript, I saw that even though Karen has a hard time comprehending Brock’s alternative idea for graphing, she remains persistence in asking for details to extend on his talk. In lines 02 and 05 she asked twice for Brock to explain what he means, until finally Brock decides to show her what he is saying. He provides another way to solve the problem of graphing space by taping an additional page on the y-axis of the graph. I later discovered Brock could participate because he could access prior knowledge of his group taping an extra sheet of paper to extend the x-axis of their graphs.

However, Karen came to her own conclusion for why Brock participated.

Karen decided to examine her own classroom discourse practices because this lesson, unlike previous lessons, sparked Brock’s participation. In previous lessons, Karen contributed a lack of student participation because her questioning, in an IRE discourse, only had one right answer. However Karen saw IRE discourse beneficial in the beginning and middle of the lessons in order to scaffold learning to answer higher order questions. The drawback to this approach was that conversations emerging from higher order questions happened at the end of the lesson when time ran out. She defined higher order questions as ‘why’ or ‘how’ questions that had multiple answers. Karen hypothesized that if she asked a higher order question that had multiple answers in the beginning of each lessons, then students, such as Brock, have adequate time and opportunities to speak in providing those multiple answers. Karen tested her theory on November 10, 2011, by beginning the lesson to ask, “Why would interviews be important to our research about the
playground?” To Karen’s surprise, Brock did not speak and only two high academic achieving students replied. Karen told students “challenges are a good thing,” but she received no further student response when she challenged their answers. What Karen learned from this experience is that “higher order questions have the potential to deeply engage students in discussions.” (Individual Report, Jan. 9, 2011) Karen also realized students would need support to participate in answering higher order questions embedded with new content in the beginning of lessons. I suggested using students’ funds as the source of mediation for questioning. Therefore, Karen develops a new awareness of questioning that includes merging higher order questions with FoK.

3. **Asking content funds questions for participation**

Karen explored fostering math and science oral participation by developing CFQs, which are higher order questions that integrated students’ funds and the mandated curricular objectives. She identified a problem of how her higher order questions resulted in mostly high academic performing students to participate, since they held the academic knowledge necessary to respond. However, Karen still wanted the higher order questions to be asked in the beginning of the lesson to maximize class time for participation opportunities. Therefore, Karen decided to make science and math participation accessible and comprehensible to non-high academic achieving students by integrating their funds in the higher order questions.

In the process of asking CFQs, Karen fostered participation, learned students’ funds, and mediated their math and science learning. For instance, in the Slides Unit on February 17, 2011, Karen creates a CFQ asking, “How can we engineer a slide to make it go faster?” The objective of this question was to teach independent variables, particularly how slope and height affect the speed of a slide. Karen recalls how the CFQ engaged Brock in a scientific discourse with Franklin, so I explored their conversation further.

14 Brock: Slide (.) with water going in it. And we got (.) go fast and (.) and to stop us we could put the pool. It would be really fast and (2sec) slippery and it
won’t and (.) and in the big pool in the li:ke big po:ol (.) and in the big pool at the end you can swim and cool down.

Franklin: What if there’s already too much people and people can’t slide down?
Brock: Too much people?
Franklin: Yeah and if they fall.
Brock: They(.) they won’t fall ↑ because there will be long for it to be.

Karen facilitates what can be an independent variable for speed as students’ explore their own funds and speak the language of science and math. Brock takes into consideration the slide’s measurement, due to Franklin’s criticism, and mathematically conceptualizes a “40 feet high” slide to set parameters on a long slide. In line 24 Karen uses Brock’s suggestion as an opportunity to teach the variable of height affecting speed. Karen further uses Brock’s water slide fund to clarify through questioning if the pool can be a variable to speed. Johnny, another non-participant EL, interjects to
explain that he too, like Brock, has been on a water slide and validates the water “makes you go faster.” Karen adds to teach that water, not the pool, serves as an independent variable. Karen uses students’ funds on water slides to connect how independent variables can be used for science experiments such as the students testing water to prove their claim.

Another point of consideration is the appropriation of the math and science vocabulary term “slope.” Although Laura isn’t able to recall the scientific term of slope, she speaks about the variable of a slide going “straight down” to make it faster. Karen builds on Laura’s idea to activate students’ prior knowledge on what the term is called. A high achieving student, Charlie now participates to give the proper term, slope, and Karen includes slope as an independent variable. Interestingly, although Charlie can recall the science term, he doesn’t apply its understanding towards identifying independent variables. Whereas, Brock, Johnny, Laura, and Yasmin, are able to apply concepts by giving examples of independent variables to speed from their funds. For instance, Yasmin provides another variable derived from her funds, towels, which I document her mentioning seeing at a carnival. An implication to be drawn is that although ELs may have difficulty to recall vocabulary, they can still demonstrate higher order meaning-making on math and science language.

Karen is able to capture low achieving and non-participant ELs to engage in scientific discourses through the use of their funds. Although experiences on a slide may not traditionally be perceived as science or math talk, Karen is able to build on students’ slide knowledge to teach independent variables, a concept found both in math and science. Karen learns that using CFQs can “lead to student participation in an academic setting. The foundation provided by their experiences provides a bridge between themselves and the content that can be used to develop content knowledge and language simultaneously” (Action Report, p. 18).

Furthermore, fostering students’ participation using their funds, brought change in how Karen made sense on the concept of speed. She writes on March 22, 2011, that “while the objective
of the lesson was for students to realize that a steeper slope resulted in a higher speed of travel…my question afforded students the chance to consider *speed in their own terms*” (p. 5). In other words, Karen learned there were multiple ways to make sense of speed that were different from her understanding of it through the independent variables of slope and height. For instance, I found that although students did refer to height and slope, they also expanded to refer to speed in terms of *friction*, such as water and towels. Karen became informed as to how students’ funds can enhance the learning objective in ways she wouldn’t have seen scientific and mathematical concepts, like speed.

4. **FoK for role shifts**

In addition to asking questions, Karen used students’ funds to foster math and science oral participation by enacting role shifts. Karen looked at role shifts during the interactions between students and students and the teacher. Role shifts were identified when the traditional role of the expert shifted to the role of a novice (or vice-versa) in an academic conversation. In the first unit, Karen noticed that role shifts occur between her and high academic students when they correct her mistakes. When Karen enacted role shifts with her gifted students, she saw herself fostering their status as the experts in the class. However, she realized that her gifted students “participation wasn’t the important factor in their status- the way that I regarded their participation was” (Action Report, p. 19). In other words, for students like Brock, Karen could enact role shifts using their funds to elevate their status as experts as well. Her thoughts were that if role shifts became the routine with Brock in whole class, then Brock would be given opportunities, as an expert, to participate during small group work as well.

Karen planned for a role shift to happen between herself and Brock on February 10, 2010. The lesson on technological design asked students to identify safety problems on a slide and to discuss what materials they would use to engineer a slide that was safer.
Karen: Brock? Where’s Brock? (makes eye contact with Brock) Brock talked about having a window and a cover on the slide to protect it from the sun and heat. Remember Yasmin mentioned being burnt once because her slide was so hot.

Charlie: [You can use solar energy, if the school (. ) there’s a blackout the lights can be on]

Karen: So you’re thinking about solar energy-

Brock: [You can go green]

Karen: You can go green? What does that mean?

Brock: Helping the environment

Karen: How can we make slides that are green to help make slides help the environment?

Brock: Use solar panels to have (. ) to have water come down the slide to to make it fa:ster and fun(.) and like the fish like clam fish.

Yasmin: (looks at Brock) We have to bring other clothes so we can get wet?

Brock: Yeah. You won’t sweat and your shorts won’t get stuffy.

Karen: So what Brock is bringing up is interesting ↑.

I observed Karen initiating the role shift by reminding the class of Brock’s solution to design a slide that is protected from the sun from the previous day’s lesson. Before Karen can allow for Brock to explain his idea further, she is interrupted by Charlie. Charlie, who is traditionally positioned as the student expert, wants acknowledgement on his slide design using solar energy. However, Brock interrupts Karen with a counter solution to share his funds on “go green.” Therefore, both Brock and Charlie are competing for the position of expert status. Karen chooses to ignore Charlie to enact her role shift and participation with Brock. She positions Brock to teach the class by questioning him what ‘going green’ means. Karen further positions herself as the learner to ask how ‘green slides’ can be designed. Brock elaborates using his funds to suggest “solar panel” energy to “have water come down the slide.” Yasmin confirms Brock’s expert position by asking him if she needs to bring extra clothes to use his slide, and Brock proudly asserts “yeah.” Karen legitimizes Brock’s funds by stating his knowledge is “interesting” and she is able to continue the role shift by questioning to learn Brock’s funds.

Karen wanted to see if the role shift between her and Brock during the whole class setting would change Brock’s role when working in small groups. Immediately following the whole group discussion, Karen observed Brock, in an expert role, facilitating the group conversation to have a pool at the end of the water slide with fish in it to full the objective of a fun and safe slide. I
discovered that unlike in lines 41-42 where Charlie dismisses Brock’s idea for his own, Charlie extends the conversation to offer brainstorming fishes with Brock.

Charlie: Where my dad works. There’s a big plant and there are fish. They have a fishing pole to fish them out. Even my cousin pulls it out and I am going to find some.

Brock: What are you going to use to catch the fish?

Charlie: When it’s summer I have a fishing pole I can get them out. Chris my cousin he’s good at fish he can get them out.

Brock: Make sure you have a a container so it won’t die. Make sure you collect enough.

Charlie: My cousin has a bucket how many fish you want?

Yolanda: Two.

Brock: How many fishes? Ten is good. I will tell you the species.

Charlie: I don’t know the species.

Charlie accepts Brock’s fish idea by reflecting on his familial funds for how to obtain a fish. Brock questions how Charlie will catch the fish from his father’s plant and shares his fish funds for using a bucket to catch the fish. Charlie affirms Brock’s leadership by asking how many fish he wants for the group’s slide. Although Yolanda offers collecting only two fishes, Charlie suggest twenty then ten, Brock is given the final authority to select ten fishes. Furthermore, Charlie positions himself as the novice when he claims he doesn’t know fish species. In contrast, Brock asserts knowing more than Charlie by using his fish funds to claim that he, unlike Charlie, can identify which fish species is safe for their slide. Therefore, Brock’s role shifts from non-participant to the expert and facilitator in the group because the slide design privileges his fish funds.

Karen learned that every student can have the opportunity to participate as an expert if she enacted role shifts for students’ to teach their funds during whole group conversations. In particular, she realized her role shifts with Brock, legitimized his funds as worthwhile knowledge for when he worked in small groups. She recalls how “Brock was not necessarily respected in the first unit, but his FoK during this lesson gave him an advantage…He was able to contribute to the conversation, and, in fact, took an expert role” (Individual Report, March 22, 2011). Therefore, providing Brock
with the chance to be an expert using his funds in whole and small groups, fostered his math and science oral participation.

5. **FoK for the division of labor in group work**

In addition to role shifts, Karen examined the division of labor in small group activities to see the distribution of student talk in math and science. In the first unit, Karen saw how Brock’s group completed their work successfully, but the division of labor wasn’t shared since Brock wasn’t afforded the opportunity to talk and contribute. Therefore, Karen organized the rules for group work by assigning *student roles*, such as timer, measurer, slide holder, and marble dropper, to each group member during the Marble Experiment. She assumed student roles would allow for students, like Brock, to have a shared contribution and talk in the group activity. However, after the Marble Experiment was completed, Karen became “reluctant to use roles that divide the work because students just do one thing” (Individual Report, March 22, 2011). She realized student roles arranged group work into individual tasks, instead of collectively problem solving throughout the activity. In other words, student roles contributed the notion of learning to perform the pre-assigned role.

As an alternative to student roles, Karen learned that Brock’s division of labor in group activities could be shared when she organized activities that foster his FoK for problem solving. Her awareness became apparent when observing Brock during the group activity on March 3, 2011, where she asked students to apply their prior knowledge of slopes and heights to engineer a model slide that was fun and safe. Karen described how Brock participated to inform the group his FoK to implement a “landing spot” and “his Lego thing [i.e. Lego wall]” (Field Note, March 4, 2011). She noticed that these “ideas were respected…the group listened to Brock and assisted” (Weekly Meeting, March 8, 2011).
I examined the group activity further to understand Karen’s awareness of FoK contributing to the shared division of labor. In the activity, Chelsea informs the group that it’s problematic to continuously chase the marble once it rolls off the slide. Brock informs the group his Lego funds to offer a solution.

67 Brock: We could use one of these (picks up a large flat rectangle Lego piece) as (.)
68 the (. ) the landing spot. It could be the pool at the end be:cause the pool
69 could cool us down (. ) at the end. You think you could make a Lego wall
70 (2 sec) so the marble wont escape↑
71 Charlie: A Lego wall?
72 Brock: Yeah a Lego wall so the marble won’t a (. ) a escape. A Lego wall has to be
73 at the (. ) at end (grabs Lego pieces to make Lego wall and shows Charlie).

Brock shares his funds on a “Lego wall” as a way to stop the marble from rolling past the slide. Charlie doesn’t understand what a “Lego wall” is so Brock grabs pieces of Lego to build a wall. However, as Yolanda rolls the marble, it bounces off the “Lego wall,” so Charlie decided to replace it with a plastic cup at the end. The students discover the force of the marble pushes the cup away from the slide. Therefore, Chelsea created a solution to integrate Charlie’s and Brock’s ideas. She places the plastic cup between the “Lego wall” and slide so the plastic cup can catch the marble as seen in figure 20. In this scenario, the students collaborated to capture Brock’s funds and modify his idea to create a solution.

Figure 20. LANDING SPOT
Brock’s “Lego wall” assisted the students in understanding the concept of speed, height, and slope, for slide safety. The students reason that if the marble bounces off of the “Lego wall,” the speed of the marble is too fast and unsafe. In figure 24, when Charlie rolls the marble, the students learn that the marble speed is too slow because it stopped in the middle of the slide and never reached the “Lego wall.” In figure 25, Brock proposes building a “bar made of Lego”, such as an incline, to sustain the marble’s motion.

When the group rolled the marble, it slipped off the slide track and Karen overheard Brock screaming the incline was “too high!” Karen walked over to question the group.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>74</td>
<td>Brock:</td>
</tr>
<tr>
<td>75</td>
<td>Charlie:</td>
</tr>
<tr>
<td>76</td>
<td>Karen:</td>
</tr>
<tr>
<td>77</td>
<td>Charlie:</td>
</tr>
<tr>
<td>78</td>
<td>Karen:</td>
</tr>
</tbody>
</table>

Brock was able to demonstrate his knowledge of slope impacting the speed and safety of the marble when he yelled “too high!” Additionally, Charlie provided justification for changing the height because the marble “slipped out.”

In reference to EL building science vocabulary, even though the students’ didn’t say the scientific or mathematical vocabulary terms, (i.e. height, speed) the students displayed conceptual meaning of the relationship between height and speed using their everyday terms of “too high” and
“fast.” Also, Karen reinforces the correct academic terminology by recalling height and speed in line 78-79. In doing so, Karen’s informal assessment showed how the students transfer their knowledge of slope and apply it in their slide design. Brock’s “Lego wall” funds contributed to his participation, the group’s collaboration through trial and error, and aided the students’ learning of balance and motion. Therefore, the students appropriated abstract meaning of slope, height, and slide safety through Lego Wall funds.

Karen found that FoK can contribute to students’ shared division of labor. She learned that designing group activities that foster FoK for problem solving are beneficial for oral participation compared to student roles that perform individual tasks. For instance, she noticed how students capitalized on Brock’s funds to allow for a collective and dynamic participation and learning experience. All students worked collaboratively by voicing a possible solution and then building to test the solution. In particular, Brock transformed from a non-participant in the first unit to participating as a facilitator in the activity through using his funds and opinions.

6. **Mediating FoK for participation and meaning making in third spaces**

Karen built opportunities for student math and science oral participation by mediating FoK in third spaces. In the literature, third space can be defined as “where teacher and student scripts – the formal and informal, the official and unofficial spaces of the learning environment – intersect, creating the potential for authentic interaction” (Gutiérrez, 2008, p. 152). Karen defined third space as “a space where traditional scripts are left as a result of a counter-script emerging as part of the ‘official’ conversation” (Action Report, p. 3). Karen draws on third space theory to inform whether the classroom participation was teacher or student controlled. Karen identified ‘teacher control’ or ‘student control’ participation based on whose script, teacher-script or student counter-script, emerged in the classroom conversation. Identifying teacher or student control was important to Karen because she struggled to share the classroom talk with her and her students.
She “didn’t value opportunities for student talk, she believed when students talk we wouldn’t get anything learned” (Researcher Journal, March 15, 2011). However, Karen reflects on FoK in student talk to make sense of third spaces in her awareness of: the first unit’s dominant teacher-control, the second unit’s dominant student-control, and finally the third unit’s shared teacher and student control.

a. **Missed opportunity for mediation**

In the first unit Karen describes when opportunities arose for third space she ignored it because she “didn’t consider students’ ‘deviations’ [counter-script] from [her] intended curriculum to be worthwhile” (Action Report, p. 26). Karen identified only one third space incident in the first unit, on September 21, 2010, where she chose to interact with students’ counter-script because she wanted to learn her students’ FoK.

**Official Script**

| 80 | Karen: | What did you observe? |
| 81 | Jacob: | We see the garden |
| 82 | Karen: | Ok, we see the garden. |

**FoK Counter-Script**

| 83 | Yasmin: | We were worried about the rocks because what if somebody falls on their face. In the park when we went on the community walk if they can like have rubber and have like the squares so nobody will get hurt. |
| 84 | | |
| 85 | | |

I reflected on Karen’s identified third space to find that the teacher’s official script asked students to make scientific observations of the current play lot at Genesis. Whereas Jacob speaks to the official script by stating he saw a garden, Yasmin provides a “FoK counter-script” on playground safety. FoK counter-scripts are defined as a student speaking about their FoK in the counter-scripts. For example, in Yasmin’s FoK counter-script, she explains to have observed hazardous pavement made of rocks but also proposes a solution, derived from her FoK about “rubber squares,” to make the play lot ground safer. Karen fosters a third space when she inquires Yasmin’s funds further.

**Third Space: “Squares”**

| 83 | Karen: | What squares are you talking about? |
| 84 | Yasmin: | It’s hard. So we have like squares (class becomes loud) |
| 85 | Karen: | Wait, hold on. Charlie is trying to help you. |
Charlie: It’s like a puzzle. The things you get in.
Susan: No on the side walk!
Yasmin: No it’s something in the ground. You land like on squares but there soft.
Karen: So there soft. They cover the whole playground. Are they made out of rubber?
Yasmin: Yes.
Charlie: [No!] (class screams yes and no)
Yasmin: There made of something else, trampoline.

The third space emerges because Karen interacted with the student counter-script by asking an Expansion of Student Funds Question (ESFQ) in line 83. Karen facilitates the third space by creating a role shift between her and Yasmin, so that she is the learner of her students’ FoK. For instance, in lines 89-90 Karen asks an ESFQ on what the squares are and what they are made of. The students’ continue the third space as they disagree on one another’s funds. For example, Susan argues you find “squares” on the side walk, and Charlie disputes that “squares” not made of “rubber.” Yasmin reconsiders her statement on “rubber” and uses an analogy from her FoK to say the “squares” are made of “trampoline” like material. Therefore, in this incident, the third space is fostered when the teacher facilitates the students’ exchange of their FoK.

In this lesson, Karen became aware of the integrated relationship between FoK, student participation, and third space. Karen learns that “third space was a great way to get students to talk because their counter-scripts arose from their FoK” (Action Report, p. 24). Karen viewed the potential for third spaces to occur when student’s presented a FoK counter-script. However, she examined that “no new academic understanding was achieved as a result of the third space” (Action Report, p. 24) Karen speculates that students’ weren’t orally participating in a math or science discourse because the lesson was dominated by her teacher control. As a result, she attempts to experiment with a dominant student controlled discourse.

**b. FoK counter-script and student controlled third space**

Karen engages in a FoK counter-script to foster third spaces where she perceived students can participate orally in math and science. Karen rationalized that she needed to
create student controlled conversations by relinquishing her control for students to engage in math and science participation. In the Slides Unit, Karen plans for student control in a lesson objective where students decided what materials would be needed to build a slide on February 10, 2010.

**Official Script**

<table>
<thead>
<tr>
<th>Line</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>Karen: Why don’t you guys raise your hands for him. Teddy, why don’t you call on people with questions.</td>
</tr>
<tr>
<td>95</td>
<td>Teddy: Hammer, screwdriver, nails, wrench, that’s it.</td>
</tr>
<tr>
<td>96</td>
<td>Charlie: How many nails?</td>
</tr>
<tr>
<td>97</td>
<td>Teddy: Nine or ten.</td>
</tr>
<tr>
<td>98</td>
<td>Karen: Keep going, you don’t have to wait for me. I’m just taking notes.</td>
</tr>
<tr>
<td>99</td>
<td>Teddy: Alex?</td>
</tr>
</tbody>
</table>

**FoK Counter-Script**

<table>
<thead>
<tr>
<th>Line</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Alex: Why do you need a screwdriver?</td>
</tr>
<tr>
<td>101</td>
<td>Teddy: So you can make the hole.</td>
</tr>
<tr>
<td>102</td>
<td>Charlie: That’s why you have a hammer because screwdrivers are for holes.</td>
</tr>
</tbody>
</table>

I observed in line 94, how Karen relinquished her control by giving students the authority to be conversational leaders as they ask and answer each other’s questions. Karen’s actions reflect how fostering student-control meant no longer teaching new content or facilitating the conversation, rather in lines 98, she shifts her role to a note-taker. Teddy explains in lines 95 which tools he thinks are needed to build a slide, but Charlie and Alex disagree with Teddy’s rational for wanting a screwdriver. A FoK counter-script emerges in lines 102, as Charlie shares his knowledge in construction for using a hammer instead of a screwdriver. Karen sees this as an opportunity for her to play the role of a student and ask Charlie a question.

**Third Space: “Screwdriver”**

<table>
<thead>
<tr>
<th>Line</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>Karen: Can you explain more about that Charlie?</td>
</tr>
<tr>
<td>104</td>
<td>Charlie: If there is a hole and you’re going to use a nail, that’s when you need a hammer. If there’s already a hole, that’s when you need a screwdriver.</td>
</tr>
<tr>
<td>105</td>
<td>Karen: Have you done that before?</td>
</tr>
<tr>
<td>106</td>
<td>Charlie: With my dad</td>
</tr>
<tr>
<td>108</td>
<td>Charlie: Does your dad build things?</td>
</tr>
<tr>
<td>110</td>
<td>Yasmin: Maybe if there’s not a hole there, you can make one with the screwdriver and then put the nail in and hammer it.</td>
</tr>
<tr>
<td>111</td>
<td>Isiah: If you make a hole with the screwdriver, then when you put the nail in with the hammer, it will fall out.</td>
</tr>
<tr>
<td>114</td>
<td>Karen: What other questions do you have for each other? They can be directed to anyone.</td>
</tr>
<tr>
<td>115</td>
<td></td>
</tr>
</tbody>
</table>
Karen creates a third space by asking ESFQ in lines 103, 106, and 108 to elicit what Charlie knows and how he came to learn about screwdrivers. Charlie responds that if there’s “already a hole in the wall, that’s when you need a screwdriver.” The third space discussion on Charlie’s funds, creates a student debate between Yasmin and Isiah. Yasmin challenges Charlie that a hammer and nail can be used after the screwdriver makes a hole. However, Isiah counter argues that the nail “will fall out.” Instead of mediating the tension about Charlie’s FoK for academic learning, Karen decided to bring the conversation back to the students to privilege student control. Therefore, she relinquished her control by asking the students to question one another and continue a discussion without her.

Karen assumed that FoK conversations that were student controlled in third spaces would contribute to math and science participation. Her assumption was debunked when Karen noticed she relinquished too much control. Karen acknowledges that she “hardly participated” and that she was “no longer the clarifier and discussion leader, the students were” (Individual Report, p. 3). She discovered that students’ were not learning new academic content because “there was a responsibility still left to the teacher to guide students through the third space and lead them to a learning-based outcome” (Action Report, p. 29). In other words, Karen became aware of needing to mediate students’ FoK and oral participation in a third space towards science and math learning.

c. **Mediating FoK for shared participation in a third space**

Karen recognized that her role needed to be a mediator to students’ FoK counter-scripts in a third space for learning. She realized it is beneficial to have a shared teacher and student control discourse. Karen identified putting these perspectives into practice during the Organisms Unit on May 5, 2011. The lesson’s objective asked students to know what plants need to survive.

**Official Script**

<table>
<thead>
<tr>
<th>Line</th>
<th>Character</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>116</td>
<td>Karen:</td>
<td>Do all plants need soil?</td>
</tr>
<tr>
<td>117</td>
<td>Brock:</td>
<td>I also (. ) put some uh dirt in a pot.</td>
</tr>
<tr>
<td>118</td>
<td>Karen:</td>
<td>So I am hearing you say sunlight, water, dirt, and I heard seed. Charlie?</td>
</tr>
</tbody>
</table>
I observed in the official script how Karen asks if “all plants need soil?” Brock explains his FoK to justify the need for soil, when he put “dirt in a pot” for his plant. Karen summarizes plant needs in line 118, but Charlie adds “compost” as another plant need. Karen extends the counter-script by asking Charlie what compost means. Charlie identifies his FoK source from a TV show to recall how “worm poop makes the flowers grow.” The Wild Krats funds are shared by Yasmin and Brock who participate. Yasmin corrects Charlie on the TV show’s name, “Wild Krats.” Brock joins the conversation adding how the show “protects animals.” With several students voluntarily speaking to each other in a student-control discourse, Karen sees the opportunity to extend on student’s FoK to mediate science learning.

Karen engages in the third space by asking an ESFQ to learn Charlie’s compost funds. Charlie elaborates that worms eat “banana peels, leaf, newspapers” to create compost. Karen clarifies if her knowledge on the students interpretation of compost is correct in lines 127, and Brock clarifies “it’s
compost.” After eliciting students’ funds, Karen mediates learning in lines 130 by challenging Charlie if compost is a plant need. Charlie explains ‘no’ but the class negotiates the role of compost for plant survival. Yasmin builds on Karen’s teaching of compost not being a plant need, to assist Charlie that compost “can help” plants. Karen provides a resolution by instructing the class how to organize their plant information into categories of “plant needs” and “plant helpers.” Therefore, students’ FoK and Karen’s mediation provided an authentic learning environment where multiple students participated scientifically and learned new ways to perceive plant survival beyond plant needs.

Karen learned that students FoK in a third space can be meaningful to student participation and learning. In the first and second unit, Karen “didn’t see third spaces as a chance to teach content. [Her] shortcoming was the ability to choose appropriate counter-scripts” (Action Report, p. 26) for science and math learning. Karen realized that students’ funds were essential in third spaces because it is where “students voice their ideas, but also a way for me to connect their FoK to a curricular goal” (Action Report, p. 26). Therefore, students FoK in a third space were no longer in opposition to science and math participation, but served as an opportunity to enrich participation and learning.

d. **Missed opportunities to mediate Spanish for learning**

Karen was resistant to Spanish as a resource for mediating learning because she didn’t share ELs’ native language. Karen didn’t value Spanish because “there was no point- I couldn’t understand them, so why would they speak anything but English” (Individual Report, p. 3). However, on January 5, 2011, Karen observed how her ELs were embarrassed to be provided with Spanish translations, even though they couldn’t understand her directions in English. Karen sadly realized the students collectively did not see Spanish as a valued academic tool in the classroom because she perpetuated an English-only environment. Karen remained resistant and guilty that she
could not do anything because of the language barrier between her and the students. I suggested for Lorena to speak Spanish and co-teach with Karen to foster students’ native language.

On March 1, 2011, Karen and Lorena decided to teach ELs science vocabulary by translating English to Spanish cognates to show that Spanish translations are an acceptable classroom practice. The purpose of the “mini-lesson” was to learn and practice the vocabulary words in both languages.

135 Lorena: Science is Ciencias. (class repeats) Engineer is Ingeniero. (class repeats)
136 Alex: [Speed is velocidad]
137 Lorena: Yes, speed is velocidad. Very good. Experiment is? (whole class responds ‘very good.’)

I found that the opportunity for Spanish mediation falls short of knowing new science concepts, since Spanish is reduced to translation, not learning. Instead, Spanish is reduced to learning to perform a translation task. For instance, Lorena translates in both English and Spanish vocabulary terms of “science,” “engineer,” and “experiment.” Lorena’s IRE discourse restricts conversation to repetition and route memorizing of Spanish terms. Students practice the words by repeating after her and Lorena responds in lines 137 “very good.” However, this lesson provided Karen with an awareness of her students’ native language proficiency. Karen learned that many of her second graders could read Spanish, such as Alex, when he interjects to read “speed” as “velocidad”, before Lorena can even get to the term. The lesson convinced Karen that students would not engage in their native language with her, but to foster Spanish meant “bringing someone from the community who shares their language” to speak with them to use it (Action, Report. p. 31).

Karen and Lorena plan the next activity for a dual language read aloud since Karen was informed by many of her ELs ability to read and translate Spanish. The lesson’s objective on May 6, 2011, called for students to explain the characteristics of a worm. Lorena read an English written book, Garden Wigglers, and self translated it in Spanish.

133 Lorena: (reads book) “A wormy morning. It rained hard all night. Now, it’s morning. The sun is shining and the grass is green and glistening.”
135 Lorena: mañana calientita había llovido muy fuerte en la noche y ahora dice es
I observed that the read aloud activity resulted in several role shifts between proficient Spanish speakers and Lorena. Several ELs would either correct or assist Lorena in her Spanish translation. For instance, in lines 136, Lorena could not remember the Spanish word for “sun” and Julio assisted Lorena by saying “el sol.” Julio also corrected Lorena when she used the word “brilla” for bright instead of “brilloso.” Although the role shifts elevated native Spanish speakers and the Spanish language’s status, the lesson did not use Spanish to mediate science learning. Instead, the rules of the activity shifted from Lorena translating to ELs translating as an individual task, not collective learning. In other words, Lorena used Spanish to teach about worms, but the students’ didn’t use Spanish for learning worm needs. For example, when the read aloud ended, Lorena and the students resorted back to English as the academic language for science learning.

Lorena speaks in English to draw on lessons learned from the book, which signifies that English is privileged in science discourse. Therefore, the students in lines 143, and 145, respond to their learning on worms in English as well. Hence, Spanish is used by Lorena and students to clarify an English word and is not central to the curriculum or learning.

The read aloud activity was important to Karen’s shift from resistance to acceptance that monolingual teachers can foster Spanish. Karen saw how she “did more than invite students to speak Spanish- I made Spanish part of the activity” (Action Report, p. 34). Karen felt a success that Spanish had been elevated into the official script of the classroom, but was unaware that it wasn’t for academic content. In our meeting on May 10, 2011, I explained to Karen that in the read aloud
lesson, Spanish was not mediated as a tool to complete the activity’s science objective. Unfortunately, Karen was unable to achieve students learning in the content areas through the use of their native language. She recognizes that assisting students in their native language for math and science learning is an area of further study for her. However, she did change her thinking towards monolingual teachers being able to “foster students’ primary language by creating activities that require Spanish to be used as part of the learning activity” (Action Report, p. 35).

7. **Additive view: Confianza in ELs’ FoK for learning to participate**

Karen changed her perspectives on ELs from a deficit to additive view by paying close attention to Brock’s participation practices and reflecting on her own FoK practices. In traditional FoK theory, *confianza* refers to the “bond of mutual trust” describing the relationship between the teachers and the families. Fostering confianza is a vital component for families to be willing to open their doors and allow teachers to access their household funds. However, outside of the home, confianza is equally important to establish in pedagogical practices with students in the classroom. For instance, when planning for the first unit, Karen lacked confianza with her students’ funds. She says, “I don’t think I valued what they had to say because I didn’t think it would help us to get to what we wanted to get to” (Focus Group Interview, July 5, 2011). In other words, Karen did not trust that students’ funds could accomplish her objectives. However, she learned that students’ speaking to and through their FoK “helps them MORE because it reaches that bridge to get them to that [science and math] objective” (Focus Group Interview, July, 5, 2011). She shifted to realize that as a teacher she could use FoK to socially organize students’ science and math oral participation and learning.

In addition, Karen reflected on her FoK practices to inform herself what it means to teach ELs. Although she recognized that ELs learn to acquire English as well as academic content and
language, she wasn’t aware what this meant for her ELs. In her own words, she explains below her understanding of what it means to be an EL.

“English learners are learning double there learning language as well as academic subject. I don’t even think I fully realized that until Lorena came in and read the book in Spanish and they were not familiar with academic language...so for many teachers it’s not just the course, but the words, and the funds of knowledge, and the goals for the curriculum will help them learn both” (Focus Group Interview, July 5, 2011).

Karen was able to put into perspective the complexities for ELs to be “learning double,” both the language and content of science and math, and acquiring English proficiency. She became aware of how students’ need to be mediated in their learning even when teaching in their native language, which is why in the Spanish read aloud she saw it was difficult for her students to grasp academic content. Karen values students’ FoK as a tool that would assist ELs learning to participate in science and math. Therefore, fostering confianza with students’ funds for learning is integral for teachers’ to value FoK as legitimate sources for learning.

8. **Summary of Karen using FoK for (language)learning to participate**

Karen demonstrates being a FoK inquiry teacher throughout the ways she problem-poses and changes her FoK practices based on the needs of her students. By the end of the first unit, Karen identifies multiple problems that relate to EL non-participation in science and math, such as the need for conversational discourses using FoK questions, role shifts between ELs to be positioned as experts, creating shared division of labor in small groups, building shared teacher-student discourse through third spaces, and fostering EL’s native language. This section describes Karen’s synthesis of how EL’s funds were used to mediate participation and meaning-making of math and science (language)learning. The section addresses FoK mediation in terms of CHAT’s mediation as tools, rules, and division of labor. Then, third spaces are explored to demonstrate Karen’s transition from falling short of FoK mediation to having command to use FoK for new science meaning making.
Karen chose to examine Brock, an EL with ADHD, because she retained him the previous year due to his underachieving performance and non-participating roles. At the end of the first unit, Karen examined Brock’s discourse and his division of labor in small group, only to reveal her assumption was incorrect. Brock attempted to participate, but his group marginalized his voice. Planning for the second unit, set the stage for Karen to develop a “FoK inquiry teacher” perspective on ways FoK can foster Brock’s oral science and math participation, as well as ELs (language) learning of math and science. Figure 26, depicts a summary on how Karen used EL math-science funds to mediate math and science (language) learning with respect to tools, rules, and division of labor. Also, figure 24 demonstrates Karen’s shifts in her FoK practices, as she learns how to mediate.

![Figure 26. KAREN’S FoK MEDIATION](image)

In reference to FoK as rules for mediation, Karen makes science and math discourse accessible by creating the rules of the activity for asking FoK questions as a way for Brock, and other ELs, to communicate scientifically and mathematically. In the second unit, Karen draws on slide funds to ask how students can engineer a slide to make it go fast. The question sparks conversation from several EL non-participants since they can connect their slide experiences to speak to science concepts on speed, slope, and independent variables. In doing so, their funds make
Karen aware that an independent variable can be more than just the slope, but create new meaning to also include friction.

Also, Karen becomes aware on the need to develop problem solving activities that require FoK to be used. Although Karen’s awareness of this occurs at the end of the second unit, the researcher saw the outcome of curriculum planning resulting in shared division of labor. Creating shared division of labor amongst students was a problem Karen also identified. She had tried...
assigning roles in the second unit’s first experiment, but realized it limited students to only practice one role. However, as noted in the rules of FoK mediation, she recognized that the problem in the activity should draw on ELs’ funds, so that students can share participation, using their funds, as experts, to solve. Brock was an example of this when his funds on a “Lego wall” served as solution to maintain the marble on the slide runway. However, the students collaborated together to extend the meaning of a Lego Wall for scientific concepts on height and slope for slide safety.

In addition to rules, the division of labor represented an area for FoK mediation. The FoK mediation Karen adopts is role shifts. In the first unit, Karen realized role shifts occur between her and gifted students, thereby elevating these students status as experts. To give Brock an expert status and foster participation, she enacts a role shift using his prior identified slide funds in the second unit. As Karen positions herself as a learner, she asks questions to extend Brock’s knowledge on slides. She finds he is able to apply environmental and technological design connections to his funds on solar panels and going green concepts. Karen legitimizes his knowledge to create a role shift between Brock and his peers, as his ideas are valued by the group and positions him as a leader.

The mediational tools were important as they consisted of ELs cultural and linguistic math-science funds. Thus far, primary emphasis has been on cultural funds on playgrounds as the tool used for mediating to and through the rules and division of labor. Whereas, playground funds were accepted for mediation, Spanish was not. Karen’s struggle to embrace Spanish in the first and second unit for mediation is a marker for the resistance teachers can face when their funds are in conflict with students funds. Karen represents falling short of using ELs’ native language, Spanish, for mediating. I contribute her missed opportunity for Spanish because unlike the previous rules and division of labor for FoK mediation, the awareness of Spanish as a problem occurred later at the end of the second unit. This left her with only the third unit to experiment FoK practices with Spanish, which is why she leaves with only awareness that Spanish has the potential for mediating learning.
Implications suggest how teachers’ can take risks into spaces that are uncomfortable for them, like ELs’ native language, so they may change their practices for the needs of ELs.

In regards to third space, Karen became aware of her teacher authority, which she refers to as “teacher-control,” as being an inhibitor to student oral participation. In the first unit, Karen is aware of a FoK counter-script, but falls short of mediation because she is unable to produce playgrounds as something scientific. In other words, “squares” are learned, but not “problematised” in a science or math context. Also, Karen’s dominant teacher-authority refrains from students’ participation to mediate learning from their funds. In the second unit, Karen shifts to create student-dominant discourse, but mediating math and science also does not occur. Although new building funds are learned, I contribute the lack of mediation because Karen relinquished too much control, as she was no longer the facilitator. Finally, Karen uses FoK to mediate third spaces and learning because she extends on student talk to acquire funds, but facilitates the discussion toward math and science, shared discourse. Figure 28 reflects Karen’s approach to third space.

For example, in the “Compost” third space transcript, she extends on a students’ FoK counter-script by asking a FoK question on the TV show Wild Krats. ELs are also facilitating the conversation as they share further FoK about the show. Once Karen is able to recognize several
students TV funds on “Wild Krats” having the potential to be scientific on the standard of plant needs, she mediates learning in a third space. Therefore, FoK mediation is critical to the teacher (a) sharing classroom discourse with students by extending their FoK counter-script, and (b) proficient pedagogical content knowledge of math and science in order to facilitate the (language)learning. Furthermore, an outcome of FoK mediation in a third space is the production of new meaning-making. Karen and her students discovered new ways to conceptualize “plant needs,” to items, such as compost, as plant “helpers” for survival.

Finally, Karen’s shifts of Brock from a deficit to additive view, presents implications to the power of examining student discourse to capture teachers’ awareness on ELs participation practices. In particular, how discourse analysis can inform teacher’s decision-making on math-science funds for classroom discourse, and other ways of fostering student talk. Furthermore, although the study looked at FoK for mediating oral participation, non-oral participation should also be explored.

D. Abby Mediating FoK for Learning to Make Meaning

Abby’s approach to FoK for mediating math and science differ from Karen. Abby is a teacher who began with a procedural-resistance identity and then, represented a FoK inquiry teacher identity. Abby’s focus is on making-meaning of science concepts for her students. This section discusses Abby’s shift from a deficit to additive view on ELs. Then, it explores her procedural-resistance identity and shift to acknowledge FoK for motivational interest, not academic content knowledge. Her emphasis on tension is explored as she learns to integrate new meaning of FoK for mediation in a third space. In particular, she explains how ELs’ FoK misconceptions can lead to science (language)learning.

1. Abby’s Deficit View of ELs

Before planning the first unit, Abby held a deficit view of ELs and their FoK. Abby didn’t value ELs native language because she believes they “have to write English because there in a
monolingual classroom” (Weekly Study Group, February 8, 2011). The cultural and linguistic gap between Abby and her students made it difficult for her to understand her students’ perspectives. Abby describes when students’ shared their everyday practices with her, she struggled to make sense of what her students were saying because she viewed it not relating to content and “going off too much, like way out in the outfield” (Interview, November 22, 2011). In addition, Abby thought ELs should have similar needs as their mainstream peers. She did not know what it meant to be an EL because she says, “I am not an English language learner myself, so I had a hard time understanding that they need support to learn English and science.” Abby’s unawareness on ELs having separate needs from mainstream students, made it challenging for her to value FoK as a tool for students’ learning.

2. **Procedural-resistance to FoK**

During the Researching Playgrounds Unit, Abby remained resistance to the idea that FoK can be a tool for math and science (language)learning. However, she represents a procedural-resistance identity because she did go through the motions that project LsciMact requested, such as gathering students funds. She explains her procedural-resistance to FoK in a lesson objective on October 14, 2010, where she inquired students to design survey questions that would inform what the Genesis’ community perspectives were on having a playground. Abby interprets the “lesson as a failure” because the students share their funds to “just talk about what they want but never get deep in content to help them understand” the science and math objective (Weekly Meeting, December 8, 2010).

I explored the lesson further to make sense of Abby’s FoK perspectives. Initially, Abby wanted to explain the importance of obtaining data from surveys as proof against or for a playground. She asked her students to think about the concept of “proof” in lines X.

**Official Script**

146 Abby: Give me proof. Why do we need a playground?
Jen: It's fun.
Abby: If I say principal we really need a playground because it’s fun, does it take one person or more than one?

Counter-Script

Jen: It’s a hard hard job.
Abby: Okay to build one takes lots of people. Talk with your groups who do you know to help us get a playground?

Abby responds in lines 148-149 to hint that more than one person’s survey data is needed for a credible claim. However, Jen interprets the need for a playground, not deriving from surveys, but in the actual construction of a playground in lines 150 when she says it’s a “hard job” to build. Abby extends on Jen’s comment to engage in a third space discourse by asking a FoK question on who the students know, as resources, to help build the playground.

Third Space: “Playground Resources”

Abby: Who wants to share a good person they know to help make a playground?
Lexus: My parents.
Abby: Your parents put it up. I over head Gracy say something. Gracy come up here.
Gracy: My cousin has money.
Abby: She says my cousin could help us because he has lots of money. You think we are going to need lots of money to build a playground? (class responds yes).
Abby: Okay heads down. Just listen. I am going to read what you wrote. I see “Ms. Abby” yes I want to help out. I see “workers.” Who said workers? (students raise hands). Oh a bunch of you. What can workers do for us?
Ron: Build it.
Abby: Oh okay so they can help us build.

In lines 154-156, Abby has students share funds such as students’ “parents” and a wealthy “cousin” to contribute. Abby restricts students’ talk to have them put their “heads down” and “listen” so she can read the responses. Students also add knowing community “workers,” however Abby doesn’t explore the funds further such as what type of workers or the relationships of these workers are with students. Similarly, Abby doesn’t expand on asking questions for how students’ parents or cousin’s funds can assist. As a result, Abby modifies her intended lesson to have students engage in a dialogue on who they know to help, but fails to connect students’ funds to the math and science objectives on surveys, data, or proof. Abby describes the lesson as being “just a tangent” (Weekly Meeting, December 8, 2010) and learning about her funds was not beneficial for teaching math and
science. Therefore, Abby viewed students’ funds being unrelated to academic content and remained resistance to FoK as a tool for math and science content.

3. **FoK for engaging student interests**

When implementing the first unit, Abby immediately saw value in FoK as a tool for engaging students’ interests, even though she was unaware of how to use FoK to mediate math and science content. For instance, during the Researching Playgrounds Unit, she describes the importance FoK has on students being “excited for the playground unit because it’s meaningful to them” (Teacher Journal, September 10, 2010). However, in the second unit, Abby builds a new awareness for using FoK to engage students’ interests during classroom discussions, as opposed to planning student interests in the curriculum topic of playgrounds. I identify Abby’s awareness as a change in her organizing student learning using FoK for mediating students’ playground interests to academic interests. Abby’s awareness on FoK for students’ interests in the discourse occurred during a lesson objective where students learn how slope is an independent variable in the Slides Unit on February 18, 2011.

164 Abby: You are turning into engineers (*class is noisy*). Sh. Sh. I want to say something that I just heard. Alex can you say that louder. Just tell us.
165 Alex: Girls can’t be engineers
166 Abby: He said girls can’t be engineers. Why do you say that Alex?
167 Alex: (3 seconds) Because-
169 Abby: [Whose ever seen a girl engineer? Maybe you have never seen one?]
170 Holly: What’s an engineer?
171 Abby: Okay let’s start with what is an engineer. Let’s talk this out.
172 Elisa: A person who works.
173 Abby: I work, am I an engineer?
174 James: A person who builds something.

I observe Abby engaging in Alex’s controversial remark that “girls can’t be engineers.” Instead of telling Alex his opinion is incorrect, Abby directs Alex’s comment into a question if girl’s can be engineers. She attempts an answer to the question by fostering Alex’s counter-script to ask an Experience FoK Question (EQ), “whose ever seen a girl engineer?” However, several students, including Holly, are unable to answer the EQ since they are uncertain “what an engineer” is.
Therefore, by engaging in Alex’s counter-script, a larger dialogue emerges on what it means to be an engineer, and if girls are included. The students conclude that an engineer is “a person who builds.” Based on engineers being builders, Abby restructures her original EQ to now ask the following FoK question in line 175.

175 Abby: So who has seen a girl build something?
176 Gabby: I saw *(makes circles with hands)* a girl they build uhmm a house.
177 Abby: So a girl was helping build a house. So do you think that girl is a
178 engineer? *(class responds ‘yes’)*. Anyone else? Derick?
179 Derick: A girl.
180 Abby: Building what?
181 Derick: A house
182 Abby: Do you know the girl or was it someone you saw walking by?
183 Derick: Walking by.
184 Abby: So you also saw a girl building a house. So what Alex said is true, lots of
185 people don’t see girls engineering things. I agree. I mostly see guys
186 building things and people outside working on construction are usually
187 boys. So this is a question for the girls. Do you think you are smart enough
188 to be engineers like boys? *(class shouts ‘yes’)* So let’s prove to these boys.

Abby provides an answer to Alex’s claim by drawing on students funds using EQ. Gabby describes seeing a girl build a house and Derrick confirms witnessing the same. Abby attempts to elicit funds by asking what relationship Derick had with the woman engineer, but Derick indicates he was just “walking by” and saw her constructing houses. Therefore, the students describe their funds to prove to Alex that woman engineers do exist.

In my findings, I interpret Abby engaging in students’ funds using FoK questions as an extension to mediating the definition of an engineer. Abby channels Gaby’s and Derick’s funds to extend the definition on what an engineer is to who an engineer can be. In doing so, Abby expands the notion of an engineer relating to math and science. Engineering is a type of scientific *technological design* (ISBE 11B) since the students are building innovative slides, and involves *mathematical practices* (Common Core) such as using measurements to problem-solve their slide heights. Therefore, Abby is able to use students’ funds to assist her students making that woman can be scientists and mathematicians.

In contrast, I attribute Abby’s understanding of FoK based on her limitation of not knowing
how FoK can connect and be relevant to academic content. Instead of seeing how FoK can assist in academic learning, Abby found the purpose of using students’ funds so that her female students would not be discouraged from partaking in the Marble Experiment. Abby says she viewed students’ “funds as [a way to] engage and motivate [her female] students” (Group Report, April 5, 2011). She further says she did not view FoK to be academic “content heavy” which is why she directs in lines 188 to encourage female academic interests by stating, “let’s prove these boys” we can be engineers.

4. **Learning FoK through tension**

Abby evolved in her understanding of tension for learning. Tension became important to study because it is through tension that Abby discovered how to make sense of FoK for socially organizing math and science learning. She defines tension as “challenging the content between students or student and the teacher” (Action Report, p. 5). I explored additional terms of how Abby refers to tension including: “challenge,” “disagreement,” “struggle,” “misconception,” “students hashing it out,” “defending ideas,” and “unsure.” In Abby’s classroom, I observed tension to be a discourse where students and the teacher negotiated their contested ideas, which included disputing students’ FoK. As a result, Abby and the students would collectively struggle to make meaning of the academic content. Table 9 summarizes Abby’s evolving awareness of tension in each unit. In the first unit, Abby recognizes the need to research her tension practices to mediate academic content. In unit two, Abby searches for ways to create tension. Finally, in unit three, Abby synthesizes how FoK can be integrated with tension through third spaces. In the following, I explore each of these shifts to show how Abby emerged to value FoK and use FoK to mediate math and science learning.
TABLE 9. ABBY’S AWARENESS OF TENSION

<table>
<thead>
<tr>
<th>Unit One</th>
<th>Unit Two</th>
<th>Unit Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abby’s awareness of tension as a tool for student learning:</td>
<td>Abby’s awareness to create tension:</td>
<td>Abby’s awareness of integrating FoK and tension as a tool for student learning:</td>
</tr>
<tr>
<td>• Tension can assist students to make meaning of academic content</td>
<td>• Teacher creates tension by asking “tension questions”</td>
<td>• FoK can mediate tension to foster third spaces for learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abby’s awareness to create tension:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Students can create tension by challenging each others’ FoK</td>
</tr>
</tbody>
</table>

a. **Awareness of tension**

In the first unit, Abby valued tension as a beneficial tool to assist students meaning making of math and science instead of FoK. Her awareness emerged on September 23, 2010, in a lesson about what students can find on a playground. A student, Anna, mentions seeing a plant and Abby inquires further.

189 Abby: How can you tell something is a plant?
190 Anna: Anything in the dirt.
191 Abby: Anything in a dirt is a plant? What’s something in dirt that’s not a plant?
192 Holly: A worm.
193 Derick: A worm makes it grow.
194 Abby: Is a worm a plant? Listen. Sh. She says a worm is not a plant. He says a worm is a plant because it makes the flower grow. Who else can tell us what is a plant?
195
196

In the lesson, Abby creates tension by asking students to come up with characteristics that make something a plant and challenging student’s answers. She contests Anna’s response by asking if there is anything in the dirt that’s not a plant. Holly responds a worm but Derick adds his knowledge of worms helping plants grow. Abby extends Derick’s comment as a way to create tension by questioning if a worm can be a plant based on what makes something a plant.

This conversation was important because it was the first incident where Abby saw tension
emerging. She saw tension as a valuable tool because it facilitated the meaning of plants with her students. Abby explains her importance of tension because it was a way for her to “hear multiple answers” (Individual Report, p. 6) from students. As students would share their responses she found tension helpful for organizing learning because “it is not just the teacher telling you something. They [students] are figuring it out and it takes tension to hash it out” (Weekly Meeting, December 8, 2010). Abby viewed tension as a way for the teacher to problem pose and students to problem solve with the teacher facilitating.

b. **Fostering tension through questions**

After becoming aware on the existence of tension, Abby searched for ways to create tension in the second unit. Abby discovered that teacher-facilitated “tension questions” can foster tension. Initially her understanding of a “tension question” was any question asked by the teacher that produced tension conversations. Her awareness of “tension questions” appeared during a lesson teaching the concept of gravity on February 9, 2011.

| 197  | Abby:  | Raise your hand if you heard the word gravity. Okay. Sam can you tell us what gravity is. |
| 198  | Sam:   | It’s like when something is falling and like you drop it but it goes down because it’s heavy. |
| 200  | Abby:  | So is this paper heavy? (*class says ‘no’*). But does it go down when I drop it? (Abby drops paper and it falls. *Class says ‘yes’*). So how does it go down when it’s not heavy? |
| 201  | Sam:   | Because uhm there’s gravity that goes down to the ground and its made hard. |
| 202  | Abby:  | But it’s not big and it’s not hard. Why does it go down? |
| 203  | Sam:   | it’s uhm really soft but its- |
| 204  | Abby:  | [So you are saying if it’s really light it goes down. You guys want to try it?] So gravity is what pulls everything down to the ground.] |

In this lesson, Abby finds herself creating tension between her and Sam through teacher questioning. Sam responds that gravity impacts “heavy” objects to fall. Abby creates tension by challenging Sam’s statement to question in lines 201 if a student identified non-heavy object, like paper, could fall. Abby reiterates again to Sam why “it goes down when it’s not heavy?” Sam provides another hypothesis that the object is “hard.” Again, Abby fuels the tension by taking Sam’s answers and
developing further questions in lines 205 “it’s not hard” so why “does it go down?” Finally, Abby provides an answer, after demonstrating to the class how the paper falls because gravity “pulls everything” to the ground. Abby saw how teacher’s questions that disagree with students’ opinion could foster tension.

On July 12, 2011, I had Abby revisit this transcript and re-conceptualize how she defined tension questions. Abby and I together identified moments of tension and examined the type of teacher questioning that emerged. Table 10 describes two types of tension questions that created tension: (a) Questioning the Fundamentals (QFs) and (b) Evidence-Based Questions (EBQs). QFs were questions that challenged students’ fundamental perspectives. EBQs were questions where the teacher asked for evidence or a counter-example to prove or disprove a students’ claim.

<table>
<thead>
<tr>
<th>Questioning the Fundamentals (QFs)</th>
<th>Example:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sam: It’s heavy.</td>
<td>Abby: So is this paper heavy? (class says ’no’)…So how does it go down when it’s not heavy?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence-Based Questions (EBQs)</th>
<th>Example:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abby: How can you tell something is a plant?</td>
<td></td>
</tr>
<tr>
<td>Anna: Anything in the dirt.</td>
<td></td>
</tr>
<tr>
<td>Abby: Anything in a dirt is a plant? What’s something in dirt that’s not a plant?</td>
<td></td>
</tr>
</tbody>
</table>

Reflecting on tension questions became important for Abby because she realized in the lesson that tension existed only between her and Sam because she only questioned Sam. She says, “I kept challenging Sam hoping to see the whole class engaged, but it was just Sam” (Action Report, p. 7).
contribute the lack of participation because Abby invited students having prior knowledge on the term gravity to speak, which restricted other students from being able to partake in the science discussions. I suggest for Abby to consider asking FoK questions during moments of tension to allow for other students who don’t have prior knowledge to be able to share. Therefore, Abby became curious to explore how she could have the whole class engage in tension as well the possibility of students creating tension on their own.

c. **On the path to FoK for learning**

In the third unit, Abby identified her awareness of FoK appearing during moments of tension on April 28, 2011. The lesson objective was to learn what an organism is. In order to define an organism, Abby asked students to provide organism examples and Deon suggests an elephant. Having been conscious of asking teacher tension questions, Abby fosters tension by initiating QFs in lines 209, 211, and 213.

<table>
<thead>
<tr>
<th>Line</th>
<th>Student</th>
<th>Natural Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>209</td>
<td>Abby</td>
<td>How do you know it [elephant] is an organism?</td>
</tr>
<tr>
<td>210</td>
<td>Deon</td>
<td>It’s alive</td>
</tr>
<tr>
<td>211</td>
<td>Abby</td>
<td>How do you know it’s [elephant] alive?</td>
</tr>
<tr>
<td>212</td>
<td>Evan</td>
<td>It has a heart.</td>
</tr>
<tr>
<td>213</td>
<td>Abby</td>
<td>Are there things that have a heart that aren’t an organism? Talk to your neighbor.</td>
</tr>
<tr>
<td>214</td>
<td>Alex</td>
<td>We talked about an organism is like without a heart I guess grass.</td>
</tr>
<tr>
<td>215</td>
<td>Abby</td>
<td>Do you agree with what Alex says Katy? What makes grass an organism?</td>
</tr>
<tr>
<td>216</td>
<td>Katy</td>
<td>It grows.</td>
</tr>
<tr>
<td>217</td>
<td>Abby</td>
<td>Who wants to respond to that? Is there an organism that does not grow? Can you turn and talk to someone.</td>
</tr>
</tbody>
</table>

Deon provides an answer to Abby’s QF from lines 210 to state that organisms are “alive” and have a “heart.” I notice after receiving a response from Deon, Abby changes the nature of her questioning to ask EBQs to fuel the tension even further. For instance, in lines 213 she asks for counter-examples of organisms that don’t have a heart, as well lines 217 asking if there are organisms that don’t grow. Abby interpreted students’ counter-examples as a way through which students’ shared their funds. She writes how “I guide their learning through questioning and having students discuss counter-examples from their FoK” (Action Report p. 55). In other words, Abby perceives students’ counter-
examples as students FoK because she is asking students to share what they know about the characteristics of organisms. Abby begins to see a purpose for how students’ funds can be shared to construct claims during moments of tension.

219 Andy: An ant
220 Abby: Is an ant an organism?
221 Andy: No.
222 Abby: Do they grow?
223 Andy: No. There small.
224 Abby: Oh they are pretty small. Let’s think about that. Has anyone seen a baby ant?
225 (class raise hands and screams ‘yes’). Has anyone seen an adult ant? Are there different sizes?
226
227 Brian: Yeah there this little (shows using his finger size of ant) but like longer
228 Alex: [Yeah they grow]
229 Abby: So you seem to think there are baby ants even if they grow a little bit. Can we say organism is something that grows? You guys are very good scientists. You figured out that organisms do grow. Plants grow and animals grow.

Andy provides a response to Abby’s EBQ from line 219 to suggest that “ants” do not grow. Abby viewed Andy’s counter-example of ants not growing as being part of his funds, and rather than tell Andy he is incorrect, she decides to use a FoK question, EQ, to inform why ants are an organism. She asks the class if anyone has seen a “baby ant” and an “adult ant” and to speak about observing a difference in size. Brian demonstrates the difference he observed in the two sizes of ants to show that the ant grows and Alex concurs. Therefore, Abby is able to assist students to recognize that Katy’s rational of all organisms growing is a true characteristic.

Although Abby views students’ counter-examples in this lesson to be a form of students’ funds, I perceive that the dialogue was on the path to FoK. Abby thought the counter-examples were FoK because she saw how the open-endedness of the counter-examples could have afforded students the opportunity to share their FoK. However, it is unclear as to whether these examples were derived from students FoK or, for example, their prior knowledge. Instead, I attribute the lesson to be an emerging FoK. The FoK dialogue emerges in lines 224 and 225 when Abby asks students if they have seen ants. In other words, FoK emerges because Abby begins a discussion on practices and experiences students have had with organisms. However, she doesn’t foster students to extend
their FoK practices with regards to ants and other organisms. The conversation could have been a representation of FoK if Abby engaged in further EFQs, such as inquiring Brian’s observations, experiences, and practices like what he did with the ants to prove how he knew the different sizes.

I found that the counter-examples were beneficial in proving or disproving a student’s claim. For instance, after Abby acknowledges that all organisms grow, the students begin to provide counter-examples to ‘test’ the claim.

232 Elisa: Apples!
233 Abby: Okay let’s do apples. Does an apple grow? (class yells ‘yes’ and ‘no’) If you
234 are going to tell me you have to tell me why. Mark do apples grow?
235 Mark: Yes.
236 Abby: Where do apples come from?
237 Mark: A store.
238 Abby: Where do people from the store get them? Danny?
239 Danny: Apple tree.
240 Abby: Do you think apples on apple trees grow from small to big? Yeah the tree↑ grows and it gets bigger.

Elisa proposes the example of “apples” to see if it is an organism or not based on the definition of organisms growing. However, tension emerges when half of the class disagrees with the other on if apples grow or not. Abby facilitates the argument by asking, what she perceives to be FoK, about students’ knowledge of apples. Mark believes apples come from the store, but Danny elaborates to explain the store receives apples from an apple tree.

Abby discovered that what she perceived as FoK, driven through counter-examples, challenged her own understanding of organisms and made her re-evaluate if the definition on all organisms grows is true. While answering the question, Abby recalls being skeptical if apples would count as an organism based on their definition because the “apple grows from small to big.” She says, “I was stuck wondering if they are not still growing because they are on or off the tree or are they still organisms. I hashed out the definition along with the students” (Action Report, p. 61). Here, Abby perceives FoK beneficial for learning because she is confronted with a counter-example that she did not already know the answer to and so she was “stuck” on how to answer it. As she
engaged with the students about apples, she came to the conclusion in lines 240-241, that if the apple is still on the tree, then the apple “tree grows” and gets bigger.

Furthermore, Abby explains that if she had pre-selected examples of organisms and non-organisms they would have been “clear cut objects, but because I opened it up to their FoK there was more learning” (Action Report, p. 60). Learning about apples, was an example of learning to make-meaning of what is an organism. The students’ counter-examples were complex because the answer required abstract thinking on what object was actually growing, the apple or the apple tree. Therefore, Abby also learns that FoK can assist in learning because it challenges the content further, such as defining what counts as an organism. In addition, she notices how when she allows for students to identify counter-examples, through her perceived FoK, it expanded the conversation to multiple students, than just between her and one student, like in the Gravity transcript. Thus, she also learns that FoK has the potential to engage multiple students through tension. Therefore, I identify the emerging funds being essential for Abby’s awareness that FoK can assist learning, and was a necessary step for her to transition into a representation of FoK for learning.

d. **FoK as misconceptions for tension and learning in a third space**

In the third unit, Abby discovered that she can use students misconceptions, derived from their FoK, to teach academic content in a third space. Her awareness and practice of FoK for academic learning emerges as she (a) identifies students’ misconceptions (b) fosters FoK to create tension in a third space and (c) facilitates FoK towards the intended objective.

1) **Identifying FoK misconceptions**

I observed Abby identifying students’ FoK misconceptions by inquiring FoK questions to learn about her students’ funds. Students’ funds appeared during a lesson on May 13, 2011, where students were to express what organisms they want on a playground and how they could create an environment for its survival. As students worked in their groups, they
expanded the objective to also discuss organisms they did not want, specifically bats. Therefore, Abby guides the students to discuss organisms’ relationship to the environment, and how they could inhibit bats from entering their playground environment.

**Official Script**

242  James: We don’t want bats.
243  Abby: How do you get them to stay away?
244  Alex: When it’s sunlight they get melt because they are like vampires.
245  Abby: Are you talking about vampires or bats?

**FoK Counter-Script**

246  Alex: Bats. But vampires and bats are the same thing. Vampires can melt like bats.
247  Abby: So are they the same thing?
248  Holly: Because vampires like blood and bats like blood. Every time they smell it they go to the blood.

I saw Alex’s FoK appears in lines 244 when he self-connects his FoK as an answer to Abby’s question of keeping bats away. In lines 246, Alex’s FoK counter-script emerges to claim that bats and vampires are “the same thing” and can “melt” in sunlight. Abby extends the conversation to ask an ESFQ on why he thinks bats and vampires are the same. However, Holly provides an answer, sharing similar FoK, that they both “like blood.” As Abby explores students’ vampires and bats funds, she recognizes the students had misconceptions. The first misconception lays in the students believing that bats and vampires are interchangeable terms, and secondly, the concept that organisms, like bats, can melt.

2) **FoK mediating tension in a third space**

Abby learned that students’ FoK mediates tension, between the teacher and other students, and can create third spaces. Abby defines third spaces as “the teacher changing the teacher script to interact with the counter-script…teacher helps bring the discussion back to content objectives” (Action Report. 4). In Abby’s definition of third space, the teacher returns to their intended objective. However, I found that when interacting with students’ FoK, third spaces created the learning of new meaning and new multiple science objectives that were unplanned from
Abby’s lesson plans. These emerging science objectives, derived from contesting students’ funds, allowed Abby to debunk misconceptions and teach the intended objective of creating an environment for organisms students want.

During group work, Abby requests Alex and Holly to explore their existing FoK claims by obtaining information on the characteristics of bats through a science research program called PebbleGo. I found Abby fosters a third space when she interacts with the student’s FoK counter-script on bats to present their results to the whole class.

**Third Space: “Bats and Vampires”**

250  Alex: Some bats eat uhm prey. Some eat in the night to find prey. Most bats eat
251   insects and a few eat small animals.
252  Abby: Stop there. What’s prey?
253  Holly: Prey is there food, like what food they like.
254  Abby: So prey is what they eat. So how can we keep bats out?
255  Alex: Yeah but we need some sun for the bats for they to melt.
256  Abby: Does it say they melt when there in the sun?
257  Alex: One time I saw a channel for vampire and bats and when when vampires or
258   bats live in the sun they melt and sometimes and they start dying (class is
259   noisy. Students disagree 'yes' or 'no' to bats melting).
260  Abby: Okay Sh. Give me a thumbs up if you think bats melt in the sun or thumbs
261   down because we didn’t read that. Do they melt or not? They’re going to
262   decide.
263  Alex: They do because they I saw it on TV.
264  Derick: Bats don’t melt in the sun. They just die and they don’t melt.
265  Abby: Okay we have to stop. We are out of time.

I observed that as a result of Alex and Holly’s research, they educate the class on the basic needs of bats, and introduce new science vocabulary, such as “prey,” a term that Abby had not intended on teaching. However, the conversation changes into an emerging science objective on scientific inquiry. Tension appears between students and the teacher’s claim on credible sources of proof. For instance, Abby questions how the students’ knowledge of prey can inform ways for students to “keep bats out” of the environment. Her questioning leads to tension between her and Alex’s FoK in lines 260-262. Alex is convinced, based on his FoK, that environments which are exposed to lots of “sun” will “melt” the bats. Yet Abby challenges Alex’s claim to figure out where his FoK source came from and asks, “does [PebbleGo] say they melt.” The tension continues as Alex argues that
although the information is not from PebbleGo, he found a TV channel credible when he witnessed vampires and bats melt. Abby decides to provide a different source of proof by polling the class’s opinion, however the class is split in their answer, and additional tension appears between students, Derick and Alex. Derick argues that “bat’s don’t melt” and adds another perceived misconception, according to Abby, from his funds “they just die.” Before the class could reach a consensus, Abby had to end the debate because time ran out.

3) **Awareness to expand FoK learning in third spaces**

Based on the lesson, Abby became aware to how students’ could initiate tension between one another through their FoK. For instance, in line 258, the class erupts to contest one another funds if bats could melt or die in the sun. Abby no longer created the tension but found she could facilitate the conversation between Derick and Alex. In my field notes on May 20, 2011, I write how Abby explains, “I thought tension came from teacher questions, but now I see tension can arise because of disagreement between students’ funds.” Abby also integrates the concept of third space and FoK to declare that “it’s valuable and FoK lends itself to third spaces, but a connection between third space and content goals must be made” (Group Report, p. 3).

Abby felt reluctant to end the debate between Alex and Derick because she had “hoped by allowing them to look up bats on the computer they would realize that vampires are fictional,” (Individual Report, June 27, 2011) but the misconceptions still existed. In other words, Abby assumed that the students would figure their learning on their own, but discovered she needed to provide further mediation. In addition, she thought FoK and third space was “only meaningful if it was in the moment,” especially for “first graders…[who easily] lose their attention.” (Individual Report, March 22, 2011, p. 7). However, by revisiting the lesson in the next class she “realized that third space [and FoK] can be continued” (Individual Report, June 27, 2011, p.3 ).

4) **FoK for meaning-making**
I found that Abby’s realization that students FoK can be continued in another lesson was important because she could foster additional opportunities and time to inquire students’ funds extensively. Inquiring students’ funds further allowed for Abby to expand on new learning objectives. For instance, students had previously defined organisms as something that grows, but didn’t address that organisms had to be living. Therefore, on May 16, 2011, Abby teaches the class to distinguish between living and non-living things, through problem solving students’ funds if bats and vampires are the same thing.

In order to identify living versus non-living creatures, Abby activates student’ FoK by asking an ESFQ to distinguish the characteristics on what makes something a bat and a vampire. Diana classifies the two creatures by “color” and “wing” attributes. Abby creates tension when she asks an EBQ on other species that have wings but are not bats or vampires. When Greg gives a counter-example of “bird,” Abby asks, according to Diana’s classification, if birds could be vampires or bats too. Greg explores the characteristics of different organisms to separate birds from vampires and bats due to their lack of “teeth.” Tension appears between Carla and Alex since their FoK conflicts with one another. To prove the existence or non-existence of vampires, Carla claims to have never seen one while Alex claims seeing one from TV. Abby provides a resolution by extending the definition
of what it means to be a living creature through “real” life observations. She facilitates Alex’s funds by asking if anyone has seen “real people come out” and not on “Halloween.” She teaches that living organisms cannot be “fictional characters” and that’s the difference between a bat and a vampire. In doing so, Abby reiterates that evidences from real life observations are credible, compared to proofs derived from fictional TV shows.

5) **Facilitating FoK toward the intended objective**

After debunking the myth that bats and vampires are the same, Abby returns to her intended objective. Abby teaches her students that human activities can alter an organism’s ability to survive in an environment. She asks the question how bats can be inhibited from the playground environment based on the survival needs of bats.

284 Abby: So what could we do to keep bats away from the playground environment?
285 Alex: In the night they move. In the morning they don’t come. If we have a light
286 Abby: They see the light and they might melt or die.
287 Abby: Does anyone know the word they call animals that like to be active at night?
288 It starts with a “n” and “o”?
289 Ned: Nocturnal.
290 Abby: Yes. It means they like to do things at night time.
291 Jen: They don’t melt because they don’t melt like ice cream because of the sun
292 Abby: Ice cream can melt, but can organisms melt?
293 Jen: I went one time with my dad and we saw bat and we put a light on it and
294 I did not see when he die or melt.
295 Abby: Maybe if you shine a light on bat and they don’t like it they might hide and
296 you think they are gone or melted but organisms can’t melt. So maybe bats
297 won’t like that environment. What kind of environment would a bat live in?
298 Carla: A cave.
299 Abby: I agree a cave because is cave very dark. So a way to keep bats out are to do
300 what?
301 Alex: Flashlight on them.
302 Abby: Have lights right so they don’t come.

Alex and Jen create tension based on their conflicting FoK if bats can “melt” or “die” in sunlight.

Jen provides proof to bats not melting by comparing its characteristics to that of an ice cream. Abby explain because ice cream is non-living it can melt, but organisms, like bats, could not melt.

Furthermore, Jen also shares proof through her FoK when she saw a bat, but did not observe a bat die when her father put a light on it. Abby confirms the accuracy of Jen’s funds by providing
alternatives that bats “may hide” or be “gone.” She clarifies the misconception and indicates a
nuance to the definition of organisms as living creatures that do not melt. Abby also uses students
FoK misconception as an opportunity to teach a new term “nocturnal” to explain how some
organisms interact with their environment at night. Abby returns back to the intended objective to
question how nocturnal creatures can be avoided from the environment. Alex is able to correct his
misconception by explaining that flashlights can create a habitat for bats to not thrive in the
playground.

5. **Learning through FoK misconceptions**

Often time’s teachers may think FoK misconceptions are inhibitors to student
learning because students are misinformed about science content. However, Abby used
misconceptions as a way to teach for new science understandings because it was through students’
FoK, even if it was misconceptions, for how they made sense of the content. She describes the
importance of FoK because “I helped students see that vampires are fictional and bats are real by
using their FoK. Students saw vampires are fictional because they were in TV, books, and on
Halloween” (Individual Report, June 27, 2011).

I observed that the teacher needs to be proficient in the learning standards and pedagogical
content knowledge in order to navigate students’ FoK for math and science. In unit one and two,
Abby found students’ funds unrelated to math and science content because she expected students’ to
make self-connections about their funds and academics. However, Abby shifted her thinking in unit
three, to discover that the teacher plays an integral role to guide students’ funds for learning. She
says she has to “facilitate student learning by using their FoK to reach the objectives in an alternative
way” (Action Report, p. 37). However, I discovered that Abby had to be proficient on the science
concepts of organisms, in order to know how to bridge students’ FoK on vampires and bats toward
the science standards. When Abby heard that vampires can be organisms, she explained how she had
to plan in the moment, not from what was indicated in her lesson plans, in order to connect students’ funds to science learning. For instance, upon hearing students’ funds, Abby makes a connection to three IL science standards that she could refer to in the third space: use questions to guide scientific inquiry (11.A.1b), describe and compare characteristics of living things in relationship to their environments (12.B.1a) and, describe how living things depend on one another for survival (12.B.1b) (Action Report). Therefore knowledge of the standards provided Abby with a direction for where to channel students’ funds for learning. Additionally, I discovered that navigating students FoK created science objectives that Abby was unaware could emerge. These objectives included new vocabulary such as “prey” and “nocturnal,” understanding living verse non-living, clarifying the definition of an organism, providing sources of credible proofs and claims, and identifying characteristics between different or similar organisms. In closing, had Abby just told the students that vampires are fictional and moved on, she may not have engaged in the multiple science objectives that emerged through students’ funds.

6. **Valuing ELs FoK for language and learning to make meaning**

Abby transitioned from being reluctant to teaching through students’ funds to embodying FoK practices for academic learning. Abby came to value FoK as a tool for ELs to develop language and meaning in the content areas. In the first and second units, Abby taught the language of science and math by defining vocabulary terms for her ELs because it would save time. However, in unit three, Abby reflected on how she taught the term “organism.” She said “I watched them figure it out and I never told them but asked questions to let them hash it out and disagree. I feel like they know what an organism is better than what I could teach them” (Individual Report, June 27, 2011). Therefore, for ELs, she learned it’s best to not give definitions in an unfamiliar language, like English, where students are already not proficient. FoK became important for language learning because Abby recognized that students’ examples and tension, arose from their
FoK, assisted students’ to challenge, hypothesize, evaluate, and reflect how to define an organism on their terms.

Although teaching vocabulary from students’ FoK in third spaces takes more time, Abby found the learning to be authentic because students comprehend science vocabulary through their FoK, and ways of making-meaning. She synthesizes that “third space, tension and FoK are all related. I believe that FoK facilitates and bring about content heavy third space and tension. When I allow students to disagree and enter a third space students get more from the content faster” (Individual Report, June 27, 2011). Abby recognized that she could teach the content “faster” using FoK because learning was mediated from the students’ perspectives. She culminates her thoughts on the third unit to say, “students’ talk about bats, vampires, worms, and dog poop because it was how they made meaning on the lessons. These were not topics I would have chosen to teach but this allowed students to make their own connections” (Action Report, p. 51).

7. **Summary of Abby using FoK for (language)learning to make meaning**

Abby’s FoK practices and perspectives differ from Karen’s significantly. Her case represents a procedural-resistance teacher learning to legitimize and mediate FoK for math and science as she becomes a FoK inquiry teacher. The table below demonstrates the evolving shift and FoK practice for Abby’s movement to mediate FoK.

In the first unit, Abby’s third space discourse on “Playground Resources” reflects how she refrains extending on student FoK counter-script because familial funds are perceived as “tangents.” We learn that mediating FoK requires a teacher to find value in the theory for learning. However, Abby shifts to have some affinity towards FoK at the end of the first unit. She regards FoK as an emotive benefit since students are academically interested in math and science because it is relevant to their life. In particular, FoK was used for girls’ motivation to be engineers, since drawing on their funds revealed that female engineers exist. Here, we learn that to mediate FoK, the teacher needs to
have awareness of an academic objective with respect to students’ funds, instead of just fostering motivation.

However, Abby’s movement to FoK mediation for science emerges from her awareness on tension. In the first unit, Abby found moments of tension meant there was not one “right” answer, but multiple answers, that may conflict with one another. These multiple responses meant different perspectives and ways to make meaning that may be different from the teacher’s intended views of the science objective. This made her identify a problem on how to foster tension in her classroom for making new meaning of science. She found that asking tension questions, such “questioning the fundamental” and “evidence-based questions” could foster student tension in the second unit.
In the third unit is where we begin to see transformation in Abby as a FoK inquiry teacher and the beginning for mediating FoK for science content. Abby recognized moments of tension in her classroom discourse when asking tension questions resulting in students’ disagreeing on examples of organisms they knew. She perceived ELs’ counter-examples were their funds during tension conversations. However, the researcher found that Abby was on the path to using FoK for mediation because these counter-examples were not further explored in the lives of students to know if the examples were funds or prior school knowledge. This suggests teachers can mediate FoK if they extend and interact with student FoK discourse for learning. From Abby, we learn the potential for the teacher to ask tension questions and have students disagree on their counter-example funds in a third space. This is represented in the figure below.

![FoK mediation diagram](image)

**Figure 30. ABBY’S THIRD SPACE-FoK MEDIATION**

The third space discourse on “Bats and Vampires” demonstrates how Abby learns to use students’ funds for mediation. Abby recognizes students’ FoK can be misconceptions, when student say bats and vampires are organisms. In addition, she is aware of how students’ conflicting funds can create tension for learning, such as students disagreeing by using their funds if vampires are real.
The figure below, shows how Abby is able to mediate FoK in a third space. Abby’ interacts with tension from ELs conflicting funds to foster a third space mediated by bats and vampire science funds. In doing so, she is able to draw on standards of scientific inquiry and vocabulary that were unplanned because it was needed to clarify the misunderstanding. In doing so, authentic meaning happens as both Abby and ELs, must re-conceptualize what an organism is.

**Figure 31. ABBY’S THIRD SPACE-FoK MEDIATION IN “BATS AND VAMPIRES”**

This shows that for teaching ELs, math/science vocabulary terms are not fixed definitions, but can have contested meanings. Whereas earlier the students thought organisms grow, here ‘vampires growing’ had to be re-assessed, from the perspective of organisms as living things. Here, we learn that often time’s teachers may think FoK misconceptions are inhibitors to student learning because
students are misinformed about science content. However, Abby used misconceptions as a way to teach for new science understandings because it was through students’ FoK, even if it was misconceptions, for how they made sense of the content. As a result, she is able to value FoK as a legitimate resource for learning, which in turns, shifts her view of ELs from a deficit to an additive view on the importance of fostering their discourse and life-experiences for science content.

E. **Summary of Mediating Math and Science in the Classroom Interactions and Discourse**

This chapter extends on how teachers’ use FoK to mediate math and science (language)learning by examining classroom interactions and discourse between students and the teacher. The chapter is also indicative of Abby and Karen’s development toward becoming a FoK inquiry teacher. Both the teachers shifted to take it upon themselves to appropriate a FoK theory in ways they saw would address the needs for their students, resulting in student transformation for participation and meaning-making. Appropriating a FoK inquiry teacher identity is important because teachers’ can contextualize decision-making and pedagogical practices to mediate student learning using FoK. Had the teachers remained procedural or resistance, they may have not taken ownership of the theory to make it meaningful to their particular ELs needs. In this sense, FoK is more than just a curriculum topic for mediation, but the theory is transitory and adaptable for mediating classroom interactions and discourse. The significance suggests that teachers must be critical and aware of learning their own FoK practices, as well as how those practices inform EL outcomes. Furthermore, teachers should explore ways FoK can further mediate (language)learning aside from curriculum topics.

The activity triangle represents an overview to the teachers movement to the objective of mediating math and science (language)learning. For Karen, FoK mediation for socially organizing classroom interactions and discourse occurred in the rules, tools, and division of labor for math and science participation. The rules she displayed were FoK questions, questions that integrate FoK with
math or science content, for making math and science participation accessible to ELs through their funds. In addition, her rule on designing group work for struggling ELs, like Brock, to leverage their funds for problem solving, is indicative in his shift in his shared division of labor. Karen was able to use FoK for enacting role shifts, to privilege Brock’s status as an expert in science based on his funds.

![Activity Triangle: Teacher FoK Mediation](image)

**Figure 32.** ACTIVITY TRIANGLE: TEACHER FoK MEDIATION

Abby represented a different case where FoK mediation is represented in her rules of fostering tension and third space. Abby’s framework of third space differed from Karen. Karen asked a FoK question to interact with students’ funds for meaning-making. For Abby third space emerges through
tension questions initiated by the teacher to extend on students funds, or student discourse represented tension with one another on their conflicting funds. Abby shows how ELs’ FoK as misconceptions can also be used to mediate learning, whereas Karen’s students self identified an accurate science connection to their funds on compost. However, both teachers demonstrate that third spaces, mediated by students’ funds, created hybrid learning spaces with new meaning-making outcomes on science content.

Furthermore, both teachers demonstrated EL’s English language developing beyond vocabulary drills or route definitions. In Karen’s case, the researcher found that struggling ELs, like Brock, were able to show application on the meaning-making of vocabulary terms like slope, even though they couldn’t recall the term. In fact, ELs may use their own terms before they can appropriate the vocabulary, which is what Brock did. Importantly, Karen reaffirmed the proper term to mediate language. For Abby, the definition of an organism was always contested in various third space moments. In fact, ELs funds challenged original concepts of the term from something that grows to something that is living. Here, we learn that students’ funds, from their own sense-making perspectives, can actually facilitate meaning on science vocabulary terms in ways the teachers may have not thought of. For instance, Abby’s unawareness that ELs could think of organisms as something that melts.

Finally, we see transformation in the teachers’ view of ELs. The teachers’ use of FoK mediation helped shape them to see that their students’ and their funds are valuable assets for (language)learning. Implications suggest that teachers should take-risks to problem-pose research based questions about their ELs that they may not have answers to, a type of action-research approach. For instance, Abby is a representative of someone who looked at FoK as what it couldn’t do and from there asked FoK inquiry questions on what it could do when she integrated FoK with third space. Throughout their mediation process, the teachers had to challenge their own initial views
of ELs to prove that the problem was not with their students for their underachieving scores. Turning
toward an additive view, the possibility of (re)socializing learning in their classroom can give insight
to EL equitable outcomes.
X. (RE)CONCEPTUALIZING FoK

If you look closely our basement roof has squares of foam and plastic lining. Some parts of the foam are uneven and others may have gaps between the lining. But this is not to be seen as a flaw in our roof but an opportunity for family projects. You see, every year my father initiates a household project that requires us to work, repair, work, and repair again from kitchen cabinets to basement flooring.

Gonzalez and Moll (2002) assert the theory of FoK “is both theoretical and transitory… the concept is not static, that it evolves through each new iteration, and that is must be renewed, that is, modified and adapted to local conditions” (p. 277). The authors encourage FoK practices to be altered and shaped by the needs of their learning communities because the theory is intended to be fluid. Likewise, I present how the teachers and I reflected on FoK practices as our understanding of the term was also evolved, modified, and adapted. The teachers critically explored their FoK practices to engage in the process of "funds of knowledging." Funds of knowing refers to theorizing FoK practices, but also as a verb, emphasizes the continuous nature of these reflections. In other words, the reflexivity on funds of knowing is on-going representing the binary relationship between theory and practice. For instance, the FoK theory informs FoK practices, and simultaneously, FoK practices informs the FoK theory.

In my findings, I also use the term (re)conceptualize²⁷ to explore the research question on how the teachers conceptualize and re-conceptualize FoK. To demonstrate Abby and Karen’s evolving learning of their FoK practices, I use the term (re)conceptualize, to further illustrate the dynamic and cyclical nature of funds of knowledging. The teachers didn’t (re)conceptualize in isolation, but their learning of FoK consisted of collaborative discussions to understand FoK in weekly meetings, which included the researcher as an active participant. Therefore, I highlight multiple interventions that I conducted in the weekly meetings that informed how the teachers’ (re)conceptualized FoK. My own perspectives on FoK are also explored as they intersect with where the teachers and I collectively engage in funds of knowledging. It’s important to recognize how the teachers (re)conceptualize FoK because

²⁷ (Re)conceptualize is a term used in this study differing from its use in curriculum studies literature. It is in reference to the teachers evolving ways they theorize the term “FoK” to conceptualize and then re-conceptualize. It is to mark the cyclical nature of conceptualization as a verb that is continuous.
their evolving theoretical orientation, guided by the researcher’s intervention, informs how the teachers would access and mediate ELs’ math-science funds for math and science.

In the first section, I show how as the teachers re-define new purposes for FoK, they extend the types of FoK from expertise to knowledge, experience, and/or skills. Next, I explain how the teachers’ shifted from traditional perspectives on household funds to life-world funds by resisting and having practical limitations to conducting home visits. The third section demonstrates the teachers’ perspectives of FoK for activism, and how they merged social activism initiatives with students’ playground funds. The teachers’ also (re)conceptualized math and science funds. They evolved to integrate language and culture with the content areas to make sense of math and science funds. Finally, the teachers developed in their awareness of contextualizing FoK for ELs’ (language)learning.

A. Evolving FoK Definition

For the teachers and myself, our FoK definitions did not emerge, but they evolved. I capture the ways the teachers and myself evolve in our FoK definitions by synthesizing themes from our weekly meetings in Tables 11, 12, and 13. These themes included defining FoK as types, sources, purposes, nuances, and a definition. The type of funds refers to the category FoK was viewed in such as an expertise, experience, knowledge, or skill. Sources included spaces where FoK can be found and were either physical (i.e. households) or ideational (i.e. peer groups, community of practices). FoK purposes included the potential for what can be done with students’ funds, and expressed the rational for why eliciting funds mattered to the teachers. Nuances to the FoK definition provides a spectrum for the trajectory of how FoK was perceived in the weekly meetings. The definition of FoK provides how the teachers’ and myself, summarized the term at the end of the study. However, given the evolving nature on theorizing FoK, these themes should be viewed as a working definition.

These themes are important because they show that FoK as a definition is not conceptualized linearly, but is multilayered and complex with multiple domains. The teachers thought about FoK in
<table>
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<tr>
<th>Participant</th>
<th>FoK Definition</th>
<th>Nuances to Definition</th>
<th>Purposes</th>
</tr>
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<tbody>
<tr>
<td><strong>Researcher (Ambareen)</strong></td>
<td>The historically accumulated and culturally developed bodies of knowledge and skills essential for household or an individual’s life-worlds functioning and well being.</td>
<td>Household funds&lt;br&gt;- “how students learn at home” (WM, 1)&lt;br&gt;- “bodies of knowledge essential for household survival” (WM, 2)&lt;br&gt;- “household networks or resources to survive” (WM, 2)</td>
<td><strong>Relational funds</strong>&lt;br&gt;- “getting to know students through math and science standards” (WM, 1)&lt;br&gt;- “establishing mutual trust known as confianza” (WM, 2)&lt;br&gt;- “relationship building between students, families, and teachers” (WM, 5)</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>- “student knowledge and/or skills” (WM, 2)&lt;br&gt;- “expert knowledge” (WM, 2)</td>
<td>Expertise funds&lt;br&gt;- “students’ expertise where the teacher is the learner and student the expert” (WM, 4)&lt;br&gt;- “expert skill or expert knowledge” (WM, 5)&lt;br&gt;- “student mastery in an out of school practice” (WM, 6)</td>
<td><strong>Status of funds</strong>&lt;br&gt;- “privilege out of school knowledge” (WM, 2)&lt;br&gt;- “students funds are worthwhile and we need to validate their knowledge as being important” (WM, 13)&lt;br&gt;- “legitimize FoK for learning” (WM, 17)</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>- “household” (WM, 1)&lt;br&gt;- “community or homes” (WM, 5)&lt;br&gt;- “individual life-worlds” (WM, 7)</td>
<td>Cultural funds&lt;br&gt;- “culture as everyday practices, like brushing your teeth” (WM, 2)&lt;br&gt;- “FoK is continuous, there is not a ‘FoK time’” (WM, 13)&lt;br&gt;- “normative practices” (WM, 17)</td>
<td><strong>Academic curricular connections</strong>&lt;br&gt;- “connecting to the curriculum topic” (WM, 2)&lt;br&gt;- “relating and connecting to math and science standards” (WM, 5)&lt;br&gt;- “students funds are central to the curriculum” (WM, 17)</td>
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<td>Linguistic funds&lt;br&gt;- “students’ native language and the way they communicate” (WM, 13)</td>
<td><strong>Academic classroom connections</strong>&lt;br&gt;- “think of funds to scaffold learning” (WM, 13)&lt;br&gt;- “building multiple opportunities to learn content and language” (WM, 13)&lt;br&gt;- “student transfer knowledge from out of school to in school, so they may make sense of their funds as mathematicians and scientists” (WM, 13)&lt;br&gt;- “additional ways of support from the familiar to the unfamiliar” (WM, 17)</td>
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<td>Life-world funds&lt;br&gt;- “asking yourself who are my students as more than students in a classroom” (WM, 1)&lt;br&gt;- “what knowledge students share or exchange in their social networks” (WM, 13)&lt;br&gt;- “derived from students’ life experiences that are historically accumulated and culturally developed” (WM, 17)</td>
<td><strong>FoK for activism</strong>&lt;br&gt;- “students are using funds as social or community activists” (WM, 6)&lt;br&gt;- “student awareness to problem pose through their funds and initiate to make a change” (WM, 17)</td>
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**TABLE 12. ABBY’S FoK DEFINITION**

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<tr>
<th>Participant</th>
<th>FoK Definition</th>
<th>Nuances to Definition</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>Abby</td>
<td>“Experiences and skills that students bring to the classroom from a setting outside the classroom to help students make connections to the content and to empower the students’ learning” (Action Report, p. 4)</td>
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<td><strong>Academic curricular connections</strong></td>
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<td></td>
<td><em>Student knowledge</em></td>
<td>-“integrating into the curriculum… so it connects with every student” (WM, 2)</td>
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<td></td>
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<td>-“what students know beyond the classroom” (WM, 5)</td>
<td>-“taking what’s relevant in science to design a unit” (WM, 17)</td>
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<td>-“personal knowledge” (WM, 2)</td>
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<td></td>
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<td><em>Expertise funds</em></td>
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<td></td>
<td></td>
<td>-“expert at their home or community” (WM, 2)</td>
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<td>-“they are experts” (WM, 2)</td>
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<td><em>FoK as counter-scripts</em></td>
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<td>-“kids are not going to say what you want them to say…always be off topic” (WM, 5)</td>
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<td>-“going off on a tangent” (WM, 13)</td>
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<td><em>Cultural funds</em></td>
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<td>-“culture from their house or traditions” (WM, 5)</td>
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<td>-“we talk about playground experience but not cultural experience…like something Mexican” (WM, 22)</td>
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<td><em>Funds as Narratives</em></td>
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<td>-“sharing personal stories…like their grandma” (WM, 15)</td>
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<td>-“their stories tell an experience” (WM, 17)</td>
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<td><em>Type</em></td>
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<td></td>
<td></td>
<td>-“knowledge” (WM, 2)</td>
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<td>-“expert” (WM, 2)</td>
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<td>“experience and skills” (WM, 17)</td>
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<td><em>Source</em></td>
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<td></td>
<td>“parents” (WM, 1)</td>
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<td>“home and their community” (WM, 1)</td>
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<td>“outside classroom” (WM, 2)</td>
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<td>“outside school” (WM, 13)</td>
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<td><em>Vocabulary skills</em></td>
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<td>-“connections to teach science vocabulary” (WM, 17)</td>
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<td></td>
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<td>-“to learn new terms” (WM, 15)</td>
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<td><em>Student interest</em></td>
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<td>-“get them interested in the material” (WM, 5)</td>
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<td>-“engage students to curriculum” (WM, 2)</td>
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<td><em>FoK for activism</em></td>
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<td>-“giving students a voice” (WM, 2)</td>
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<td>-“capitalize funds for activism” (WM, 13)</td>
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<td></td>
<td></td>
<td>-“empower learning” (WM, 17)</td>
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**Notes:**
- WM = Written Materials
- Action Report = Action Report
- 1 = Written Watermark
- 2 = Written Mark
- 5 = Written Mark 5
### TABLE 13. KAREN’S FoK DEFINITION

<table>
<thead>
<tr>
<th>Participant</th>
<th>FoK Definition</th>
<th>Nuances to Definition</th>
<th>Purpose</th>
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</thead>
<tbody>
<tr>
<td>Karen</td>
<td>“The knowledge, skills, and experiences students have outside of the classroom that can be used to enrich or build curriculum” (Action Report, p. 2)</td>
<td><strong>Expertise funds</strong>&lt;br&gt;- “something good at, something know a lot about (WM, 2)&lt;br&gt;- “super knowledge, super skills” (WM, 2)</td>
<td><strong>Academic curricular connections</strong>&lt;br&gt;- “build an entire curriculum from using FoK to build based on them” (WM, 13)&lt;br&gt;- “building block for future activities” (WM, 17)&lt;br&gt;- “knowledge, skills the child has to survive aspects of the curriculum and used to build curriculum” (WM, 22)</td>
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<td><strong>Ways of knowing</strong>&lt;br&gt;- “resources for knowing” (WM, 11)&lt;br&gt;- “something not taught by a teacher” (WM, 17)&lt;br&gt;- “how they [students] know what they know” (WM, 17)</td>
<td><strong>Experiential funds</strong>&lt;br&gt;- “all people have experiential funds” (WM, 2)&lt;br&gt;- “experiences here in school understanding what their day is like” (WM, 5)&lt;br&gt;- “drawing on not just knowledge but what students’ experience” (WM, 17)</td>
<td><strong>Academic classroom connections</strong>&lt;br&gt;- “rich resources from which children can pull and apply their current understanding to new experiences in the classroom” (WM, 2)&lt;br&gt;- “power to bridge…enhance or contextualize science objective…and contextualize it in their own life” (WM, 13)&lt;br&gt;- “daily data that happens on a daily basis and to change your lessons based on what your discovering day in and day out” (WM, 17)&lt;br&gt;- “connect and make meaning from whatever angle they are coming from” (WM, 17)</td>
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<td><strong>Cultural funds</strong>&lt;br&gt;- “what’s a big part of your life” (WM, 11)&lt;br&gt;- “what they do on a daily basis” (WM, 17)&lt;br&gt;- “includes home and culture” (WM, 17)</td>
<td><strong>Linguistic funds</strong>&lt;br&gt;- “language that we speak, including Spanish” (WM, 13)</td>
<td><strong>Additive view of ELs</strong>&lt;br&gt;- “response to the deficit view of impoverished families considered bereft of intellectual or cultural richness” (WM, 18)</td>
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<td><strong>Type</strong></td>
<td>Source</td>
<td></td>
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<tr>
<td></td>
<td>- “home experiences” (WM, 2)&lt;br&gt;- “expert knowledge” (WM, 2)&lt;br&gt;- “life experiences” (WM, 5)&lt;br&gt;- “resources” (WM, 11)&lt;br&gt;- “knowledge, skills, and experiences” (WM, 17)</td>
<td>- “parents or families” (WM, 2)&lt;br&gt;- “includes school” (WM, 2)&lt;br&gt;- “home or community” (WM, 5)&lt;br&gt;- “outside of school setting” (WM, 11)</td>
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<td><strong>Oral participation</strong></td>
<td>- “encourage participation because of the way they can connect to students’ funds” (WM, 18)&lt;br&gt;- “student voices are empowered and content is deeply examined” (WM, 18)</td>
<td><strong>Funds for activism</strong>&lt;br&gt;- “students become aware of resources that could help them and have ownership to get a playground” (WM, 5)</td>
</tr>
</tbody>
</table>
relation to these various themes to create a working definition. As will be shown in the next sections, these themes act upon each other to inform the teachers understanding of what counts as FoK. For instance, the purposes of FoK (i.e. playground activism) can inform the definition of FoK (i.e. empowerment). Similarly, the sources of funds (i.e. community) can inform the teachers’ understanding on types of funds (i.e. experiences beyond household funds), which also shape their definition (i.e. FoK as out of school knowledge).

B. (Re)conceptualizing FoK Types

This section explores the relationship between types of funds and the purposes of FoK to inform how the teachers (re)conceptualized FoK. The teachers shifted in their types of funds from expertise to experience, knowledge, and/or skill. In doing so, they added another purpose for FoK to socially organize learning in the classroom interactions and discourse. Viewing funds as expertise was challenging for the teachers to see math and science because being an expert was contested. However, when expanding the types of FoK to practices such as knowledge, experience, and skills the teachers found it clearer to view what counts as math and science funds to mediate ELs’ content learning.

1. Expertise funds for developing a thematic curriculum.

As an alternative to exploring household funds, I introduced FoK as a form of “student expertise” for developing a curriculum theme. The rationale of student expertise existed as a result of me wanting the teachers to experience similar outcomes of a home visit, without entering into students’ homes since they refused to do so. I revisited the article that I shared previously with Abby and Karen by Gonzalez et. Al (1995) to identify critical findings that could inform how I define and assist the teachers to practice FoK as close to home visits as possible. In the article, I discovered the concept of “teachers as learners” (p. 449) being a common denominator of transformation for all teachers in the study. The study suggested teachers became learners when “someone comes to your home to teach you
something” (p. 449). Therefore, I chose to replicate this similar experience, by articulating FoK as student expertise, with the difference being the teachers as learners outside the home space. The idea of students teaching knowledge that they were experts in would position Abby and Karen as novices to learn their students’ funds.

Before I introduced the concept of student expertise, I asked the teachers to synthesize their year of course work and formulate a written FoK definition, so that I may gauge their initial understandings. Then, in our meeting on July 14, 2010, I had the teachers share their responses with the group.

Abby: It’s what I wrote that students are bringing to the classroom from community or home and uhm what parents are doing.

Lorena: I think of it as like I knew my dad was a baker and works at a meat store so they [students] just like knew about the market.

Karen: I make sense of the term by thinking of funds in a monetary sense, just like you might have funds from a savings or checking account, like all people have experiential funds they bring with them to school.

All three teachers hold different stances on what counts as FoK. Interestingly, Abby accepts students’ funds deriving from households, but also extends the sources of funds coming from “community” and “parents.” She views FoK for teaching as networks that transfer from these sources to the classroom. Lorena defines FoK by explaining an example of a child learning through adult practices at the meat market. In contrast, Karen draws parallels from monetary funds to all students carrying “experiential funds” to school. As I heard the teachers’ reflections, I noticed none of them responded to the purpose of what FoK would mean for their teaching. I saw identifying the purpose of FoK essential for defining FoK because it guides and filters the teachers to the types of funds they are looking for. I interject the conversation to explain the notion of expertise and its purpose for curriculum development.

Ambareen: Yeah it’s that students are seen as the experts like at the market and you as a teacher are learning about it. So the student can tell you or has mastered something about it. But just because you master something doesn’t mean you can’t learn more. Now they are looking into the market through the lens of a mathematician and scientist.

Karen: What about mastery?

Ambareen: Our job as practitioners is how can we take their knowledge and create a unit out of it. We are not privileging school knowledge over student knowledge- meaning we find out what students mastered or know a lot about and then connect to school. I don’t think you can ever truly master, but students have a
wealth of knowledge about a topic and they can learn math science in a context that relates to them.

I refer to Lorena’s market example to mediate the teachers’ thinking of FoK as student expertise. I explain that being an expert is mastering something, like the knowledge and practices of the marketplace. However, when Karen questions the idea of mastery, I clarify that in theory no one can “ever truly master” because we can always acquire additional Discourses, like being a mathematician or scientist, to make sense of our current Discourses, such as the market. I emphasize the role of the teacher as learner to students’ expert knowledge and skills. In doing so, I provide a purpose for FoK to create thematic units that are based on students’ expert knowledge, to learn math and science. Therefore, students’ expert knowledge becomes just as important as prior or “school knowledge.”

By the end of our meeting, the teachers adopted their own ways of speaking about FoK as expertise and its curriculum purpose. Abby referred to expertise in physical spaces when she says FoK is “being an expert in their home or community” (Weekly Meeting, July 14, 2010). Abby became aware of the need for a universal fund shared by all students’ expertise to achieve her curriculum purpose when she says “we need to integrate it into the curriculum…so it connects with every student” (Weekly Meeting, July 14, 2010). Karen shifted from experiential funds to skills and knowledge when defining expertise as “something their good at and something they know a lot about” (Weekly Meeting, July 14, 2010). Karen informs her purpose for FoK curriculum to develop “building blocks for future activities” using expertise funds (Weekly Meeting, July 14, 2010). Therefore, I guided the teachers with a purpose for learning FoK which informed how they defined the term. I channeled the teachers with a purpose to use FoK for locating a “universal fund,” that all students were experts in to build as a foundation for the curriculum theme. As teachers became learners of students’ playground funds, the students became learners of viewing their playground as mathematicians and scientists would.

a. **Views of learning through the familiar**
Conceptualizing FoK as student expertise for thematic curriculum informed the teachers’ view of learning from the familiar. For instance, both the teachers addressed the purpose of a FoK curriculum theme to provide familiarity for students in the units. Abby refers to learning from the familiar in order to “make a connection to math and science” (Weekly Meeting, March 8, 2011) based on a mutual understanding of playground content. However, Karen refers to learning from the familiar as more than just making a connection, but necessary for students’ “curriculum survival” (Weekly Meeting, March 8, 2011). I reflected on Abby’s and Karen’s emphasis on familiarity by observing their previous curriculum practices. I infer that the importance of what’s familiar to students became essential for how the teachers valued student learning because they recognized their school’s curriculum practices were unfamiliar for their ELs. For instance, mandated curriculum texts were difficult and unfamiliar for ELs who were already struggling with reading. Furthermore, prepackaged FOSS curriculum kits carried unknown science themes such as “solids and liquids” which failed to connect to lives of ELs created further unfamiliarity. Therefore, the thematic content and the artifacts in the curriculum kits, added an additional layer of complexity and hardship for the ELs (language)learning environment. Thus, Abby and Karen began to value ELs learning from the familiar to the unfamiliar content of math and science by creating an expert FoK thematic curriculum to reduce ELs’ unfamiliar variables.

I also became aware that there are different types of familiarity within students’ funds. I conceptualized that FoK as student expertise had its advantages for curriculum development. I hypothesized that students carry numerous FoK, but they are not all equal in terms of what students know about particular funds. Identifying student expertise became important because it moved teachers to investigate the hierarchy of students’ funds based on what students could explain proficiently more than other types of funds. For instance, all students had experienced mosquito bites, but could not explain further practices or knowledge about mosquitoes or healing the bite. In contrast, I inferred that
playgrounds were funds that the students could explain additional information such as the rules, safety, procedures, and practices because they acquired being a playground member and had experienced it more often than mosquito bites. Although both mosquito bites and playground funds are familiar to students, there is a difference in the degree of knowledge the students held about each of these funds. Therefore, referring to funds as student expertise had its benefits in terms of the way the teachers contextualized the curriculum theme from not just anything that was familiar to the students but the most familiar to all students. Thus, having in-depth knowledge and skills of funds, like playgrounds, allows for students to tap and expand into further tools for meaning making based on what their familiar to learn math and science.

2. **FoK for mediating classroom discourse**

    The teachers and I conceptualized FoK as we reflected on the purposes of FoK for their classrooms. Prior to the first unit, the teachers used FoK to plan their unit themes which were informed by student’s expertise funds. However, after implementing the first unit, the teachers became aware that their ELs struggled with (language)learning math and science. Karen raises concern for her ELs lack of oral participation in small group and whole class settings. Abby identifies problems in developing academically rigorous conversations for ELs through a tension discourse. As the teachers shared these problems with the group, I began to see an additional purpose for FoK to mediate the social organization of learning in the classroom interactions and discourse.

    I noticed the teachers referred to the coding tools of “participation” and “tension” in isolation from other coding tools, such as FoK. I decided to plan for an intervention where the teachers could analyze how the coding tools intersect or act upon each other as a means to explore their problems using FoK. On January 18, 2011, I implemented an activity where as a cohort we read one another’s individual report and group report which contained personal reflections on the coding tools.
As seen in figure 33, we then compared the group report, Lorena, Abby, and Karen’s report to identify the following coding tools which were common across the teachers: FoK, tension, and questions. Identifying common coding tools allowed for the teachers and I to focus on areas where FoK could be resourceful according to what was meaningful for the teachers. In addition, we also added “participation” even though it was not common across the teachers because it was emphasized by Karen to be important to her learning of the classroom. Finally, I engaged in a discussion to inform the teachers how these coding tools can overlap with other coding tools.

Ambareen: Keep in mind these overlap. Like Abby when you talk about tension, you also talk about participation. So maybe think about it together as when I have tension does it help students participate? And so think about FoK. How can I make this significant based on what I know, like use FoK to guide their participation.

I build awareness to the relationship of different coding tools through modeling examples such as how tension can inform student participation or how FoK can foster participation. I ask the teachers to think about their action research and how FoK can be significant for what they want to study.
Karen: We are making a list of the big ones, which is using FoK.
Ambareen: To do what?
Karen: It goes into planning, the participation, the questions we ask.
Abby: Also tension to hash out their meaning making.
Karen: Question and tension can go together because the question creates the tension.

I question Abby and Karen how they are making sense of the relationship between the coding tools identified and FoK. Karen claims that FoK can go into planning since we used it to inform thematic units, but she also acknowledges that FoK could relate to participation and teacher questions. Abby interjects to add that FoK could assist in tension for the purpose of meaning-making. The teachers build off one another’s idea and Karen suggests that there is a relationship between question and tension, since “questions creates tension.” I synthesize our conversation to create a diagram with the teachers as shown below in figure 34.

![Diagram showing the relationship between FoK, planning, questions, and participation.]

**Figure 34. INTEGRATING FoK WITH CODING TOOLS**

Ambareen: I see a triangle here they all connect. If we put FoK in the center we are using it to facilitate participation, and these can even switch.
Abby: Yeah questions leads to more participation.

I explain to the teachers that FoK could inform student participation, teacher questions, and thematic unit plans. I also expand the relationship to say that although I placed FoK in the center of the triangle, other coding tools could be switched as well. Therefore, Abby draws parallels to questions leading to more participation.
The goal of my intervention was for the teachers to conceptualize FoK, not in isolation to just a curriculum topic, but in relation to the coding tools from which the teachers’ made sense of their classroom discourse. This intervention was important because I informed the teachers’ thinking about FoK which they built relations across multiple codes for the second and third unit. For instance, Karen theorized how FoK questions can foster participation, and how FoK can be used for role shifts and the division of labor in group. She conceptualized the relationship of FoK across multiple coding tools such as mediating FoK for participation and meaning making in a third space. Similarly, Abby made sense of FoK fostering tension and learning in a third space. Therefore, FoK acquired an additional purpose for its mediation in the social organization of learning.

3. **Expanding expertise to knowledge, experiences, and/or skills**

Our newfound purpose of FoK in relation to other coding tools challenged the teachers and I too re-conceptualize our existing thoughts on FoK as student expertise. Working with the teachers on their action research, made me question the way I defined FoK. I realized that student expertise was a characteristic or outcome of a teacher’s FoK practice, and not necessarily a complete definition for what counts as students’ funds. In other words, not all students’ funds had to be *expert* knowledge for it to be considered a FoK. Although looking at student expertise was beneficial when planning a curriculum theme, it had its limitations when looking at the classroom discourse. This distinction became important for the way the teachers’ could expand how they mediate FoK in the classroom discourse.

Furthermore, as a researcher, I felt a responsibility to not misrepresent the theory of FoK based on the work of the Tuscon academics. I revisited the FoK literature and became alarmed that I could not find any results of FoK being referred to as student expertise. I questioned if all along the teachers and I misinterpreted FoK because home visits were not conducted. I decided to ground my theory in FoK by turning to the founding father himself, Dr. Luis Moll. I emailed Dr. Luis Moll on January 27, 2011, requesting his opinion if FoK counts as student expertise. His response was to read an article by Hogg
(2011), which at the time was in-press that synthesized the variations to how FoK researchers appropriated the term.

I presented the article to the teachers and collectively we re-conceptualized our understanding of FoK in a meeting on March 1, 2011. We turned to page 670 in the article as shown in figure 35, to compare and contrast how we thought about FoK in relation to other researchers. Hogg (2011) synthesizes the Tuscon academics foundational definitions of FoK on the left hand column. I found my view of FoK to fit with this category and highlighted on the left column how I interpreted FoK as “household or individual functioning and wellbeing” (p. 670). In contrast, the highlighted right column represents nuances to the definition where the teachers resonated with their FoK understandings. As we read these definitions, the teachers began to theorize how they used FoK and how they re-defined the term.

![Figure 35. HOGG (2011) FoK DEFINITIONS](image-url)
Based on these definitions, were not alone in accessing students’ funds beyond the household. I facilitated the conversation as we created a working definition for how we each viewed FoK.

Ambareen: If what I’m hearing is that FoK is anything outside of school, are you really identifying everything out of school? What are you selecting in your curriculum and that would help us define.

Abby: It’s knowledge they can bring to the classroom out of the school but we are choosing to take what’s relevant to math and science.

Ambareen: How do you define relevant?

Abby: To the unit. So if we are measuring and the survey says he made a bird house with his dad who is a builder, then you try to take what they know and make connections.

Karen: The way we have been using FoK is experiences even though we defined it as expert. What has been effective is FoK experiences they have that provide an avenue to understand the objectives we are trying to teach. Like Yasmin said she was burnt on a slide and reminding them to achieve a goal of different designs. Like how can I reach you based on what you know and have experienced.

Abby: Because there not an expert about gravity or falling but experiences when they fell and make a connection.

Referring to FoK as anything out of school was too broad of an understanding. Therefore, I asked the teachers about their decision making process for how they selected FoK in their curriculum as a way to help narrow the term, and to re-evaluate our stances on funds as student expertise. Abby says she chooses FoK that represents knowledge relevant to the math and science unit. However, Karen makes a distinction that when it comes to the classroom discussions her and Abby relied on student experiences, not expert knowledge to draw connections to math and science. Abby agrees indicating that all experiences aren’t necessarily an expert fund.

Karen: The way I would have organized it before was trying to get there funds so they could teach the objective of my lesson and be the expert. The kid knew about gravity but not enough to teach it and that limited me. Being an expert can help the kid be leaders or lead a group.

Karen elaborates on the benefits and limitations of student expertise. She suggests that when she defined student expertise to use in the class discussions, she thought the purpose was for students to teach the objectives because they were the expert. However, she realized that her understanding of funds as student expertise was limiting for class talk because as the teacher she held the expert knowledge to teach academic content. Instead, she found student expertise beneficial for group work where students
can shift their roles to be leaders. Therefore, both Abby and Karen began to reconsider ways they made sense of FoK in the classroom discourse.

Because Abby and Karen identified collecting student experiences as FoK, I challenged the role of student expertise in their FoK practices. I question the teachers if they viewed their students as experts on a playground.

Ambareen: So you don’t see your kids as experts in the playground?
Abby: Expert is not a good word. I have that problem what’s an expert? It has the same purpose like we want them to be experts and make those connections. I think there an expert on a playground. They know about playgrounds and know how to play.
Karen: I feel like there an expert in a playground but my objective is not what’s happens on a playground but some science or math of a playground, so it goes back to experience and what they know about that I can use to meet my objective.

The teachers began to theorize between FoK purposes and concepts. Both the teachers agree that their students are experts in a playground. However, Abby interprets the concept of expert versus experiences as having the same purpose which is to make connections. Abby finds it easier to identify student experiences compared to expert because she claims to have a problem with what counts as being an expert during class discussions. Karen clarifies her purposes of FoK as the objective not being a playground but learning math and science in a playground. Therefore, she sees the definition of experience aligning to her FoK purposes. After reflecting on their purpose for FoK and reading the article, I have the teachers develop a working definition of FoK.

Abby: Experiences outside of school that helps them make connections as a way to access the math and science content objectives to empower student learning.
Ambareen: Okay so we have this empowerment or activist piece.
Karen: Knowledge, skills, and experiences students have outside of the classroom that can be used to build or build on curriculum.
Ambareen: What do you mean to build or build on curriculum?
Karen: I can build an entire curriculum from using FoK or they can be used to enhance curriculum.

Abby shifts in her understanding of FoK from what students bring to the classroom in home, community, or parents spaces to now referencing funds as out of school experiences. In her explanation she includes additional purposes for FoK which is to “make connections,” “access,” and “empower” student learning of math and science content. Importantly, Abby develops her own purpose of FoK for
activism, as she views funds as experiences. Furthermore, Karen returns to her original understanding of experiential funds, but extends it to include FoK as knowledge and skills outside of the classroom. She also develops additional purposes of FoK by merging the concepts of expertise and experiences. She claims that funds, like expertise, can be used to build curriculum theme, and funds can enhance the curriculum such as providing mediation in the classroom discussions.

I also shifted in how I conceptualized FoK after reading the article with the teachers. I began to think about FoK in terms of knowledge and skills, and student expertise as an outcome of a FoK practice. For instance, students’ could enact a role shift that positioned them from a novice to an expert as they shared their funds. Additionally, I was informed that FoK includes a household or individual’s life-worlds functioning and wellbeing. I found that expanding FoK beyond student expertise was beneficial for the way the teachers thought about learning math and science for ELs. The teachers could build awareness to locate math and science funds when they looked at funds from an experience perspective. For instance, Abby mentioned how students may experience falling which she related to a science objective on gravity, even though she viewed falling as not a student expertise. Reflecting on funds as practices, such as knowledge, skills, and experiences, provided a greater pool of funds from which the teachers could identify for connecting to math and science when mediating classroom discussions.

4. **Summary of FoK types**

The table below summarizes the shifts in Abby and Karen (re)conceptualization on the types of FoK as they informed new purposes for using FoK. For instance, the teachers understood FoK as student expertise for the purpose of developing a curriculum theme. In addition, the intervention of reading FoK articles and linking FoK with codes such as participation, questions, and tension, brought a new purpose for using FoK for socially organizing learning during classroom interactions. Furthermore,
as the purposes for FoK were re-defined, the teachers expanded FoK types to view math and science funds as experiences, knowledge, and/or skills.

### TABLE 14. SHIFTS IN FoK TYPES AND OUTCOMES

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Unit</th>
<th>FoK Types</th>
<th>Outcome (FoK Purpose)</th>
<th>Outcome (Language)Learning View</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abby</td>
<td>Unit</td>
<td>Shift from “what they bring from home/community” to “being expert in home/ community”</td>
<td>Identify a fund shared by all ELs, universal fund, for curriculum theme</td>
<td>Learning through familiar: “make connections to math and science”</td>
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<tr>
<td></td>
<td>One</td>
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<tr>
<td></td>
<td>Unit</td>
<td>Shift to include expertise and “out of school experiences”</td>
<td>FoK for socially organizing learning in classroom interactions and discourse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karen</td>
<td>Unit</td>
<td>Shift from “experiential funds” to “something good at or know a lot about”</td>
<td>Identify a fund shared by all ELs, universal fund, for curriculum theme</td>
<td>Learning through familiar: “curriculum survival”</td>
</tr>
<tr>
<td></td>
<td>One</td>
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</tr>
<tr>
<td></td>
<td>Unit</td>
<td>Shift to include expertise and experiences, knowledge, and skills</td>
<td>FoK for socially organizing learning in classroom interactions and discourse</td>
<td>FoK as expertise beneficial for role shifts in whole group or small group division of labor</td>
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<tr>
<td></td>
<td>Two</td>
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</table>

### C. From Households to Life-worlds: Ideological Resistance and Limitations to Home Visits

The traditional theory of FoK predicates itself on conducting household visits. For children from middle class homes, where FoK corresponds nicely to those of school, experience less discontinuity from their home to school practices. In contrast, ELs’ FoK can go unrecognized in school and may be in conflict with those valued in school (McIntyre, Rosebery, & Gonzalez, 2001). Household visits are important because they can identify the gaps and bridge between students’ home practices and school
practices. In doing so, ELs from working class backgrounds “receive the same privileges that middle-
class students have always had: instruction that puts their knowledge and experiences at the heart of
their learning” (McIntrye et al., 2001).

In this section, I describe the challenges Abby and Karen encountered when presented with
conducting home visits. The challenges lay in resistance versus resources to attend a home visit. There
was an ideological resistance to the concept of household visits as well as practical limitations that
prevented the teachers from entering students’ homes. By refraining from conducting household visits,
the teachers conceptualized FoK to extend from household funds to life-world funds. As a result, the
teachers’ recognized the need to establish stronger networks between families and the school.

1. **Introducing household visits: Repositioning the researcher**

As previously mentioned the teachers were introduced to FoK and conducting ethnographic
household visits in their university course on “Action Research and English Learners: Integrating
Literacy, Science, and Mathematics” in October 6, 2009. Prior to the establishment of the study group
meetings, my role was the teaching assistant in this course that was designed for the teachers across
school cohorts in Project LSciMAct. For the course, the teachers had read the article “Funds of
Knowledge for Teaching in Latino Households” (Gonzalez, 1995) for the purpose of learning how to
gather funds and conceptualizing “culture.” The course activity requested the teachers to imagine they
had a Korean student in their class and what ways they would go about gathering her funds. The Genesis
teachers listed visiting a museum, choosing a holiday to share, and comparing buildings in Korea to their
neighborhoods. As the teachers were working in their groups on these suggestions, I, along with the
other teaching assistant in the class and the instructor, began to notice a narrow and romanticized view
of culture across all the cohorts. I was surprised that none of the cohorts alluded to ethnographic tools to
learn their students’ culture since the article suggested this, so we collectively began to mediate a
discussion on culture. I asked the class if their suggestions would get at the experiences of the Korean
girl or are they simply getting a romanticized ‘official version’ of what it is to be Korean. In other words, there is an official history of these holidays, but is this how we culturally live? (Researcher memo, October 6, 2009). The conversation prompted the instructor to speak to an *ethnographic* perspective to position oneself to understand and live through the everyday practices, and home visits being a valuable tool to do so. I remember there being a divide in the class between the teaching assistants advocating for home visits, and the teachers, who for many of them was their first time hearing the concept, refusing to do a home visit. The class erupted with anger, where the Genesis teachers aligned themselves to a neighboring cohort who argued they were not aware nor would they sign up for this program with the intention of going into dangerous communities where they could potentially be robbed or hurt. The instructor pushed forward to challenge that their *fears* are the very reason they must learn about their students’ homes and communities. Although the end of the class resulted in no change in the teachers’ view of home visits, it did change how I thought about the teachers and the mediation for home visits.

The conversations from the course were important because it developed my awareness to the teachers’ ideological resistance. From this discussion, I walked away understanding that historically teachers have been positioned to work with students in the classroom, and this is how the teachers defined their boundaries as well. I began to question if the teachers found in-school “safe,” simply because it was their comfort and an experience they knew well, and if households were “unsafe” because it was an unfamiliar place. After all, the schools are part of the community that they claim to be ‘unsafe.’ I questioned if home visits were just the result of the fear of the unknown.

On June 1, 2010, a semester after the course, I would have the opportunity to work with Abby and Karen in our study group meetings. I began to reflect and prepare for our meetings by drawing on the conversations form the university class. I became conscious of the role of race, socioeconomic class, and political issues that could contribute to the factors that inform the teachers’ resistance and fears of
home visits. I felt I could relate to the teachers because they both came from a city with a small population, predominately English monolingual and white residents, which is similar to the environment I grew up in for twenty years. Also, as a former teacher who taught in low-income neighborhoods in the same city as the teachers, I felt I could understand Abby and Karen’s cultural disconnect of working with students whose FoK did not resemble their own. Furthermore, I was familiar with the neighborhoods both teachers chose to live in, which is a white, middle class neighborhood in the north side of the city. Additionally, I thought I could advocate for the ELs because I am a bilingual, Pakistani-American, Muslim, female, who was also raised in a low income neighborhood and could understand the struggles of being a language minority. I saw my role to navigate both of these worlds: the teacher’ and the students’ communities.

When we began our study group meetings on June 9, 2010, I targeted our initial meetings on the topic of home visits. I came prepared by having the teachers read an article by Genzuk (1999) “Tapping into Community Funds of Knowledge,” which describes the benefits of home visits and provided a toolkit for how teachers can conduct these visits. I introduced the article by addressing “the elephant in the room” which was the concept of fear and discomfort.

Ambareen: One thing you will experience, I will tell you upfront, is you are going to be pushed in uncomfortable zones, even beyond home visits but pedagogical practices. Like some of things we may ask you to do are different or in conflict with strategies you are familiar with. You should document this, it is important to hear like you said that it is uncomfortable, and it is!

I wanted the teachers to understand that the professional development they were a part of is introducing changes, and in particular, changes in their practices which require them to try something new, like home visits. However, I also aligned myself to legitimizing that their discomfort is real, but it is important to document and share their fears. In response to my request, Abby strongly rejects:

Abby: I don’t want to do them. I would need a translator and I don’t know these kids. Their neighborhoods are not that great. I just don’t feel good. Everyone I talk to says it is uncomfortable.
Abby’s response unpacks many of her hidden fears of immigrant communities. Although she explicitly states she does not want to do home visits, she provides a series of reasons. She begins by attempting to find common ground for reasons one would not do a home visit such as the lack of school resources, like needing a translator. However, her next comments, indirectly speak to issues of race and class. She adds to say she does not know “these kids,” which in her discourse is marking the ‘othering’ of Latino kids from her own racial identity. This is her admitting she is not familiar with the cultural practices of Latino students, and because of her unfamiliarity she refrains from entering an unknown community. Furthermore, she addresses fear of immigrant communities by stating that their “neighborhoods are not that great” which makes her not feel good. To provide context, the students’ homes are situated in a low-income neighborhood in the “south side” of the city. Politically the “south side” symbolizes larger assumption of the deficit view where these neighborhoods are perceived as dangerous in comparison to the “north side,” where Abby resides. In fact, the city is recognized as one of the most racially and socioeconomically divided places in the nation.

Lorena, who has lived in the same neighborhood as the students, confirms Abby’s notion of their neighborhoods being “poor” and “needy,” but provides an additive view.

Lorena: Yes the families are very poor and very needy people. But they are wonderful. Most families welcome the teacher. They see us very high.
Ambareen: The things that worry us about our students’ home is the very reason why we need to go.
Karen: Yeah like problems with doing homework.
Ambareen: The purpose of this is our students have so much cultural and linguistic knowledge and their homes contain so much valuable knowledge…we can have an understanding of what they know to bridge the academic and build a relationship with them.
Karen: I think going before would be me forcing it on them. I want them to feel like their welcomed.

Lorena also disagrees with Abby’s earlier perspective that families wouldn’t want to see the teacher because she argues that Spanish culture honors teachers. Ironically, even though Abby does not perceive her students’ home in a high regard, Lorena advocates that her parents are viewing her with respect. I
remind the teachers of the conversation from the course, that these perspectives or fears we have are the very reasons for doing home visits. Even though Karen hints at the idea of doing a home visit, she is still not receptive to do so because she views it as her “forcing” her way into students’ home. Therefore, Karen may not have explicitly alluded to race or class, but these were still concerns for her as well.

As our conversation continued, I wanted to come back to my original point of embracing our discomfort and exploring new practices by explaining my own struggles and goals.

Ambareen: I do get emotional doing this work because you do change as a person. There is something about learning through other people that makes you learn and change yourself. So I welcome you to learning about yourself and things you may have never known and embracing a field that is really rooted in making a difference in your students and yourself. So yes, this program is hard, but it is also inviting to have the power to change. Action research is not just writing to get a degree, but to share what you are doing with the rest of the world. For me research is for change and its passionate work, I hope I can ignite that passion in you and it is going to be a bumpy road, but it will also be fun. I want us to be close to each other and we all need to be here for one another.

I explained to the teachers the purpose of research and its power to change, not only their students but also themselves. I describe action research as a way to learn about who they are, while also learning their students. Also, I advocated for building community by motivating the group to be there for one another and embracing a FoK type of work. However, in my moment of cheerleading for home visits, I was naïve to the personal situations of my teachers. After saying these words, Abby began to cry and immediately left the room to a private area. Karen followed after her, while Lorena and I stayed back. I remember asking Lorena if she thought I said anything offensive because I was confused at what could spark Abby with such emotion to leave. Lorena reminded me of the cultural differences between our experiences as minority women. She told me that I was blinded to the cultural demands I was requesting Abby and Karen to do. She said that she has lived in this neighborhood for several years so she knew how friendly the parents can be, but that, in her opinion, Abby and Karen had not been exposed to the neighborhood the way she had.

The critical moment for me was when Abby returned ten minutes later, with her eyes red full of tears and her body shaken up. I could clearly tell there was more to the story than I knew about her.
Seeing her reaction, made me realize that I have pushed too far. Upon her return, I apologized but she refused to speak the subject. Later that day, she messages me in an online chat forum, where she expresses her personal reasons and fears for not wanting to do home visits, but also requests that I not share these private conversations. However, she did grant permission to articulate an important factor. Abby writes feeling discomfort to foster relationships with male parents. She writes on June 7, 2010, in an e-mail, “I have had many uncomfortable situations where fathers have tried to hit on me and I do not want to put myself in an uncomfortable situation.” Her past experiences with male parents have put her in a vulnerable situation where she is no longer willing to take a risk where she could potentially be harassed.

Therefore, as a researcher, I was facing an analytical bind between respecting the privacy of my participant, and also recognizing that her story is pertinent to understanding the context of my research study as well. I took a step back and began reflecting up on my own identity and shifted from an instructor advocating home visits to a mentor for my teacher. My conversations with Abby transformed how I would continue to do research that would protect the well-being of my participants. I changed to advocate for the teachers by respecting their comfort which allowed me to recognize that my study is more than detached research, but it’s about fostering relationships with the teachers, on a personal level and beyond our identities as teacher but as people with complex lives.

For Karen, she saw a language barrier between her and families as a factor preventing her from doing home visits. As monolingual teachers, Abby and Karen could not communicate with native Spanish speaking parents. Abby and Karen said it was hard for them to find the resources and someone who was willing to accompany them to students’ homes. Although Lorena offered to join, she no longer worked at Genesis, and her initiatives to lead household visits were seen in conflict to the new administration. Therefore, both teachers preferred to not have Lorena involved as a translator, and were unable to find a bilingual speaker to go with them.
Also, Abby and Karen expressed time as a practical limitation hindering them from going to students’ homes. The teachers thought home visits were not practical because they would have to be conducted after school hours. Karen said, “time-wise it felt nearly impossible” because they had other priorities after school. For example, their time after school each day was spent teaching extra-curricular activities like Drama Club and the Science Club, writing grants and researching for the playground, hosting the Playground Committee meetings, and attending courses at the university. Both the teachers held multiple positions which they viewed to restrict their time for household visits.

2. **Sources versus types of FoK**

Given the teachers did not visit students’ homes, and acquired other methods to learning students funds, the teachers’ changed in their thinking of FoK as being household practices. Fundamentally, I had viewed FoK as household networks that exchanged resources of knowledge and skills used for household survival. Therefore, the location of the home, was an integral place for where I viewed FoK could exist. However, since the teachers had an ideological resistance to ethnographic household visits, they expanded how they defined FoK being more than household networks, but individual networks. For instance, Karen writes “FoK can absolutely include bodies of knowledge that have been built over time within a family, but I believe that the concept can extend beyond the family…FoK are resources, observations, or experiences beyond school” (Action Report, p. 6). Karen explains that the types of funds is more than just family, but can be from the individual. She explains that the student, as an individual, has resources, observations, and experiences that are separate from their families. The students’ funds can also be examined in other places outside of the home and family. Similarly, Abby conceptualizes FoK to consider learning students’ funds that are not in the homes. She writes “broadening the definition and using any personal knowledge from outside the classroom helps connect to content” (Action Report, p. 3). Abby didn’t view FoK to be just privileging household knowledge, but instead to learn knowledge that exists in places outside the school. Here, both teachers
acknowledge that the location of the home is limited to where potential funds can exist and instead consider out of school places, known as life-worlds to be important. In addition, the teachers acknowledge the types of funds to be more than household knowledge.

3. **Establishing FoK networks between families and school**

Household visits are a method where teachers can establish relationships with students’ families. The teachers recognized their limitation of not conducting home visits impacted the types of relationships they created with parents. Abby and Karen learned that the playground initiative was a stepping stone to foster school and family relationships because parents were invested and involved in the playground initiative. In contrast, the teachers discovered that “when we requested parents to contribute academically, we were disappointed that we received little participation” (p. 37). The way the teachers reached out to parents for academic assistance was through a survey, Parent Content Survey. I suggest that surveying was used to reaffirm an already established distant relationship between parents and families because the students are the communication brokers, instead of the teachers entering the homes and establishing personal relationships themselves. Therefore, refraining from home visits for academic purposes may be a factor resulting in the lack of academic parent participation.

The teachers also found that establishing *confianza* was happening one-way, with the school dictating when and how parents could be involved with school events like Open House or parent-teacher conferences. The teachers challenged this approach and valued FoK as a theory could bridge families and school together.

“We found ourselves recognizing that like us, parents felt hindered by not sharing the same native language….teachers need to show parents and the community that Funds of Knowledge and native language are important tools for their students’ learning….to feel secure to come in and support the academic curriculum. We believe schools should empower parents to bring their native language and Funds of Knowledge into their classrooms” (p. 37).
Abby and Karen conceptualized students’ funds and parents’ funds to be equally important. The teachers became aware that the purpose of parent’s funds can be used to create networks between school and families. In particular, they refer to linguistic and community funds as assets that teachers can use to engage families to participate academically in school. The teachers recognize that it should not just be the parents reaching out to the school, but teachers also mutually fostering relationships with families in their life-worlds. In doing so, the bridge between homes to school practices can be aligned since families, children, and teachers are engaged in both places collectively. Thus, by not conducting home visits, the teachers developed awareness on its importance to consider conducting them in the future.

4. **Summary of household visits**

Traditionally, FoK have been elicited by teachers via home visits. In this study, the teachers refrained from household visits. The diagram below describes the teachers (re)conceptualizing from a deficit to additive view on home visits.

![Conceptualizing Home Visits Diagram]

Figure 36. CONCEPTUALIZING HOME VISITS

The teachers refrained from conducting home visits for reasons of resistance and lack of resources. Abby is a teacher who represents an ideological resistance to home visits given her negative prior
experiences with parents and concerns of neighborhood safety. Whereas, Karen illustrates declining home visits due to time and language barriers. The clash between Lorena and Abby competing views, a deficit versus additive home visit perspective, serves as an example for how conversations about home visits can be misinformed, contested, or affirmed. Implications need to be made for situations presented, like Abby’s, on how teachers can repair confianza, once trust have been broken by families. This is necessary in order for teachers to reconnect with families for (language)learning and mediating EL’s funds. Furthermore, for schools to foster relationship with families requires schools to provide the time and resources for teachers to conduct home visits.

We also notice a shift in the source of funds. Because the teachers held tension and reservations to the source of home, they adopted other sources and, in turn, other types of FoK. For instance, they extend beyond the home to define FoK from households to life-worlds. The types of funds also extended from household knowledge to out-of-school knowledge and experiences. Therefore, this suggests that teachers need to be aware and ask how they conceptualize ELs funds with respect to sources because it may inform the types of funds they receive. Had the teachers just restricted themselves to the home, they may have not found the value of playground funds in their life.

Importantly, the teachers realized their limitation to avoiding home visits resulted in not fostering strong familial relationships or confianza. Although the playground activism initiative was a stepping stone for involving parents, it didn’t do so academically. Therefore, the teachers realized to extend the (language)learning community to families required the direction of relationship to be bidirectional with teachers and school staff going to homes. Here, we learn that if teachers stay in their comfort zone of the school, and if parents stay in their comfort zone of the home, it will be difficult to foster relationships. Hence, teachers need to find mutual comfortable places and negotiate their discomfort collectively to meet in the middle and find a place to build these relationships, or teachers should take the initiative to venture into unknown, uncertain, and unfamiliar places to establish confianza.
D. **FoK for Activism**

I interpreted Abby and Karen’s perspectives of FoK within a social justice and capital framework. Hytten and Bettez (2011) describe social justice in educational contexts as “creating educational environments that empower historically marginalized people, that challenge inequitable social arrangements and institutions, and that offer strategies and visions for creating a more just world” (p. 8). Although a shared rhetorical commitment to social justice exists, in that schools should provide equality of opportunity (Hytten and Bettez, 2011), there is difficulty in how this idea is put into practice because “it does not have a single essential meaning” (Rizvi, 1998, p. 47). The perspectives and practices of what is “just” differ due to the fact that peoples’ meaning makings are embedded within their historically constituted Discourses. Therefore, it is beneficial for teachers to learn and teach to their students FoK because it provides what counts as socially just from the perspective and practices of the students themselves, and not their own interpretations which may be in conflict with their students needs. For Abby and Karen, (language)learning about students’ playground funds transformed what they saw as equitable learning opportunities for their students to include playgrounds, which they didn’t consider before. Abby and Karen defined social justice as:

> “someone who explores their community, identifies an issue, and takes steps to solve that issue. These steps include researching the problem and the possible solutions, as well as involving the community to make that change” (Group report, p. 2).

Important to their understanding of integrating FoK and social justice theories is the outcome of community activism. FoK is interpreted from a community lens but is integrated with social justice to “make [community] change.” For example, the teachers define interactions with community, as a geographical place, by identifying an issue, steps to solve the issue, researching methods to build knowledge, and involving community members in the process. What’s missing from the teachers’ definition is the social change producing an educational outcome of student success (i.e. test scores) in their learning.
Rios-Aguilar (2011) addresses the gap of educational outcomes to understand FoK theory from a capital perspective. A capital perspective includes “examination of processes that convert or transform various funds of knowledge into other more tangible kinds of capital (e.g. better grades, higher college enrollment rates, higher civic participation) (p. 167). Moreover, she explains that FoK and school practices are intricately related to social class, ideology, and power which are important to “how existing power dynamics influence the conversion or transformation process” (p. 167). There is dearth research that addresses FoK from a capital perspective, and is essential in order to know the possibilities of how students’ funds can be transformed to other form of capital in addition to test-scores (i.e. civic engagement).

In this context, I explore capital as being the outcome produced from the social justice process that the teachers engaged, when exploring their students’ playground funds. I explain how Abby and Karen theorized FoK for activism in relation to student and teacher roles, and a change in site at Genesis. I look at how the teachers conceptualize the playground problem and reflect on who the activist(s) would be. Then, I explore the playground activism initiatives and activities. Finally, I describe how the third unit’s assessment demonstrates an example toward attempting to transmit students’ funds into capital.

1. **Awareness on the need of a playground**

   When Abby and Karen’s students identified the problem of Genesis needing a playground, the teachers conceptualized their students’ playground funds with respect to (language)learning. The teachers nested playground funds within the larger construct of childrens’ play. Specifically, the teachers questioned how important play is to students’ (language)learning. When answering this question, the teachers found that the lack of Genesis having a playground revealed a greater problem grounded in how (language)learning is constructed from the district level, school level, and locally from the perspectives of students. Each level interpreted what learning should look like for
students differently, including the teachers vision of education. Therefore, conceptualizing students’ playground funds marked implications and struggle for the types of learning that should be fostered.

For the teachers and students in Abby and Karen’s class, their initiative on Genesis needing a playground is in conflict with the dominant district’s perspectives of playgrounds. At the time of the study, the teachers and I discovered the district educational policies refer to play through designing laws about recess. The district handbook titled, Developing a School Recess Plan, defines recess as a form of play such as “an activity during the school day that provides students…to engage in play with their peers and participate in unstructured activities” (p. 5, CPS). Furthermore, the handbook indicates that recess must occur during non-instructional time. The district views recess as a type of “break” from academics, and therefore, an option. Additionally, the Illinois General Assembly educational laws do not mandate schools to implement recess (see section 110 ILCS 13/1). Instead, the policy suggests that the authority to allot recess is democratically decided by the school board. The option for or against recess is not aligned to achieve math or science learning standards, but rather its purpose suggests being a student behavioral marker for punitive or reward measurements. At the district level there is no warrant suggesting recess or children play is a vital contribution for students’ educational success. Thus, play is absent from learning. Therefore Abby, Karen, and their students were faced with advocating for a playground in opposition to district laws that made play simply an option.

a. **School level: Students are jailed**

Students’ playground funds made Abby and Karen aware to the lack of authentic learning opportunities available for students at Genesis. As students shared how important it was to be outside on playgrounds, the teachers reflected on the school learning space. The teachers concluded that the structural arrangement of schooling was not conducive to positive learning environments. For instance, Karen and Abby concur in a meeting on November 22, 2010, that it is “unreasonable to have young children stuck in a classroom, not even school, but a classroom all day.” Karen elaborates further
by writing “to make matters worse, our students now eat universal breakfast in the classroom, lunch in the classroom, and health and art are held in the classroom (general education classes currently occupy the rooms for the special)” (Individual report, p. 1). In addition, the teachers explain the school policy asserts “all teachers are no longer allowed to take students outside...because a student was sent for stitches as a result of falling on the play lot’s broken cement pavement.” (Group Report One). Therefore, in the name of safety and the limited number of classrooms, the school promotes a closed learning environment where students are confined to only the classroom space. As a result, the teachers equated the school’s arrangement of learning as a type of jail. When students are left in the classroom all day, the teachers saw their students as “prisoners” in the classroom, and themselves as prison guards who enforced “holding recess hostage” (Unit 1 Group, p.1). Although this may appear to be exaggerated equating school to jails, the point is that students’ were physically confined, and the teachers emphasized their strong modality against the district and school’s policy.

b. **Local level: Playgrounds are a student need**

Abby and Karen disagreed with the district and school’s educational policy that recess be an option, rather as they learned students’ FoK they confirmed that playgrounds are a student need both in-school and out-of-school. The teachers conceptualized *playgrounds essential to maintaining students’ well-being for (language)learning in school.* For instance, recalling when the teachers first heard stories of their students’ interactions with playgrounds in the IPP, the teachers interpreted playgrounds as students’ interests. However, it was at the end of the first unit, I found the teachers recognized playgrounds were integral to the *culture* of their students’ way of living, and not merely just an interest. The teachers found that students’ spoke about playgrounds frequently than any other topic which was an indicator that playgrounds were part of the students’ everyday culture. For instance, Karen recalls on November 8, 2010, that “all students talk about is playgrounds and parks like crazy informally.” Abby reiterates on November 22, 2010 that “playgrounds are meaningful for my
kids…they always write about being at the park, like playing on slides” (Focus Group). The frequency of student talk about playgrounds clarified the teachers’ understanding on how important playgrounds were to students’ lives. Furthermore, in a researcher memo on January 10, 2011, the teachers discuss how the cultural practices of school are in conflict to the cultural practices of students outside of school. For example, the teachers thought for their primary first and second graders not having a playground is challenging to deal with than for older students. Their rational was that because primary students are still new to school they are still closely tied to the practices they would adhere to during the hours when they weren’t in school, which consisted of the playground space. Thus, the teachers hypothesized their students needed playgrounds more than older students because their students haven’t completely transitioned into the schooling practices, and faced “playground withdrawal.”

Engaging with students playgrounds funds, allowed the teachers to know how their students reflected upon their practices outside of school and the ways it shaped their student identity. For instance, Abby writes how her first graders on several accounts are referring to themselves as “bad kids” as an answer for why they don’t have recess or cannot play. The district’s mandate of optional recess provided schools to use recess as a punitive or reward consequences from which the students internalized themselves as being punished for being “bad kids.” As a result of the Community Walk, Karen’s students questioned their status as students. For example, Karen’s students felt unprivileged when students in a private school nearby had access and resources to playgrounds and they didn’t. Karen’s students would make comments that “they [private school students] have money” and “we don’t” (researcher memo, August, 2010). This cultivated students to see them as having lower status compared to private school students who could afford a playground. The teachers conceptualized their students FoK responses to build awareness to the macro implications of social class and power that set barriers for students’ from accessing their playground needs. Therefore, the teachers realized that playgrounds or play was vital to students’ school survival because students negatively saw themselves in
school. Karen and Abby were concerned at how they could establish students to see themselves as successful mathematician and scientists when they refer to themselves as “bad kids” or having low status. Thus, advocating for a playground with their students through academic learning, became important more than ever for the teachers to show solidarity with their students, and to change and redistribute the resources in Genesis.

The teachers conceptualized that students’ ways of living are imperative for learning and need to be supported in their schooling. However, the teachers believed, through awareness of their students’ playground funds, that access to the geographical environments of the school is just as important to student learning as instruction of the curriculum content. The teachers didn’t value students’ educational conditions to be restricted in one single classroom. Furthermore, they felt a positive learning environment consists of students moving to and through the school’s physical space. They interpreted students sitting in a desk all day, as detrimental to students’ social and emotional well-being which they hypothesized would negatively affect learning outcomes. Therefore, exploring students’ playground funds was important because the teachers saw the asset of a playground contributing to the positive social and emotional health of their students. Abby supports Karen’s testimony that students deserve learning opportunities that foster “exercise and socialization with other students” (Individual Report, January 9, 2011, p. 1) through the act of playing on a playground. Abby and Karen viewed recess as an essential factor that could enhance students’ learning outcomes because recess provided a space for students to re-energize their health.

2. **FoK for change in students, teachers, and site**

Abby and Karen changed their students and themselves to become activists. In addition, Genesis changed into a site for activism. The teachers theorized FoK by engaging in social justice processes and transmitting students’ funds for capital. In doing so, they added to their understanding that learning in a FoK framework includes student empowerment that advocates and implements for
social change. This section explains how students’ funds were transformed into a movement advocating for a playground. The teachers reflected on the evolving number of actors involved to conceptualize how the playground activism moved beyond the students. In addition, the teachers created activities to collaborate with the community, Genesis staff, and the students. Finally, students used their funds to write a persuasive letter to their alderman for support.

a. **Identifying the activist(s)**

As the teachers conceptualized FoK as activism, they evolved in their interpretation of who the playground activists would be. Identifying the activist(s) was important to the way the teachers began to theorize the power and potential of FoK reaching beyond the students and into the community. For instance, when I first introduced identifying a social problem grounded in students’ funds for a curriculum theme, I was thinking along the lines of a curricular question that the students could ‘theoretically’ solve. I hadn’t imagined that the teachers would take it upon themselves to develop pedagogical actions and solve the social problem practically for their community. I saw schooling as a place to question and wonder, but now schooling is transformed into a site to make change. Therefore, FoK included teaching math and science that was relevant to students, to becoming an *investment* for their future. These changes were informed by the dynamic conversations between the teachers and me as we reflected on who emerged as the activist(s).

b. **Students as activists**

Our meeting on September 7, 2010 is the first conversation where the teachers and I develop an action plan for the playground. For the sake of privacy and to protect the teachers, we chose to hold our meetings secretly outside of Genesis, and instead in my home. I arranged our meeting to discuss playground activism and planning for the first unit as two separate agenda items.

Ambareen: We need to brainstorm two fronts. One is the lesson planning and secondly what are the political or legal jumps we need to do to get a playground.
I explain this separation to the teachers by portraying the steps needed for a playground as a political action taking place outside the classroom, whereas the curriculum is developing non-activist lesson plans in the classroom. As a result of disconnecting the lesson plans from playground activism, I naively situated the playground activism actor to be teachers, not the students. However, Karen challenges my approach to privilege the students as activists and implement lesson plans that are critical in pedagogy.

Ambareen: So for the lesson plans, we’re creating a survey to see the views of administration, parents, and other students.

Karen: We could do a ballot for the whole school, and when they [students] interview the kids we can get hardcore data and tell Rodrigo. They can say look we have the numbers and this is good ammunition.

For example, when discussing the lesson plans for the first unit, I offer surveys as a way for students to learn perspective for or against a playground. Karen argues that the surveys in these lesson plans should be more than just knowing perspectives. She integrates playground activism with lesson planning by suggesting the surveys to count as ballots to vote for or against the playground. In addition, she privileges students as activists when she says students “interview the kids” and they “get hardcore data” and “tell Rodrigo.” In this context, playground activism is initiated through lesson plans. Karen and Abby do not view themselves as activists but facilitators, through lesson planning, to the students being the only actors involved in advocating for a playground.

c. Teachers as activists

Even though the students were the ones doing the field work of fighting for the playground through collecting survey responses, I returned to my initial thoughts on needing to take political initiatives to make having a playground a reality. In other words, the teachers could not remain absent as facilitators if the playground is to become a reality. Drawing on my own FoK, as a grass roots organizer for Muslim advocacy groups, provided with me with the insight that the teachers needed to establish an organization. I present my ideas in our meeting on September 27, 2010, to assist the teachers to become activists by having them establish the Genesis Playground Committee (GPC).

Ambareen: I will be learning with you because I know we need approval from
administration or school boards, but I don’t know what the protocol is. But anytime you are going to do something like this, you need to form a committee. So who do we know?

Karen: Jenny and Doug they are both teacher representatives of the LSC.
Ambareen: What about parents?
Karen: Mrs. Mendez she is a parent who is also in the LSC. She volunteers in my room. I bet she would be willing to do it. We need coverage from the LSC.
Ambareen: So what are the steps we need to make this happen? So long term goals and a short term goals.
Abby: We need to talk to our principal and then present to LSC.
Ambareen: Okay so those are short term, and long term we need to apply for grants.

I position myself as a learner since I’m unaware of the school and district policies, but I also expand my role from the researcher to a community organizer. I saw my intervention of forming an organization imperative to the change the teachers were seeking. By forming an organization, who became an activist changed from individual responsibility to a collective responsibility thereby extending participants from students to members in a collaborative organization. Karen adds potential activists to include fellow Genesis teachers and parents who are members in the Local School Council (LSC). However, I redirect the conversation to invite the teachers to become activists when I asked what “steps we need to make this happen” by organizing our short and long term goals. Abby accepts her role as an activist to plan for her and Karen to talk to the principal and present their goals to the LSC.

The teachers conceptualize FoK for activism with respect to their own roles extending beyond educators in their group report on December 28, 2010.

“We thought we were only changing the identities of our students to becoming community activists, but we realized that our roles have shifted to also become community activists with them…we have emerged as leaders (p. 8).

As the FoK theory was put into practice, the teachers evolved as community leaders and activists. The teachers claim their evolving roles were unexpected since they didn’t view themselves, when planning for the first unit, as activists or leaders. However, at the end of the first unit, Abby and Karen became aware of their leadership and activists roles as they presented the playground initiatives to the LSC members. In addition, they were approached by their principal to give presentations during school staff meetings to update the staff about their progress. In other words, the teachers began taking necessary
political actions that were separate from the students because the students were considered minors and adult initiatives were needed (i.e. presenting to LSC). Therefore, FoK for the purpose of activism redefined how the teachers began to conceptualize FoK as having an outcome in a change to their identity.

d. **Change in site: Fostering relationships and collective activism**

Abby and Karen also conceptualized FoK for activism by reflecting upon a change in site at Genesis. Genesis changed as a result of the teachers implementing multiple activities to advocate for a playground. These activities included school fundraising events, such as monthly movie nights, weekly jean day, and holiday parties. In addition, grant proposals were written to organizations such as BING and Lowes. As a result, the teachers conceptualized FoK for activism through these activities aiming to collaborate and foster relationships with participants from Genesis, the neighborhood, and/or community organizations. These relationships are between the teachers and their students, within Genesis’ staff, and across Genesis and the community members. I describe the intricacies of these relationships using monthly movie nights and the BING video as examples to show how teachers thought about the outcome of FoK as a change in site.

1. **Monthly movie night**

   The social interactions between the teachers and the students changed as both participants began to work collectively towards planning for monthly movie nights at the school beginning in October, 2010. Previously, the teachers facilitated the students’ field work of collecting surveys. In addition, the teachers worked separately to advocate for the playground during staff and LSC meetings. However, the movie night built collaboration between Abby, Karen, and their students. The students would advertise to their families and neighbors, while the teachers would chaperon the event. The purpose of the movie night was to raise community awareness and collect money for a playground.
The teachers discovered an unexpected outcome of the movie night resulting in an increase of parent and family attendance at the school. Abby and Karen collectively write in their group report on August 2, 2011, “in previous years, our school did not have many events that were open to the community” (p. 36). However, the creation of movie nights provided a place at the school where “families could enjoy together…we would fill approximately 300 seats for the movies” (p. 37). Therefore, the teachers conceptualized the magnitude of FoK for activism lending itself to an increase participation of families and community members getting together to socialize and build positive relationships with the school. The school was a place not just for students and teachers but becoming a community center hosting events, while promoting playground activism. In addition, the network of people extended to the LSC members who attended the movie nights as volunteers. The LSC members would contact local companies, such as the Salvation Army, to donate candy and popcorn at each event. This extended the schools relationships across LSC members and community organizations. Although the administration did not take an active role, their acceptance to use the school’s auditoriums each month solidified their support for the playground. Abby and Karen describe how FoK for activism created a change in site as the “playground initiative became a popular after-school activity…and became the general community gathering place” (p. 37).

2. **BING video**

The teachers also noticed a change within Genesis as the staff changed to work collectively outside their own classroom and office walls to fundraise for the BING grant in the months of October and November, 2010. BING is an online search engine that rewarded an educational grant competition in 2010 to financially support schools needs. BING accepted video submissions and winners were selected based on the highest number of online votes. The teachers describe the BING fundraising opportunity being a change in Genesis in their group report because previously “teachers would apply individually for grants, but there was not anything where teachers, administration, students,
parents, and community members were working together” (p. 36). For instance, several Genesis teachers attended the GPC meetings to either write the proposal or generate the online video.

In addition, the atmosphere of Genesis changed as there were images of the BING grant posted all around the school. Genesis members, such as the secretary staff, teachers, and students, worked together to create BING posters outside and inside the school to advertise voting for their BING video. As one enters the building, there is a large thermometer symbolizing the playground movement and identifying how much money has been collected. The administration assisted by opening the computer lab to give access to community members to submit their online votes. Although Genesis did not win the grant, the initiative built a stronger collaboration within and across the school.

3. **FoK for pedagogical action**

The teachers transformed students’ funds into capital. Previously, the teachers used students’ funds to mediate their learning. However, FoK for activism allowed the students to take their funds and transform it into capital. An example, of this occurred when the teachers had their students use their funds to write a persuasive letter to the alderman to deliver them a playground. Whereas examples of fundraising contributed across school to community participation, writing a letter to the alderman engaged students in transmitting their funds for civic participation.

Karen’s students all wrote similar letters since the content of the letter was written collectively in a whole group setting.\(^{28}\) However, minor differences exist within each students’ letter as they either added or omitted sentences. I highlight a few FoK examples that were addressed by Karen’s students to show how they used their funds in the letter to the alderman. For instance, the letter exhibited FoK when the students acknowledge that playgrounds in their neighborhood had soft flooring. The students persuaded the alderman to consider similar playground flooring safety at their school since they write

\(^{28}\) See appendix E.1
below the potential play space is hazardous.

In addition, the students carried knowledge that they and their community needed a playground. Since students conducted the playground survey, it allowed for their funds to be presented from personal knowledge to reliable quantitative data. The students refer to these surveys as proof for needing a survey when they write the results of the survey indicated a unanimous agreement of wanting a safe playground:

The students also provide their FoK to advocate for a safe playground when referencing their knowledge of gang activity surrounding the school making their neighborhood dangerous. When writing the letter, several students shared the same example, derived from their funds, that husky dogs serve as the best protectors against gang violence. Therefore they refer to these to convince the alderman that safety has to be a priority for their playground.

The purpose of highlighting these few FoK examples in the letter, is to represent how students were able to take their funds and transform them from community knowledge to participating in civic action. In doing so, the teachers were able to tap into understanding their students’ resources, or in this case playground knowledge, and have students take agency to write and challenge mainstream schooling practices. Abby and Karen conceptualized FoK for activism through the lens of pedagogical action as
they engaged in critical thinking and participated in constructive dialogue so that their students may create a persuasive argument, grounded in their funds, to the alderman.

4. **Summary of FoK for activism**

Based on Abby and Karen’s (re)conceptualizing FoK for activism, we learn how FoK became a theory that when implemented helped them (re)conceptualize the magnitude, power, and potential that FoK could be used for activism through social justice processes and a capital perspective. Traditionally, FoK examines the micro-level interactions within a classroom for (language)learning. However, Abby and Karen provided an additional purpose for FoK to work towards transforming their school and community environments for the students. Table 15, summarizes the main themes that were conceptualized by the teachers and the outcomes on FoK for activism.

**TABLE 15. (RE)CONCEPTUALIZING FoK FOR ACTIVISM**

<table>
<thead>
<tr>
<th>(Re)Conceptualizing FoK Activism</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers’ awareness that playgrounds are essential for maintaining ELs well-being in-school</td>
<td>Teachers’ awareness (language)learning environment includes, social,</td>
</tr>
<tr>
<td></td>
<td>interactional, and <strong>physical</strong> contexts, like playgrounds</td>
</tr>
<tr>
<td>Change in students: Teachers’ awareness students are community activists</td>
<td>FoK for capital (i.e. civic engagement; letter to Alderman)</td>
</tr>
<tr>
<td>Change in self: Teachers’ awareness they are community activists</td>
<td>Formation of Genesis Playground Committee</td>
</tr>
<tr>
<td>Change in site: Teachers’ awareness the school is an activist site</td>
<td>Fostering community relationships and collective activism</td>
</tr>
<tr>
<td></td>
<td>Community events for fundraising: monthly movie nights, weekly jean day</td>
</tr>
<tr>
<td></td>
<td>holiday parties, writing grant proposals,</td>
</tr>
</tbody>
</table>

Their trajectory began when they recognized during the first unit the complexity that playgrounds are a cultural practice and essential for maintaining ELs well-being in-school, and not
simply a student interest. They found themselves in conflict with the district policy on playgrounds as an option, and the school’s policy that students should be confided to the classroom for safety precautions of injury in the play lot. The teachers were looking at playgrounds as (language)learning from a social, emotional, and health perspective, such as exercise, socializing with other kids, and emotionally, how ELs view themselves as “bad” students without playground privileges. Notably, a limitation is that the teachers are (re)conceptualizing playground funds not within particular academic subjects like math and science, but for overall school survival environments. However, in this study, I argue that playground activism should also be examined through “zones of comfort” framework” (Velez-Ibanez & Greenberg, 1992). The playground activism initiative became a symbol that the school did not foster students’ cultural ways of being that they needed to support their zones of comfort in-school. In its traditional definition, zones of comfort, references the children-adult interactions and practices for learning at home. These household practices would then transfer to school for teachers to use with students to maintain similar zones of comfort learning environment. In other words, I reflected on the teachers wanting to adopt student learning in school through zones of comfort by preserving the playground space. In this context, I interpret zones of comfort as not just a practice, but for the students their zones of comfort included a physical artifact, the playground. Teachers saw this as important for learning because playgrounds were important to maintaining their well-being. There’s a question of who gets to define what are authentic learning environments and opportunities for students? FoK provided an answer to this question as the teachers explored how important play was to students learning and became aware by giving students’ a voice through learning their funds, the types of learning artifacts students needed to include a playground was essential to their school survival. Based on student funds, the teachers re-defined (language)learning to include the physical arrangements of school and the need of a playground.

The teachers also evolved in how they (re)conceptualized playground activism with respect to
change in students, change in themselves, and change in site. Initially, the teachers wanted their students to take the reigns and advocate for a playground. However, the teachers realized they couldn’t remain passive facilitators, they would have to also become playground activists too. They did so by forming the Genesis Playground Committee, where they would fundraise, advertise, and communicate with local officials and organizations to lobby for a playground. Here, we learn that teachers cannot simply state they support their students’ initiative, but they too build solidarity with their students to do actions, take up agency, that work toward students’ initiatives. Furthermore, the teachers (re)conceptualized a change in site for Genesis to become an activist site through conducting fundraising activities at the school like, monthly movie nights and a voting location for the BING grant. In doing so, we learn how FoK for activism can foster relationships with community members to interact with the school in ways they might not have interacted before. Finally, FoK is (re)conceptualized in relation to understanding how the theory can activate students’ funds for capital. The teachers had students build on their community and playground funds to advocate for a letter to the alderman for a playground. Thus, students’ funds have the potential for ground breaking change in themselves, teachers, and school.

E. (Re)conceptualizing Math and Science Funds

Abby and Karen conceptualized the way they perceived math and science within a FoK framework. The relationship between the content areas and FoK is one that is reciprocal. As the teachers expanded defining FoK from expertise to knowledge, skills, and/or experiences, they broadened the range to where math and science is exhibited in students’ funds. Furthermore, as the teachers theorized the definition and purposes of FoK they were able to develop an understanding of what counts as math and science literacy from traditional topics in textbooks to examples in students’ lives.

In this section, I share the process and outcomes of my intervention during the weekly meetings as it pertains to the overlap of theorizing math and science and FoK. I describe how the teachers thought about math and science from the official viewpoints of the mandated curriculums. Next, I explain the
shift in how the teachers made sense of integrating language and literacy into the content areas as well understanding how math and science concepts can be embedded within one another. Finally, I describe the transformation in the teachers conceptualizing FoK in relation to math and science. In other words, the teachers had to broaden what counts as math and science, in order to see its intersection within FoK. This transformation was necessary in order for the teachers to know how to mediate students’ funds for math and science (language)learning.

1. (Re)conceptualizing the integration of math and science with language

While the teachers and I were theorizing what counts as FoK, I was also mediating the teachers thinking about math, science, and (language)learning. When planning for the first unit, I shifted the teachers to expand their perspectives on math and science as subjects that can be integrated together. In addition, when the first unit ended, I helped the teachers change their view of language from vocabulary terms to a socio-cultural perspective. These two shifts became precursors for the teachers to be able to conceptualize FoK because it expanded the teachers’ meaning making for what counts as math and science funds.

For instance, Abby and Karen evolved in their understanding of integrating math and science. In my first interview with the teachers on November 22, 2010, I asked them to explain their views of math and science. Abby spoke to math and science as opposites and in isolation from one another. She explains that science is a subject where there is flexibility to make mistakes and students are encouraged to explore because “if you mess up it’s a science question and you can figure it out.” However, math is “teaching by the book…teach me what you want…but science let’s talk.” Math is considered to be unidirectional learning from the teacher to student, where science is perceived as a collaborative learning between teacher and student. Similarly, Karen speaks to science being dynamic “interactive…hands on,” whereas math consists of linear “concrete rules.” Unlike Abby, Karen is aware of a potential integration between the two subjects since she’s “always seen a connection between math
and science.” In the same interview, I asked how they theorized learning math and science, both teachers emphasize learning through a discourse. Karen refers to discourse as “hearing the students use the terms” and Abby agrees its “using vocabulary words.” Therefore, the teachers conceptualize a language of math and science through appropriating content vocabulary.

Throughout our weekly meetings, I facilitated the teachers’ thinking to conceptualize math and science integration from a CHAT perspective. In addition, I transformed the teachers’ understanding of learning beyond vocabulary proficiency to Discursive shifts, such as socializing students to become mathematicians and scientists. These two claims were presented during our thematic planning for the first unit on September 27, 2010. As the teachers and I negotiated what the first unit’s final assessment would be, I remind Abby and Karen to consider the assessment in terms of the integration of math and science through Engestrom’s (1987) activity triangle.

Ambareen: Learning in a socio-cultural context does not constitute a shift in information. Just because a student knows how to add numbers doesn’t mean he has learned math, rather learning means how does the student become a mathematician and a scientist beyond information. So let’s think back to our activity triangle. What did we say we wanted our final outcome to be? We wanted our students to be what kind of identities? (reads teachers’ activity triangle) Community activists. Researchers. So how can the assessment hint at elements of this identity piece?

I explain to the teachers that assessing ELs learning through a CHAT perspective allows them to think beyond vocabulary development or shifts in acquiring new math or science information. For instance, just because an EL may be able to use a proper math or science term, like “independent variable” in a sentence doesn’t mean the child has “learned.” The term “independent variable” can have different meanings depending upon the community to which the student is speaking. In the Slides Unit, an independent variable was referring to a physics experiment of what physical objects or variables influence the speed of a slide. However, for algebraic equations, independent variables are important for solving unknown numerical values. Therefore, I disagreed with the teachers’ idea of privileging vocabulary as the primary marker for language learning because words have different meanings in various communities. I placed emphasis on the teachers to re-conceptualize EL language learning from a
language socialization background as they assess how their students become mathematicians and scientists. I refer to the activity triangle because I remind the teachers to reflect upon what Discourses they wanted their students to be socialized into, which they identified to be community activists.

Therefore, the integration of math and science isn’t a shift in knowing new academic information in both subject areas, but math and science practices are embedded as a Discourse within the socializing identity of becoming a community activist. The activity triangle helped the teachers arrange learning as Discursive shifts, from playground experts to community activists, mathematicians, and scientists. Math became conceptualized as being a mathematician and similarly, science was viewed as being a scientist. In doing so, math and science is theorized as an integration within the socialization toward a community of practice.

Karen: How do you think this helps us to get a playground? Hopefully they say because we collected data.
Ambareen: I see like do a more reflective piece to reflect on the whole experience, so they hit on the social activism piece and how it relates to also being a mathematician and scientist. We want students to see math is all around us, science is all around us in our endeavor toward a playground.
Karen: Each group can have a poster and have elements like have a graph and information they found, a quote, they can present that. And that way they can get a lot of practice speaking.

Karen responds to my intervention to create an assessment question, “how do you think this will help us get a playground.” She doesn’t ask students to define math or science vocabulary, but instead targets the question to display their community activist identity. Since in her planning her intended goal is to socialize students as community activists, this question allows for her to see how the students speak and practice that identity. In addition, she shows her understanding of math and science integration within the Discourse of a community activist. For instance, Karen pre-determined an answer to the question by guiding students to demonstrate their math and science practices through the use of interpreting data, such as the survey, graph, and interview in an assessment poster. I elaborate further on Karen’s question to extend that what counts as math and science can be seen in the Discourses our students belong to or
are becoming socialized into. Therefore, I am pushing the teachers to move away from vocabulary markers that they emphasize and to view math and science as Discourse practices.

This was a new way of thinking for the teachers about math and science, because traditionally math and science was explored in mandated textbooks. However, traditional mandated textbooks isolate math and science as separate subject areas; but in the real-world math and science can be found within similar settings, such as the playground. So I had to mediate the teachers to think about how math and science is integrated in order for them to identify its existence beyond a textbook. I expanded the teachers to ask what counts as math and science in other spaces, such as Discourses, by referring to the activity triangle. Thus, the teachers began to look at how the integration of being a mathematician and a scientist is important for being socialized into a community activist. In doing so, the integration of math and science practices are reflected in the broader Discourse of a community activist, which was a new perspective for seeing where math and science can exist.

In my interview on July 5, 2011, I tracked the teachers’ conceptual understanding of integrating math and science. Abby demonstrates a shift in understanding how integrating “everyday math and science is meaningful…before we taught it more separated and the school has specific subjects at this time…but the subjects are connected, and they are not cut and dry, they all go together.” Abby challenges the social structure of schooling that reproduces learning as isolating math and science. However, viewing math and science as practices that can be integrated in a Discourse, like community activist, gave new purpose for how math and science can be connected. Therefore, Abby expanded math and science from being opposites to complimenting one another. Karen took a different perspective than Abby to reflect further on the integration of math and science from a CHAT perspective. She says that planning to integrate math and science using the “activity triangle forges a connection between students’ learning in the classroom and their developments as individuals in society.” Math and science integration is being compared to beyond textbooks and now, through the use of activity theory,
“focusing on the goal of an identity, which considers the relationship between concepts and language as they are being acquired simultaneously.” Here, Karen displays her shift in language learning from vocabulary discourses to Discursive shifts representing language use. For the teachers, their understanding of integrating math and science was a precursor to conceptualize FoK with math and science.

Expanding math and science as Discourses, changed the way Abby and Karen conceptualized language learning. Both teachers found that the language of math and science is more than knowing vocabulary words. Abby used to think that science is “knowing the challenging academic language…but its student’s taking part in a scientific Discourse…value their culture [FoK] and develop their identities as science learners” (Action Report, p. 4). Here, Abby stresses learning the language of science not through grammar or vocabulary approaches, but socializing students into science learners while valuing their FoK. She recognizes that students come to school with their FoK and it is to be used to develop identities in secondary Discourses. Similarly, Karen has also changed the way she perceives math and science. She says in her interview on July 5, 2011, that she refrains from (language)learning in “read[ing] a book during math but now I understand it’s a type of Discourse. There’s a language to math and science and you are teaching them a whole new Discourse.” She broadens her perception of math and science as a community of practice with their own “language.” She adds that language is not acquiring academic vocabulary, but “engaging with words than just knowing a definition…if they don’t know the term they can still talk about math or do scientific process in the realm of science Discourse.” Karen is able to decipher that being a scientist isn’t speaking, but it’s also engaging words in the practices of the scientific Discourse. Even if a student falls short of not saying the appropriate word, she doesn’t dismiss them as scientists because they can show scientific practices as well. Therefore, the teachers’ perspective of math and science is integrated with language. The teachers expanded their perspectives on math and science and saw its existence in Discourses. This became a critical stepping
stone for Abby and Karen to transfer where in students’ own life-worlds math and science funds can be found.

The teachers were successful in conceptualizing math and science as practices, in addition to content knowledge. For instance, Karen and Abby began to conceptualize common math and science practices, such as challenging claims. She says in an interview on July 5, 2011, “math and scientific Discourse are marked by challenging each other...when Eric challenged I feel that’s scientific discourse as scientists who study science by modeling and pointing out.” Karen draws parallels to how scientists challenge one another results and her students were engaging in similar practices. Abby’s perspective of practices expanded how she could further students’ math and science practices beyond the math or science block but integrate it into the reading or social studies hour. She says, “math and science discourse can be weaved in the rest of the day throughout other curriculum...like challenging in reading.” Abby becomes aware of how although she can’t teach math knowledge of equations in other subjects, she could teach math as ways of being in other curriculums. Teaching math and science practices, such as argumentation, or challenging claims, into other content areas gives ELs more time, opportunity, and exposure to strengthen their math and science practices.

2. Integrating FoK with math and science

In this section, I explain how although the teachers speak to math funds, they privileged science funds because they conceptualized science as a subject that resonates closer to the theory of FoK. In addition, I explore how Abby and Karen evolved in their understanding of what math and science funds were. The teachers began viewing math and science funds as they were explicitly referred to as topics found in the mandated curriculum. Next, they began to look at how math and science funds represent the mandated math and science topics as they are embedded in students’ life-worlds to solve social problems. Also, the teachers viewed math and science funds with respect to the state learning standards. They also explored potential math and science funds as they expanded viewing math and
science as Discourses.

a. Privileging science funds

As the teachers’ conceptualized math and science funds, they privileged science funds compared to math funds. In our meeting on February 15, 2011, the teachers theorized science as a subject that aligned closer to the theory of FoK.

“We talked about math in graphing and there is not a lot of funds. It’s hard to find funds applied to graphing lesson whereas these lessons are more science based and experience based like falling, going fast on something, and gravity.”

Abby explains how FoK is predicated on student experiences and that science is also a subject that is “experience based.” Thus, Abby conceptualizes examples of students’ funds, as life experiences, as resonating closer to science concepts. In contrast, she uses the math concept of graphing to say that she is unable to reflect on how graphing knowledge and practices can relate to student experiences. Karen confirms her view of science resembling FoK. She says, “I’m trying to decide if it [math] is more personal or not, but I don’t think it [math] is.” For Karen, FoK is viewed as being “personal” since it involves students’ experiences and practices. She is conflicted in that math as a subject requires quantitative analytical practices which limits her to see larger possibilities of qualitative FoK existing as math funds because FoK is so personal. In contrast, science is a subject where she feels students can be “personal because they can research their community.” Science is perceived as an inquiry process where one asks questions and researches these questions which can be integrated to students’ funds explicitly. Therefore, in this section, the teachers’ speak greater to science funds, than in comparison to math funds.

b. Math and science funds as official mandated topics

Abby and Karen changed their views on what counts as math and science funds from mandated curriculum textbooks to students’ life-worlds. The teachers had thought that math and science funds were those math and science concepts derived from mandated topics in their curriculum textbooks that the students exhibited their life-worlds. I refer to the mandated curriculum math and
science topics as the “official” math and science perspectives. Examples of the official science topics included: balance, motion, insects, plants, animals, air, weather, environment, solids and liquids (FOSS and STC). Example official math topics included: counting, money, telling time, number patterns, place value, measuring, addition, and subtraction (Everyday Mathematics). Therefore, the teachers had to shift their perspectives of seeing official math and science as mandated objectives and topics that are easily apparent in a textbook and transfer where these topics existed in students’ life-worlds.

For instance, when I first asked the teachers in our meeting on September 7, 2011, what potential math and science funds they found they refer to the following:

Abby: Well they know about gardening and mentioned about fertilizer.
Karen: My kids talk about what they did in their community it had to do with keeping it clean or picking up trash or recycling.

In our meeting the teachers counted science funds as they pertain to organisms students interact with such as fishes, pets, and plants. Abby refers to the official science topic of plants when she mentions gardening, and Karen identifies the science funds of environment when referencing students’ recycling in their community. Gardening and recycling funds were topics that directly connected to official math and science topics. Therefore, the teachers initially viewed math and science funds as mandated curriculum topics in the lesson objectives that students referred to in class.

c. Creating math-science funds through solving social problems

The teachers began to expand their view of math and science funds by identifying where the official topics can exist as they are embedded within students’ life-worlds. This was difficult to do because unlike topics of gardening, students’ have funds that can exhibit math and science but are not as apparent because the topics of these funds are not the official math and science topics one sees in a textbook. For instance, in the same meeting on September 7, 2011, I agreed with the teachers that the gardening and recycling items were science funds. However, I challenged them to find out where the official science and math topics could exist in the lives of students. I decided to have the teachers think
about students’ funds as social problems, since we wanted the curriculum to be about problem-solving and problem-posing.

Ambareen: What’s something problematic that lends itself to math and science?
Karen: Gangs. They are surrounded with gangs and getting tagged constantly.
Abby: And the violence and stuff too.

Here, I guide the teachers to think about math and science not as official topics, but problems that could be solved using math and science. My intent was to have teachers think about what lends itself to math and science. However, the teachers thought about problems as social problems such as gangs, tagging, and violence. They did not see a connection to social problems and math and science. I recognized that topics such as gangs were not viewed as an official science or math topics, therefore the teachers did not consider these topics as a math and science fund. I rephrase my question to ask the teachers to think about solving a problem. My intent was as they thought about what problems could be fixed, I could make them aware of how math and science is apparent to solve the social problem.

Abby: Remember you talked about the playground. My kids had strong feelings about that one.
Karen: Uhm, I forgot my community walk. It was a flop because the kids didn’t know how to use the map to write things but a lot of them were like I like that playground. I wish we had that.
Abby: Like I see where it can go physical but that’s not in our core topic.
Karen: Kind of like the idea of citizenry almost you know.

The teachers identify another social problem of not having a playground at their school. The teachers are able to see how advocating for a playground can connect to academic content. Initially, Abby sees this problem linking to a gym standard and Karen views the problem from a social studies perspectives. Yet, both teachers are unable to view playgrounds as a math or science fund, because similarly with gangs, playgrounds are not an official math or science topic.

The teachers were able to see math and science funds in students life-worlds because as we discussed practical solutions for the playground problem, they become aware of where math and science
can be used for solving the playground problem. For instance, I use the concept of playground funds to assist the teachers to see the playground as math and science.

Ambareen: You can do science observations to identify really what is going on in the broken cement lot. You can even get into gadgets and physics like do something with levers and pulleys on a playground to see if it’s safe. The math is everywhere with angles and geometry. Or you mention citizenship you can do taxes and money like why certain schools have better playgrounds.

Karen: It could be about money an addition and how much this cost.

As we discuss possible solutions to get a playground, I explain where math and science can be beneficial for the playground cause. I provide examples that science observations allows students to examine what’s wrong with the current play lot to establish a need for a playground. I also share ways how using math can explore the inequality that exists between schools by discussing taxes and income. Karen was able to see the math by referring to math monetarily to calculate the cost of a playground. Once we establish the concept of surveys to advocate for a playground, Abby views the playground as a science fund because the students “engage in the scientific process through conducting surveys” (individual report).

Although topics like gangs and playgrounds appear to not contain official math and science topics, I guided the teachers to see where the official math and science topics can exist in students’ FoK. The teachers expanded to view math and science funds by developing creative ways that the official math and science topics can be used to solve students’ social problems grounded in their funds. By using official math and science topics to solve problems in students’ life-worlds, math and science funds are created since they are embedded within the fund. Thus, Abby and Karen conceptualized math and science funds as they merged official topics that could be connected to students’ funds.

d. **Math and science funds as state standards**

Abby and Karen also conceptualized what counts as math and science funds by extending looking at math and science from official topics in their mandated curriculum to focusing on the state learning standards. Even though the mandated math and science curriculum topics are aligned
to state standards, the teachers began to view students’ funds with respect to the state standards. I explain to the teachers in a meeting on February 8, 2011, the importance of knowing the standards to create a math and science fund.

Ambareen: You have to know the standards so when they bring their funds of knowledge you know how to weave them through that objective. So if a kid talked about being robbed, yeah that’s a fund, but now connect that to a math and science standard.

Abby: All the kids have slide funds. I think we are doing that now so they were on this bumpy slide and the kid pushed so its force.

I explain to the teachers that they should know their students’ funds, but importantly they need to view how the fund can relate to a learning standard. Abby shows her understanding of how students’ funds can be connected to standards. She recognizes that all of her students have funds relating to slides and draws on a student experience of being pushed on a slide to see its connection to the learning standard on force. In addition, both teachers also write in their action report how using the inventory table (see appendix) allowed them to be cognitive of the standards when conceptualizing students’ funds. They write how the inventory table “included values and principles of math, science…by using this table it organized us in a way that standards…[are] making connections to students’ community knowledge [FoK]” (p. 12). Therefore, the teachers thought about students’ funds in relation to the standards. Karen describes her understanding of FoK by stating, “it’s what you said Ambareen, you really have to know the standards so you know where your heading.” The teachers counted math and science funds if they were able to forge connections to students’ funds with the learning standards.

e. Math and science funds as Discourses

In addition, the teachers became aware of what could be a math and science fund when thinking about math and science as Discourses. The teachers thought about what math and science content knowledge the students needed to know. However, when thinking about Discourses the teachers were considering what the practices of a mathematician or a scientist are and how that can be counted as being math or science. I provided on-going examples for how the teachers can think about
ways students’ funds can be embedded with math and science practices, and not just content knowledge. For instance, I shared with the teachers performance descriptors for scientific habits of mind to represent specific scientific practices [see appendix]. From the descriptor list, Abby integrated students’ FoK and the scientific habits of mind of speaking with claims and evidences as a way to think about scientific funds. For instance, she fostered a tension discourse where students use their funds as evidences to engage and challenge one another claims. She explains on November 8, 2010, how “students’ funds leads to tension within between and there’s argument and at some point there is going to be learning.” Therefore, Abby created scientific funds as students’ funds were used for the scientific practices of argumentation. Furthermore, Karen also identifies scientific practices in students’ funds as well. She explains on February 15, 2011, “Brock built a Lego fire truck and we were thinking of using Lego to build the slides. He says it took hours to make so he understands the process to building something.” Here, Karen reflects on how Lego fund practices represent similar scientific technological design practices. Although the technological design standard reflects to “build a design,” the science and math practices in building Lego trucks, reflected from Brock, represents the need to build and re-build, an outcome to his realization of a longer process. When building something it requires several iterations to modify the structure as well as planning for additional time to create the object. Therefore, Karen identified Brock’s Lego funds as scientific practices in his funds.

3. **Summary of (re)conceptualizing math and science funds**

The teachers evolved in how they (re)conceptualized math and science funds. However, (re)conceptualizing math and science funds, required the teachers to make sense of integrating “math and science,” then, math and science with “language,” and also “FoK” in math and science. Collectively, these different perspectives represented the teachers’ (re)conceptualization of math and science with language and culture (i.e. math-science funds).

To begin, Table 15 represents a summary of the teachers’ shifts in the integration of math and
science, and then with language. The researcher’s intervention on mediating teacher’s awareness of Discourse and language socialization theory shifted the teachers’ to view the integration of math and science, instead of the school’s approach to separate these subjects in textbooks. Also, the concept of math and science expanded from content knowledge to practices. For instance, both teachers mention a shared math-science practice on challenging claims. It was necessary for the teachers to see math and

**TABLE 16. (RE)CONCEPTUALIZING THE INTEGRATION OF MATH AND SCIENCE**

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Conceptualization</th>
<th>Researcher Intervention</th>
<th>(Re)conceptualization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abby</strong></td>
<td>Math and science are different</td>
<td>Integrate math and science by appropriating a Discourse, like community activist</td>
<td>“before we taught it more separated…but subjects are connected”</td>
</tr>
<tr>
<td></td>
<td>Math and science is knowledge-based</td>
<td></td>
<td>Math and science is a practice (i.e. challenging claims across content areas, even language arts)</td>
</tr>
<tr>
<td></td>
<td><strong>Math-Science Language</strong></td>
<td>“using vocabulary words”</td>
<td>“taking part in a scientific Discourse”</td>
</tr>
<tr>
<td><strong>Karen</strong></td>
<td>Math and science is connected</td>
<td>Integrate math and science by appropriating a Discourse, like community activist</td>
<td>“activity triangle forges a connection between students’ learning…and developments in society”</td>
</tr>
<tr>
<td></td>
<td>Math and science is knowledge-based</td>
<td></td>
<td>Math and science is practice (i.e. challenging claims)</td>
</tr>
<tr>
<td></td>
<td><strong>Math-Science Language</strong></td>
<td>“hearing students use terms”</td>
<td>“a type of Discourse…engage with words than just knowing the definition”</td>
</tr>
<tr>
<td></td>
<td><strong>Integration of Math-Science</strong></td>
<td>Language socialization</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Integration of Math-Science</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

science integrated because it could inform the teachers to identify a math-science fund with respect to a greater Discourse, like the markers of a community activist who uses math and science. Also, the teachers shifted in their understanding of language development in math and science from vocabulary.
markers to focus on meaning-making of the terms. In doing so, it could assist the teachers to see that students’ way of talk, or linguistic funds, could appropriate meaning of a vocabulary word, even if they hadn’t used the term.

Figure 37. (RE)CONCEPTUALIZING MATH-SCIENCE FUNDS

The teachers’ also (re)conceptualized how they viewed “FoK” in math and science. The teachers evolved as they discovered ways they could make sense of what counted as a math-science fund. However, a limitation emerged when the researcher found the teachers’ privileged science-funds over math-funds. This occurred, because the teachers’ found greater affinity to FoK with science than math, because science was viewed as experiences, closely resembling to FoK as ELs’ experiences. Initially, the teachers identified math-science funds if it was a life-world topic matching in-school math and science topic found in their mandated textbook curricula. However, the researcher intervention on problem-posing funds through social contexts, allowed the teachers’ to create math-science funds as long as it used math and science concepts to problem-solve. Additionally, the teachers’ counted math-science funds if they could relate the fund to a state math and science standard. As the teachers’ awareness on math and science Discourse emerged, they counted math-science funds as math and science practices.
Thus, we learn that grasping the concept of math-science funds is not simple, its complex in the layers the teachers had to peel. It implies that the teachers had to move from looking at math and science in contexts that are non-school based, such as life-worlds. This was challenging for them, when their mandated curriculum and standards had the teachers look at math and science in formal in-school contexts. Bridging out-of-school and in-school contexts meant the teachers had to re-define how they conceptualize math and science, and also how they conceptualize FoK.

F. **Conflicting Teacher and Student FoK: (Re)conceptualizing Linguistic Funds**

For monolingual teachers, like Abby and Karen, it can be challenging ideologically and practically to foster students’ native language because their FoK may be in conflict with their students’ linguistic FoK. The language barrier between the teachers and students may result in ELs finding that they do not know how to show the teachers their ways of speaking in such a manner that the teacher acknowledges. Furthermore, ELs “may be asked to engage in activities they do not fully understand” (McIntyre, Rosebery, & Gonzalez, p. 3). Therefore, many of the ELs rich linguistic funds may go unrecognized by the teachers or fall in conflict with the teachers’ traditional practices of teaching. Because oral language is the primary tool that Abby and Karen used to teach, they were conflicted with how they could educate ELs who are not proficient in English, the language they traditionally teach to and through. Abby and Karen struggled to recognize the value in fostering students’ native language as an integral component to FoK because Spanish, the students’ native language, went against their traditional language of learning.

In this section, I explore the teachers’ development as they evolve to value the importance of FoK for integrating students’ native language in math and science activities. The teachers shift from resistance to helplessness to searching for strategies to foster Spanish in the class. As a result, the teachers recognize that Spanish can be a tool for their science and math activities. In addition, they
change their perspectives to value linguistic funds.

1. **Spanish resistance to helplessness**

Abby and Karen resisted fostering students’ native language because they could not comprehend Spanish. In the first unit, Karen illustrates the conflict between her linguistic funds and her students when she writes, “I was convinced they would never use Spanish with me because they knew there was no point- I couldn’t understand them” (Action Report, p. 30). Additionally, Abby clashes with the idea of fostering multiple languages in the classroom. She privileges an English only environment where “I’m teaching and their learning in English” (Focus Group). The teachers’ ideological resistance from a monolingual to a bilingual classroom was at odds with their traditional practices of teaching in an English environment. Thus, using students FoK which considers fostering linguistic funds, was challenging for the teachers to conceptually accept.

However, both teachers changed their perspectives of resisting Spanish to feeling helplessness in the second unit. Karen revealed how during a book club meeting with the students a misunderstanding occurred and an EL told a bilingual student to not speak to him in Spanish at school. The EL’s comment triggered Karen to realize that she “had passively partaken in the continuation that Spanish is not valuable for success” (Action Report, p. 32). Although Abby did not experience this event with her students, our discussions in the weekly meetings informed Abby to reflect on Karen’s perspectives on March 8, 2010.

Karen: No matter how much I tell them it is okay to speak Spanish they know I don’t speak Spanish so why would they waste their time talking to me. I feel stuck. How am I going to help these kids make connections to their native language?

Abby: You can’t be helpful because you do need to know the language. You can’t help them in Spanish.

FoK as a linguistic tool for ELs’ math and science learning is challenged by the teachers. Whereas in unit one, the teachers dismiss the concept of multiple languages, in unit two the teachers begin to find value that Spanish is important to how EL identify themselves in school versus at home. Karen
recognizes that her students’ practices at home, such as speaking Spanish, are not valued in school because she unknowingly created that environment. However, when Karen attempts to think of solutions, Abby and her find themselves helpless to make change because they do not know Spanish.

2. **Native language as tools for learning**

Abby and Karen shifted their perspectives from teachers who are helpless to teach ELs to active agents of change fostering native language. As a former ESL teacher, Lorena, offers to be a Spanish resource for the teachers by translating vocabulary into Spanish cognates in the science lesson plans. In addition, I suggest that Lorena can co-teach with Abby and Karen Spanish lessons. Abby agrees to share the cognate list with her students, but rejects to have Lorena co-teach because she was not comfortable relinquishing her authority in the class to another teacher and in a language she did not know. On the other hand, Karen was open to the idea of co-teaching and was willing to make linguistically pedagogical changes in her teaching to show her students she valued Spanish.

The teachers and I theorized on how Spanish was being used in the classroom in a meeting on February 8, 2011. When reflecting on the lessons where Abby and Karen taught cognates, they still had reservations to how Spanish was being used. Abby states that, “I told them about cognates and I tell them to say a couple of words, but I am not going to force them.” Abby’s approach to fostering native language is to verbally let students know they can speak in Spanish. However, she did not notice an increase in students’ speaking Spanish even though she gave them permission. Similarly, Karen reflects a minor shift in students’ native language use. She says, “I notice kids teach me the word cactus and spine, but they would have never taught me had you [Lorena] not come.”

I noticed how the function of Spanish was reduced to students or the teachers translating terms. Sprinkling Spanish vocabulary into the conversations was a new practice for the teachers, but I challenged on how native language could be pushed further to mediate authentic meaning making for ELs.
Ambareen: What makes ELs different than mainstream kids?
Abby: They just need a lot of like language support.
Ambareen: Exactly. So how are we going to build on linguistic FoK for learning? Our kids have language needs and how are we addressing those needs.
Abby: They can speak Spanish.
Ambareen: But there’s a difference saying translate this word for me in your language versus talk in your group and figure out a problem and they are using Spanish as a resource to solve the problem.
Abby: How do you do that?
Ambareen: It’s not enough to say you can speak Spanish. It’s the type of climate you bring in your room. So if you bring a parent who doesn’t know English to come in and talk about some experience you have showed Spanish is a language of status here and is needed to complete the objective. Even though the assessment is in English doesn’t mean they can’t use Spanish as a resource to get them to the assessment.

Although Abby provides students the option to speak in Spanish in their groups, I challenge that it’s not enough to simply say it’s okay to speak Spanish. To foster ELs’ native language, requires students to use Spanish in meaningful ways in the design of the activities. Spanish as a resource or tool to complete problem solving an activity, gives students’ an academic purpose for their native language. For instance, when the teachers created the playground surveys, they could have had parents or community members complete the responses in Spanish. Therefore, the students’ who were Spanish proficient could of used the Spanish surveys towards their math and science objectives in the playground units.

Karen evolved in her understanding of Spanish as a tool for the activity by experimenting with different language approaches during the third unit. Initially, when Karen co-taught with Lorena, she was an observer to the students speaking Spanish with Lorena during a science read aloud activity. However, she wanted to engage with the students in Spanish as well, so she attempted to decode Spanish words during a language arts read aloud session using a Spanish book. Although she didn’t understand Spanish, the students assisted her in pronunciation and decoding Spanish words to comprehend the story. Karen reflects on this experience to build awareness to how even though she wasn’t Spanish proficient, she could “foster students’ primary language by creating activities that required the use of it…I did more than invite them to speak Spanish, I made Spanish part of the joint activity” (Action report p. 35). However, Karen realizes that the read aloud activity, lacked using Spanish for science or math objectives and intends on researching further Spanish for math and science literacy.
3. **Valuing students’ linguistic funds**

The language that ELs speak and how they speak it socially situates them into whether or not they are included or excluded from the classroom learning community. Karen reflects how privileging an English only environment excluded many of her native Spanish speakers. She writes, “I, along with the school, had communicated a classroom culture that put students’ primary language in opposition to the Discourse of the classroom.” (Action Report, p. 4). As a result, students were socialized to view their first language as a fault rather than a resource for their learning. Abby also shifts to value ELs native language when she writes, “it is not necessary for a teacher to speak his/her students’ native language in order to foster it” (Group Report, June 15, 2011). The teachers collectively write how “we focused on providing outside resources, such as Lorena, and learned to develop activities that ask students to incorporate Spanish” (Group Report, June 15, 2011). Abby and Karen were able to move from being helpless to actively finding strategies to teach children whose language is not their own. Therefore, students’ FoK that are in conflict with teachers’ FoK, requires teachers to make adjustments to their pedagogical practices so that students are learning in their zones of comfort. Karen reflected on exploring multiple pedagogical adjustments, and Abby grew to build awareness on the need in the future to change her linguistic practices.

4. **Summary of linguistic funds**

The teachers struggled to shift from a deficit to additive view on students’ native language. The teachers and I discussed their learning to conceptualize and use Spanish, and is documented in Karen’s action report in figure 38. Although Abby did not take up similar practices than Karen, in our meetings she was informed from Karen’s FoK practices and shifted toward an additive view. This suggests, the power of study groups as a place where teachers who may be uncomfortable can learn from others, and grow together to change their FoK perceptions.
How do I foster students' native language in an academic setting?

Initially, when presented with the idea of fostering students’ native language, Abby and Karen shifted from resistance to helplessness because their language funds were in conflict with students’ Spanish funds. Lorena offers to co-teach Spanish lessons to foster students’ native language. In addition, I mediate the teachers to change their thinking of FoK practices from inserting translations to using Spanish authentically as a tool for problem solving an activity. In doing so, the teachers began to value and enact agency that monolingual teachers can support languages that are not their own. However, questions still remain such as what teachers’ can do when they are addressed with ELs funds, like Spanish, that are in conflict with their own. Other funds, such as playgrounds, were not as resistance compared to Spanish.

G. (Re)Conceptualizing (Language)Learning: FoK for Teaching ELs

Many teachers like Abby and Karen, thought that that ELs need additional “time, direction, and review” (Weekly Meeting, October 21, 2010) to understand math and science objectives compared to their mainstream peers. However, Abby and Karen realized their students weren’t “slow” learners. Often times, when educators think of ELs taking longer to achieve an objective, they may assume it’s a

**Figure 38. KAREN FOSTERING EL’S NATIVE LANGUAGE**
cognitive deficiency. Instead, the teachers rationalized that their ELs had limited access to their meditational tools, like FoK, so that they may connect and grasp concepts from their meaning making perspectives. Therefore, it wasn’t the rate students’ were learning, but the route, or social organization of learning, the teachers were guiding them. By teaching to and through students’ funds, the teachers theorized the benefits of FoK for contextualizing ELs language learning. I found that Abby and Karen reflected on contextualizing FoK for math and science language learning in: meaningful contexts, relevant contexts, and learning community contexts.

1. **Meaningful contexts**

The teachers theorized that ELs learn using FoK when curriculum is meaningful to their students. Meaningful contexts would refer to students having an interest or investment in the learning they are a part of. In relation to math and science language learning, meaningful contexts are important because Karen refers to how “we need to make what we teach to our students meaningful…we need to contextualize what we are teaching so the content and language are understandable to students’ experiential knowledge” (Action Report, p. 4). Abby also adds how learning a language through the “sink or swim approach does not work…[because] ELs are simultaneously trying to master content and the language which its being taught” (Focus Group). As ELs engage in socializing into English proficiency, they need to learn language in a manner that is meaningful to them. Therefore, students’ FoK are important because they can serve as a place to understand what is meaningful to the students.

2. **Relevant contexts**

Abby and Karen also speak to how mediating math and science language learning requires students to engage in relevant contexts derived from their FoK. Relevant context refers to the FoK practices that are experienced everyday in students’ lives outside of school. For Karen, what makes language learning in the content areas accessible to students’ is using “FoK to provide the opportunity for some kind of schema to connect and make it comprehensible” (Action Report, p. 3). In her
perspective, FoK serves as a bridge to learn from familiar funds to unfamiliar math and science language learning. Abby adds to the concept of relevant contexts by referring to the importance of students’ cultural funds from home to school practices. She says that before she used to mediate science language learning by scaffolding “using visuals…but now I’ve gotten better at contextualizing it in their own life” using FoK. She mentions that science language learning for ELs should consider how “science instruction recognizes the cultural experiences of ELs” that are brought from their home or community” (Action Report, p. 5). Therefore, relevant contexts involves knowing what students’ everyday experiences are as well as grounding students’ FoK experiences for math and science language learning.

3. **Learning community contexts**

As the teachers adopted a sociocultural perspective they also referred to the importance of contextualizing FoK within a community of learners. The teachers did not just engage students’ with their funds inside their classroom walls, but they expanded the community of learners to be active participants such as parents, community members, and other teachers in the playground activism initiatives. Karen recognizes that “playgrounds are a big part of your life, that’s how you spend most of your day outside of school, but you don’t have that in school” (Focus Group). Karen proposes that contextualizing students’ funds from out of school practices to in school learning community environments are important. Both the teachers became aware of how the dominant discourse in the classroom may be in conflict with students’ funds. For instance, Karen writes how “Latino students have a culture that is rooted in community and helping each other. Many teachers including myself, will scold this behavior without considering that this is part of the social identity the children have built in their homes before it collided with school norms” (Action Report, p. 3). Thus, Karen acknowledges that FoK can assist in math and science language learning by contextualizing students’ funds into the larger learning community. Thus, the community of learners as part of the activity is contextualized and is socialized as well.
4. **Summary of (re)conceptualizing (language)learning: FoK for teaching ELs**

Abby and Karen (re)conceptualized how they contextualize FoK for ELs. They saw contextualizing FoK in terms of meaningful contexts, such as engaging students in math and science content that their students are interested and invested in. In addition, they theorized contextualizing FoK as relevant funds that teach to students’ everyday practices. Finally, FoK are contextualized as it relates to the larger learning community fostering student’s math and science funds. Therefore, and outcome of (re)conceptualizing FoK resulted in teachers’ making meaning to learning itself.

**H. Summary of Funds of Knowledging: (Re)conceptualizing FoK**

The teachers needed to (re)conceptualize FoK because it informed how they would access and mediate ELs’ math-science funds. The various sections in this chapter reflect how (re)conceptualizing FoK is not a simple task, but a complex and on-going process as teachers’ learned to make-meaning of ELs’ math-science funds for math and science (language)learning. The process was also cyclical as the teachers had to conceptualize and then re-conceptualize FoK, resulting in the teachers’ continuously evolving in their understanding. The complexity in making sense of FoK is contributed to the dynamic and multiple layers within FoK. The researcher found that Abby and Karen (re)conceptualized FoK in multiple layers. These layers are shown in Figure 33 providing a pictorial on how the sections in this chapter are related to one another.

The first layer teachers’ (re)conceptualized is “FoK” in its *sources*, *types*, *purposes*, and nuances to defining FoK. The findings indicate a reciprocal relationship between the types of FoK and the purpose. As the teacher’s found FoK *purpose* for a curriculum theme, they shifted to locate *types* of funds rooted in expertise. Consequentially, as teachers continued to theorize and problem-pose FoK, new purposes for FoK emerged (i.e. classroom interactions and discourse) and the types of FoK evolved (i.e. experiences, knowledge). Additionally, the *sources* for where to gather ELs’ math-science funds
also is reciprocal for the types of funds collected. The teachers’ resistance and restrictions to home visits pushed them to view funds from household knowledge to life-world knowledge and experiences. In turn they shifted from a deficit to additive view on home visits because they realized their limitation inhibited fostering confianza with families for academic purposes. However, even though Abby could appreciate home visits, she still struggles with repairing confianza with families after trusts were broken. Therefore, it’s necessary to explore how teachers can overcome to repair confianza, and reconsider home visits. Implications also suggest teachers can (re)conceptualize FoK according to the purpose, or objectives, for using FoK and then consider the types and sources of funds that can assist towards that purpose. The researcher also found certain types of funds were less resistance than other, like playgrounds as a cultural practice compared to using students’ native language, Spanish. The teachers
also shifted from a deficit to additive view on Spanish, but Karen struggled to implement mediating Spanish for (language)learning. How teachers’ can incorporate native language for authentic math and science meaning-making is important to study further, especially since it took an entire school-year for Karen and Abby to change to an additive view. The researcher also explored the teachers (re)conceptualization of additional purposes on FoK for activism. The teachers shifted to view playground funds from interests to an essential cultural practice for maintaining their well-being in school. Exploring ELs’ funds provide implications for how teachers think about the cultural needs of ELs and ways they can provide those needs. Importantly, for the teachers addressing ELs needs emphasized funds for capital. Although Abby and Karen did not receive a playground, they advocated and built solidarity with the community and students. In doing so, they were attempting to create “zones of comfort,” derived from a physical space, playgrounds, to familiarize (language)learning environments for their students to use in-school (and for the community after-school). The progression of FoK for activism resulted in a change in students and the teachers becoming activists, as well as a change in site to develop Genesis into an activist site.

Understanding FoK as sources, types, and purposes informed the teachers on what counts as FoK so that they may make sense of “funds” in math and science. However, the teachers also needed to consider the ways they thought about “math and science” to reflect on math-science funds. Genesis mandated curricula, like many schools, taught math and science isolated from one another. However, in order for the teachers to make sense of math-science funds collectively, they (re)conceptualized how math and science relate to one another through Discourses. The teachers saw how math and science integrate through the concept of Discourses. The Discourse of a community activist required the use of math and science practices to achieve the activists goal, or in their case a playground. Extending math and science to Discourses also allowed the teachers to view math and science as practices in addition to content knowledge. This allowed the teachers to (re)conceptualize and identify math-science funds as
practices. Furthermore, the teachers shifted in their (language)learning view to teach math and science language from vocabulary definitions to meaning-making of vocabulary, a language socialization perspective. Thus, how teachers can expand their sense-making on math and science, including the language practices of ELs, can help teachers to capture what counts as a math-science fund. This was evident when the teachers learned to (re)conceptualize ‘math-science’ funds from students’ life-worlds. The teachers were able to develop an understanding of math-science funds from mandated curricular topics, to standards, and Discourses. In addition, they discovered that they can create math-science funds if they problem-.pose students’ funds that requires math and science to solve. How teachers conceptualize math and science, in addition to FoK, is imperative for teachers to be able to integrate the two concepts as “math-science funds” for (language)learning. Therefore, the teachers had to learn how to (re)conceptualize math and science with language and culture (FoK). As a result, the teachers transformed how they thought about (language)learning as “contexts” for teaching ELs. They found to teach ELs in meaningful and relevant contexts, in addition to extending the learning community beyond students and the teacher.
XI. DISCUSSION

There are three ways to say ‘you’ in Urdu: tum, tu, and aap. Historically these terms represented ways of talking to various groups within and across caste groups in India. If I ever talked to an elder saying ‘tu’ I would get scolded. To come across being well-mannered, I thought I could be clever by always addressing everyone with the highest level of respect as “aap.”

It is important to address the (language)learning needs of ELs in math and science because these students are found to significantly be underperforming (National Assessment of Educational Progress, 2007). With the increasing influx of ELs into mainstream classrooms, many teachers are inadequately prepared to meet the cultural and linguistic needs of their diverse learners (Duff, 2005). In particular, many elementary teachers struggle to instruct math and science because they lack pedagogical content knowledge to teach effectively (Crawford, 2000). Additionally, many teachers are not knowledgeable in language learning theories necessary to facilitate ELs language proficiency in the content areas. Furthermore, many teachers are working under conditions where ELs’ cultural and linguistic resources are marginalized for (language)learning, which is necessary to capitalize on since these resources are ELs frame of references for knowing. For instance, educational policy on a monolingual goal of English proficiency, limits ELs multiple language use in schools (Shannon, 2000). Also, the culture of power (Delpit, 1995) in schools leverages math and science from Eurocentric perspectives limiting many ELs non-Eurocentric cultural practices to learn content (Meidl and Meidl, 2011).

Recognizing these complex factors involved for teachers to educate ELs, several theories emerged to assist teaching this population of students such as prior/background knowledge, language acquisition, culturally responsive pedagogy, and FoK. The researcher also sees a gap on how teachers can use these theories, even integrate multiple theoretical frameworks, to inform their practice and explore these several theories that have emerged. Each theory has its limitations and benefits and the teacher must know how to use these theories, not as prescriptive formulas for teaching, but theorize themselves on how these theories can inform the (language)learning of ELs. However, this study concentrates and advocates for a FoK framework because it addresses the gaps identified in the other theories.
Prior and background knowledge, used as parent terms, privilege the use of students in-school knowledge to schematically build background in the regular curriculum. Consequently, the focus on in-school knowledge contributes to a deficit view because the knowledge that counts is from formalized schooling, which is problematic because it marginalizes ELs rich out-of-school knowledge and skills (i.e. FoK) viewing these resources as not legitimate practices for school. Additionally, ELs may not be able to draw on prior in-school knowledge to scaffold math and science content because many of these students are already significantly underperforming and struggling with academics in the school environment. In my study, this finding was present for Karen who identified that only her gifted students were able to draw on in-school knowledge and could speak to math and science and so it became her driving force where FoK could extend the math and science discourse accessible for ELs too. Supporting Karen’s awareness on the limitation of prior knowledge for ELs, McNeil’s (2010) study also confirms ELs level of L2 knowledge can constrict the use of background knowledge. Furthermore, leveraging in-school knowledge can make it challenging for students to connect math and science to out-of-school contexts that are necessary to achieve in the math and science reform standards. However, using ELs math-science funds can help students see a connection to how math and science is applied in their everyday practices to fulfill these standards (Bouillion and Gomez, 2001). Therefore, a FoK approach to capitalize ELs linguistic and cultural funds addresses these gaps in prior and background knowledge.

The idea of recognizing what is in-school versus out-of-school can also be identified in the popularized (language)learning theory of Cummins’ (2008) Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (CALPS). The theory of BICS and CALPS suggests that ELs acquire different language practices, such as oral language that is social (BICS) or used in out-of-school contexts versus academic language used in-school (CALPS). The theory recognizes how ELs proficiency in BICS can take about two years but does not necessarily mean these students are English proficient in their CALPS, which takes longer about five to seven years to acquire.
Similar to prior and background knowledge, the BICS and CALPS approach differentiates between the in-school and the out-of-school, but in this case leverages in-school academic discourse. Although language practices in-school can differ from ELs out-of-school language practices, assuming that there are finite boundaries between the social versus academic language can be problematic for ELs. For instance, there is potential to draw on ELs language practices out-of-school and it can be marginalized when focusing on their being boundaries of what’s considered academic talk. This leads to the question on what counts as “academic”? In my study, ELs’ FoK did not polarize that what is social language found out-of-school is “non-academic,” and what is academic language found in-school is “academic.” In fact, Abby and Karen drew on ELs playground conversations to create their social language to become academic. The findings in Chapter VIII, demonstrated how the teachers mediated ELs to talk about playgrounds mathematically and scientifically as they advocated for a playground at Genesis. Therefore, my study on a FoK framework is significant because its approach to (language)learning represents fluid ‘seamless lines’ between what counts as ‘academic’ and ‘non-academic’ talk. Additionally, it created a hybridity between what appears to be at odds with one another, BICS versus CALPS or prior knowledge versus out-of-school knowledge, and hence the term math-science funds is applicable. What traditionally appears to be math or science content and language is integrated with ELs funds to create the hybridity of academic (language)learning which is beneficial because it capitalizes on what is familiar to ELs. Therefore, rather than eliminate social language or out-of-school knowledge that ELs may be well-versed in, a FoK framework can provide a purpose for ELs strengths derived from their out-of-school language and cultural practices for academic content.

Culturally responsive pedagogy (CRP) and FoK are both part of multicultural education and provide a varied theoretical orientation for working with ELs. The goal of CRP advocates for cultural diversity and the learning of cultures across global environments to become ‘culturally competent’ (Ladson-Billings, 2001). In doing so, CRP represents learning culture through “othering” to mark
cultural groups various dispositions. However, Sleeter (2012) recognizes how many teachers of CRP focused then on learning culture, disconnecting culture from academic learning. In turn, CRP has been simplified to conceptualize culture as “cultural celebrations” or “heroes and holidays” perspectives (Sleeter, 2012). In contrast, FoK suggests for teachers to empirically ground their knowledge on culture within their students’ lives, through research methods like ethnographic home visits. In my study, the teachers found that when they used ethnographic tools of conducting a Community Walk, they were able to excavate meaningful funds, like playground practices, to identify areas of contestation in the lives of ELs for math and science when advocating for a playground. As such, a FoK approach to culture as practices can avoid stereotypical or generalized traits of a group of people, since examining the process of everyday practices takes into account multiple perspectives and reveals differences in cultural groups and their varied ways of living (Gonzalez, 2005). Additionally, the goal of FoK draws on students’ cultural strengths to create a curriculum, rather than CRP practices that may peripherally insert culture into the regular curriculum. Grounding ELs funds centrally to the curriculum, provides teachers to get to know and build relationships with their students. Rather than learn math and science from ‘other cultures’ teachers are able to capitalize ELs funds from what is familiar within their own lived practices, therefore, leveraging ELs cultural frame of references for math and science meaning-making.

The potential of FoK to address the gaps found in other theoretical frameworks makes it necessary to study further how FoK can be used for teachers to work with ELs. The study in this research stands out because there is dearth research within the FoK literature concentrating on teacher development. Additionally, there is limited research on working with ELs in the content areas of math and science. My study attempts to explore not only FoK and ELs in the content areas, but the study is a contribution and unique in its nature because of its focus on FoK with the thematic integration of math and science.
The remainder of this chapter provides the collective results in the study to show a synthesis on theorizing for teacher development. Next, limitations in the study will be identified. Then, key implications from the findings will be suggested for researchers, policy makers, and teachers. Finally, future areas of research will be discussed.

A. **Summary of Key Findings**

The setting of the study took place in an urban school on academic probation, Genesis, representing a predominant low-income Latina/o community. The study explored how a cohort of mainstream elementary teachers learn to use and make meaning of FoK as they design curriculum and engage in teaching first and second grade ELs integrated math and science. The researcher used case-study methods and collected data over a year and half period. The data sources included teacher artifacts such as action reports, individual and cohort reports, field notes, and journals, as well as transcriptions from weekly study group meetings, interviews, and classroom videos. The sub-questions for the study included:

1. How does a cohort of teachers’ access ELs’ math-science funds?
2. How does a cohort of teachers’ mediate ELs’ math-science funds for math and science (language)learning?
3. How does a cohort of teachers’ (re)conceptualize FoK?

In answering these questions, the researcher found three key findings. First, the teachers accessed math-science funds by working towards fostering confianza through multiple activities such as using surveys, ethnographic tools in a Community Walk, and asking FoK questions during class discussions. Additionally, the teachers moved towards gathering math-science funds by transforming ELs’ funds into social problems for math and science, extending the need for gathering more funds from a curriculum theme to mediating classroom talk, and accessing funds from preselected to, in addition, emerging FoK questions. Secondly, the teachers mediated math-science funds in their lesson plans and in the social
organization of (language)learning. The teachers lesson planned to design students learning from the familiar, such as to and through their funds, by creating a third space curriculum, where ELs funds became central to the curriculum. Importantly, the teachers shifted from mediating one universal fund to multiple math-science funds, thereby, expanding the mediational tools that ELs can make sense of math and science. Furthermore, Karen mediated the classroom interactions for math and science participation using ELs’ FoK to enact role shifts, division of labor in small groups, and asking content FoK questions. Also, Abby and Karen fostered third spaces mediated by FoK for ELs meaning making in the content areas. Abby integrated FoK for tension to mediate how ELs FoK misconceptions can be used for (language)learning in third spaces. Thirdly, the teachers (re)conceptualized FoK for community activism to transform the purposes of ELs’ math-science funds for capital to attain a new playground. Furthermore, the teachers theorized what counts as math-science funds through its connection to mandated curricular topics, state standards, and problem-posing funds that require the use of math and science to solve.

1. **Synthesis on teacher development**

To capitalize and prioritize ELs’ math-science funds, the study found that teachers need to access, mediate, and (re)conceptualize FoK. The researcher also discovered that contextual factors (e.g. scripted curriculum, teacher views on content and language) also inform how a teacher will access and mediate in what ways, which is addressed in the earlier finding chapters. In figure X, the researcher presents a visual of how all the findings collectively fit together to show a continuum for the teachers’ development over time.

Figure 40 represents Abby and Karen’s contextual factors related to their teaching. As the researcher facilitates the intervention of being a curriculum designer and a community activist, there are variances in how the teachers mediate and access ELs’ math-science funds. Additionally, mediating and
accessing FoK is multidirectional to inform their (re)conceptualization of FoK, which leads them to the outcome of becoming FoK inquiry teachers.

A summary of the findings from the study can be examined further by drawing on the teacher development continuum figure. Prior to conducting the research, Abby and Karen had external (e.g. school policy) and internal factors (e.g. teachers’ stance on learning) representing their initial context in the study. It is not coincidental that Abby and Karen have many similar contextual factors because both teachers were the same first grade level teachers for three years. Genesis was the first school where the
teachers began their careers, and at the time of the study, this was the first year they were placed in separate grade levels. However, a distinct difference between the two teachers is in their past content knowledge and experiences with science, math, and reading. Abby demonstrated a concentration on science as the lead science teacher, and Karen’s focus was on reading as she too moved up the ranks to become the lead reading teacher. Prior to the study, Karen’s reading perspective informed viewing math and science as integrated; whereas, Abby differentiated between science and math. Also, both teachers did not see a bridge between content and EL populations to draw on their strengths within the content areas. Therefore, the contextual factors that inform the teachers to being an activist or a curriculum designer is somewhat similar because of the shared community they were from and similar practices from extensively collaborating together for a number of years. These contextual factors informed how the teachers struggled, based on their prior understanding of what counts as math and science, to be curriculum designers to integrate ELs funds with mandated curriculum. Additionally, Abby and Karen were traditional teachers whose educational philosophy was void of social justice and so being an activist teacher was something they had to learn to become. Furthermore, their initial deficit views on ELs also had them struggling to leverage funds for social change while teaching academics. Here, what we learn is that it is important to acknowledge teachers contextual factors as it represents their historically trajectory, and then to explore how these factors can transform as the teacher’s develop as FoK inquiry teachers.

The teachers’ roles as curriculum designers and activists continuously evolved and fueled the actions they would take to mediate and access ELs’ math-science funds. Consequently, as the teachers mediate and access ELs funds it also informed their roles. The researcher found that for the teachers to access or mediate funds, the teachers’ enacted agency in response to a restrictive scripted curriculum. Their agency can be interpreted as the teachers being activists for their ELs right to learn through their cultural and linguistic strengths. From instructors of scripted curricula to becoming curriculum
designers, the teachers re-mediated the curriculum as they grew to use multiple funds in their lesson plans. For instance, the teachers designed lessons to mediate playground funds for math and science. However, as they continued to gather ELs’ funds they found multiple math-science funds that could be asked in the lesson’s FoK questions for math and science. Also, the teachers mediated funds by using the standards for learning, and not learning to the standards. In turn, the teachers learned to design flexible lessons by relinquishing their teacher authority to privilege student discourse to communicate mathematically and scientifically through a FoK language of power, which also allowed them to learn additional funds. Here, we learn that the FoK curriculum represented a hybrid curriculum, or third space, that built seamless boundaries between ELs math-science funds and the scripted curricula. This type of curriculum is necessary to leverage and centralize ELs’ funds, as opposed to sprinkling funds into the regular curriculum which can limit the resources ELs can draw upon. Also, the role of a FoK curriculum designer requires that the teacher may not be the expert or have all the answers when developing curriculum because the curriculum is grounded in the expertise of the students funds which may be unfamiliar to the teachers. However, positioning students with the shared teacher role of an expert in the curriculum is beneficial as this study found it makes math and science content accessible to ELs (language)learning.

Accessing funds was pivotal for the teachers to become activists because it was during the Community Walk that they built solidarity with their students’ funds on the need for a playground. Consequently, as teacher activists, Abby and Karen continued to access ELs’ math-science funds in order to work with their playground knowledge to advocate for a playground. The teachers mediated ELs’ math-science funds to have students become community activists by conducting Playground Surveys and through civic engagement where ELs used their funds to mathematically and scientifically write persuasive letters to the alderman. Simultaneously, the teachers’ activist identity mediated curriculum with the goal of achieving a playground. Here, we learn from Abby and Karen that teachers
should consider transforming ELs math-science funds into other kinds of tangible capital, in addition to raising their math and science achievement scores. Recognizing FoK for activism, the teachers showed the need to extend the learning community to include families and other community members or organizations. However, their shortcoming lay in using these participants for activism and not to facilitate math and science content. Therefore, teachers need to create collaborative learning environments to include members in ELs’ life-worlds. Furthermore, a capital purpose to FoK, extends the meaning of confianza. As teachers gain mutual trust with families, confianza can include a teacher responsibility on the lives of their students to make change. Therefore, as activists and curriculum designers, the teachers are developing and thinking of ways to access and mediate ELs math-science funds (and vice-versa). In addition, they are also developing their identity to become activist and curriculum designers.

The Teacher Development Continuum diagram also demonstrates how the teachers’ action of mediation and access informs multidirectional how they (re)conceptualize FoK. These actions are building on itself and are not static because the mediation and access are also changing as the teachers develop new practices for mediation and accessing ELs’ math-science funds. For instance, as the teachers mediate or access funds they conceptualize these funds to inform future mediation or access practices (and vice-versa). When accessing funds to select a curriculum topic, the teachers engaged in multiple activity iterations (i.e. Lunch Talks, Community Walk). Their (re)conceptualization on each activity, facilitated by the researcher, would inform them to create new activities in order to access math-science funds. In turn, the teachers conceptualized new purposes for FoK to mediate the social organization of learning, and therefore the teachers developed new practices to access funds through content FoK questioning. We learn from Abby and Karen that to access funds requires teachers to be comfortable with the unfamiliar and perhaps uncomfortable spaces, such as gathering funds in out-of-school contexts, like the community or home. Although Abby and Karen were uncomfortable with
gathering funds via home visits, they changed to an additive view of the home because they recognized the importance of parent involvement when they needed their support for playgrounds and developing an engineering unit. Therefore, teachers need to value parents FoK in addition to students. Hence, to build confianza requires to access funds in places where their families and students are a part of such as the home. Furthermore, the teachers theorized accessing funds based on their (re)conceptualization of whose funds to gather, students and/or parents. Also, the teachers theorized where to access funds, in-school verses out-of-school in students’ life-worlds, and what type of funds to access moving from gathering interests to math-science funds. Importantly, the researcher found that teachers can misrecognize math-science funds because of the conceptual understanding of what counts as math and science as well as limitations in methodology for how teachers analyze the data sources where they collected funds. Therefore, teachers need to become aware, as FoK inquiry teachers, of their own limitations in the methods used to access funds, such as what potential limitations exist in the activities they design to gather funds.

As Abby and Karen would mediate math-science funds they also (re)conceptualized FoK for future mediational practices. For instance, their initial purpose of FoK was for planning a curriculum topic, therefore, they mediated math-science funds in their lesson plans. However, observing their struggling students, prompted the teachers to (re)conceptualize FoK to modify how they socially organized learning which informed their mediational practices. Both teachers mediated FoK through questioning, such as Abby integrating FoK with tension questions or Karen integrating FoK with higher order questions. Karen continued to mediate math-science funds for participation through using funds for role shifts and the division of labor in student groups. Abby transformed her resistance identity to (re)conceptualize FoK as valid tools for science content when she saw how students FoK fueled tension for meaning-making in third spaces. However, both teachers had to learn how to use FoK to mediate, especially during third space opportunities. Sometimes the mediation of an ELs’ math-science fund
could fall short, as was the case in Karen’s classroom on playground materials funds because the teacher
would leverage too much student discourse and no longer facilitate content, and so she had to learn to
balance her discourse with students. Abby also learned that mediation could occur when the teacher
could ‘see’ a connection between students’ funds and math and science content. For her, students’ funds
on vampires may not be seen as connecting to organisms in science; however, she built an opportunity to
teach through misconceptions. However, for Abby to reach the point to make academic connections
required her to continuously evolve how she (re)conceptualizes what counts as math and science in
conjunction with FoK to mediate math-science funds. Therefore, teachers need to learn to recognize
non-school based FoK and create them to be school-based by problem posing students funds with math
and science practices.

Furthermore, as illustrated (re)conceptualizing FoK also informed the mediation and access of
math-science funds. The researcher found that FoK is dynamic and evolves, but it can be helpful to
categorize FoK through types of funds, purposes for FoK, and sources to gather funds. Critical to
theorizing FoK is the teachers’ (re)conceptualization of understanding what counts as math, science, and
FoK, and then seeing how these overlap to constitute a math-science fund. Initially, the teachers
struggled to identify math and science in ELs life-worlds because they referred to math and science
based on in-school texts. Recognizing math and science in out-of-school contexts, required the teachers
to problem pose ELs funds where its integration with math and science can be used to solve the
problem. The researcher also discovered that identifying social problems grounded in ELs funds
continued as each unit evolved from the previous. Collectively, students and teachers would identify
problems for the need of future math and science practices. For instance, in the first unit the students
collected data demonstrating the need for a playground, but encountered problems in their play lot on
safety, so the teachers assisted to address slide safety on the playground. In turn, a hybridity emerged,
where “math” and “science” became integrated with FoK to explore ELs’ “math-science funds.”
Therefore, what counted as a math-science fund became the teachers’ agency to transform ELs funds that could align to the standards or mandated curricular objectives to engage in problem solving activities.

Therefore, as the study researches how teachers’ access, mediate, and (re)conceptualize ELs’ FoK, an outcome is the teachers themselves developing as FoK inquiry teachers. A FoK inquiry is a process recognizing that teachers have contextual factors that can inform their roles to be curriculum designers and activists. These roles can also inform the types of actions teachers engage in when mediating and accessing FoK. Furthermore, a FoK inquiry teacher will engage in the process of “funds of knowledging” which is theorizing their FoK practices and awareness for (language)learning. Also it involves teachers inquiring ways to use FoK, and appropriate the theory to make meaning for it according to the needs of their students and their own teacher development.

B. **Limitations**

There are many limitations to consider for this study. First, the researcher’s position is a limitation because she is part of the study. Since the study is an intervention, the teachers’ FoK practices and awareness were informed by the mentoring of the researcher. The researcher engaged in both a professional and personal relationships with the teachers which played a pivotal role in determining the outcomes of the findings. Also, the study group meetings served as part of the teachers’ university course work, and so the researcher’s role is also a teaching assistant in the project. Hence, the researcher was in a position of power to facilitate the data on the teachers’ artifacts, such as their individual and cohort reports. Additionally, the teachers conducted action research, but the researcher assisted the teachers’ analysis of their action report thesis as well. Secondly, the study lost a cohort participant, Lorena, since she was displaced from Genesis. The study focused on two teachers and their relationship with Lorena as it informed their FoK practices such as the five co-teaching sessions and weekly meetings. Given the use of case study methods, the results are not generalizable to comparable settings.
or cases. However this type of work allows for a detail rich account of the teachers experiences providing contribution to the FoK literature. Thirdly, the study occurred over a year and a half data collection period, and so a limitation is the need for a longitudinal study.

C. Implications

The educational goals of NCLB are to promote educational equity and excellence for all students, including ELs. Issues of equity are imperative to consider for the success of ELs math and science achievement. However, what counts as “equity” has distinct meanings. Many proponents of standards based reform have argued for high standards for all students because of the belief that holding the same standards is a form of equality. Importantly, holding high standards is not the same as standardizing learning. In fact, a risk in adopting standards is the potential for standardization where, in the name of equality and sameness, a one size fits all approach can emerge. I argue that sameness is not fairness, especially for minority students who vary in their needs and knowledge base, and so a uniformed approach to teaching all students the same should not be standardized. This is a key point I will return to when discussing scripted curricula. For now, a clarification is made on equity for fairness, not equality through sameness.

I agree that policy makers, educators, and administrators should set high standard expectations for ELs, but it is important to consider how these students can achieve success based on their access to high quality learning environments. Here, equity is referring to the access in resources made available to students, in addition to the learning outcomes mandated by standards. Too often, ELs from low-income, urban schools have limited access to updated curriculum, equipment, academic extra-curricular activities (Barton, 2001). Additionally, ELs may have limited access to highly qualified teachers or administrators educated in the complexity for teaching language minority students (Oakes, 1990).

I argue that ELs need access to adequate and equitable resources. Not all resources are fair for all students. For instance, there were artifacts provided to Karen’s students in their science kits on “Balance
and Motion,” are unfamiliar to the cultural frame of references for her ELs because these mandated curricula teach to the “culture of power” (Delpit, 1995) which minority students are not a part of. In addition to learning unfamiliar science concepts, Karen’s ELs were provided with mediational tools that were also unfamiliar, thereby making it challenging to fulfill the standards. This is important because in CHAT theory, (language)learning contexts are socially organized activities that are mediated toward a goal-oriented activity. Thus, the mediation is critical for determining success. This is representative when Karen altered the tools to teach balance from ELs familiar mediational tools such as material artifacts on Lego and ideational artifacts on concepts of slide safety. Drawing on familiar mediational tools her ELs had greater access to make meaning and have points of contestation on the science objectives on how variables of height, slope, and speed inform balance for slide safety. My claim is simple, teach ELs from the familiar to learn the unfamiliar. To do this requires teachers to adapt curriculum and consider students’ FoK as nontraditional resources, or mediational tools, to facilitate (language)language. Therefore, FoK is a central matter to equity issues in ensuring that ELs are provided with access to equitable resources.

What is daunting is how the American context of (language)learning is becoming restrictive for ELs to use these necessary familiar mediational tools derived from their funds. Our educational language policy enacts a monolingual goal to attain English proficiency. Since the advent of NCLB references to bilingual education has been eradicated and consequently has pushed many states, such as California and Arizona, in the direction of English-only instruction. Although I agree that ELs should become English proficient, I do not believe that this should be at the expensive of the intolerance for multiple language use in schools. ELs native language are vital resources that can be facilitated for learning content and English. In addition to language as a resource, Gandara (2010) describes language as a fundamental right, and thus to ban students from speaking another language is discriminatory. Historically, we are a society of assimilation and one that loses language to become “American.” This is
a problem when considering equity, because marginalizing native language use is not only a problem for learning, but the goal of monolingualism produces conformity to limit what we have to offer society, a society that is multilingual. Educational language policy needs to reconsider, especially for ELs, how these students can have access to capitalize on their native language as strengths, not deficits. Furthermore, our language policy goals should be multilingual so that ELs can also grow in their own native language as well.

Educational language policy drives the way language interactions can occur in classroom interactions. For instance, the hegemony of English was apparent in Karen and Abby’s view of teaching to and through English. Both teachers struggled to permit their ELs to use Spanish because they could not comprehend. However, Karen transformed to value Spanish and began to see a connection to its mediation for content. Because of the study group meetings, Abby was able to learn from Karen’s experience to also believe that sharing students’ native language is not necessary to assist ELs. Therefore, teachers of ELs need to understand that simply telling ELs they can use their native language is not enough to mediate academic content. The teacher still must facilitate native language use.

Implications can be made for teacher development on how to provide mediation in ELs native language. For instance, teachers should consider native language use from a CHAT perspective, and how they can use Spanish as a mediational tool for completing the goal of the activity. In fact, this is an important area for future research, specifically, understanding how teachers become aware of their own language ideologies and how this informs the mediation of ELs FoK for (language)learning. Also, research should address how teachers conceptualize and practice using ELs’ funds that may appear to be in conflict with teachers’ own FoK, like in the case of this study ELs Spanish skills.

In addition, teachers should recognize student language, what it means, and then how it can be a linguistic resource to teach the language of math and science. In particular, teachers should also consider language socialization theory in addition to language acquisition. From Karen and Abby we saw how
ELs were (language)learning “through language” instead of “to language.” Teachers should wean away from teaching language through vocabulary and grammar discrete skills, but push towards Discourses to make meaning in contexts. For example, Abby did not give concrete definitions for the term “organism,” instead teachers can draw on her framework for teaching vocabulary through meaning making. The concept of what counts as an organism was hypothesized, examined in different contexts, and then contested to bring new meaning to the term. Therefore, a language socialization approach is more dynamic because of its emphasis on the role of social interactions and how one socializes through language to use language in socially appropriate ways. Future studies should address how teachers can learn ELs native language practices based on interactional patterns from their life-worlds.

Aside from restrictive language educational policy, we find that schools may add to restrictive environments for teachers’ to access ELs funds for resources. Teaching through students FoK is not something that can be identified or prescribed in mandated curricula because these funds are not generalizable to ethnic groups. ELs FoK are dynamic, evolving, and vary within and between students. In other words, students’ lives are complex and their FoK are complex, but it is this very reason that teachers learn to teach through complexity, and not simplicity. In fact, there is merit in teaching math and science through complexity as it can add push critical thinking and problem solving skills. We found many examples of this as Abby’s students could challenge one another through their funds to learn about environmental needs of organisms in a playground. So it is necessary that teachers’ have the means to learn about their ELs FoK to facilitate their learning from the familiar. This requires schools to foster confianza and open the networks between families and community, which means that they shouldn’t expect participants to come to them, they must also venture out. Therefore, schools should provide opportunities, both time and resources (e.g. translators), for teachers to conduct ethnographic visits. Additionally, schools should value the need to learn about their ELs identity beyond students. Sub sequentially teachers must be open to venturing into places that may be uncomfortable zones
because these are the spaces that their students are a part of and where their meaning making is derived from. In doing so, schools can extend the learning community to families and community members to create a collective environment. Teachers should recognize that establishing confianza is an ongoing process and a constant relationship building tool. Thus, future studies should explore repairing confianza, in cases where teachers may have established mutual trust but trust was lost or in need to reestablish confianza.

It is becoming even more restrictive for teachers to access and mediate ELs FoK, and part of the problem contributes to a conflict in the goals for teaching math and science and the practices of narrowing curriculum. I expand on Moll and Gonzalez’s (2004) problem statement of a “multicultural paradox,” to describe a “FoK paradox.” For instance, the goals for teachers of math and science are to educate through students’ culture. The National Council of Teachers of Mathematics (2005) focused on the needs of ELs stating “all students need the opportunity to learn challenging mathematics from a well qualified teacher who will make connections to the background, needs and culture of all learners.” Also, the upcoming 2013 Next Generation Science Standards (NGSS) legitimized teachers to draw on FoK by stating:

“Effective teachers ask questions that elicit students’ funds of knowledge related to science topics. They also use cultural artifacts and community resources in ways that are academically meaningful and culturally relevant” (Public Release II, p. 4).

A FoK paradox exists because on the one hand ELs culture is recognized in math by NCTM and FoK is even cited by NGSS, but the practices for teachers to teach through FoK is restrictive (i.e. language policy, teacher resources to access funds), especially for teachers in scripted curricula environments.

In the climate of high stakes accountability, school districts seek methods that will provide immediate results in all students improving their test scores, including ELs. Local officials, such as area officers, have required schools to implement mandated curricula as a way to uniform learning across schools. Mandated curricula, which are aligned to state tests, are valued as solutions to increase
test scores. Schools have various degrees in flexibility in how scripted they implement mandated curricula. In schools that are not on probation, there is more likelihood that teachers are able to teach outside the boundaries of a mandated curriculum, but even then teachers need to be skilled to adapt curriculum using FoK. In contrast, schools that are at-risk may not be able to adapt curriculum, and have decreased flexibility because of pacing structures outlined in the mandated curriculum. Therefore, scripted curricula, in schools like Genesis that are at-risk with a large population of ELs, limits the creation of a space for teachers to adapt the curriculum so that they can learn intimately the needs of their students and identity. Teachers are unable to tap into funds that are needed for mediating ELs learning because scripted curriculum has imposed restrictive boundaries that do not allow for a space for students funds of knowledge to exist. Advocates in favor of adopting standards-based approaches believe that standards will enhance achievement, but there is not strong evidence indicating that adopting standards will improve achievement (Beach, et. al, 2012). In fact, standardizing curricula leads to narrow textbooks, pre-packed scripted curricula, and a one-size-fits-all teaching that do not and will not fulfill the high expectations of the Common Core State Standards (Beach, et. al, 2012). Furthermore, Kincheloe (2001) differentiates between “technical standards,“ focused on standardized tests, and “standards of complexity, ” that recognize learning in culturally and linguistically diverse contexts. Technical standards ignore cultural diversity and assume that math and science is in the existence of a “common culture” associated with the “culture of power” (Delpit, 1995). For ELs who do not represent the culture of power, they may not meet technical standards because of their limited experience or access to the common culture. We can even take this a step further to argue that scripted curricula, in its alignment to technical standards, for math and science also leverage the mediational tools that represent the culture of power, also making it challenging for ELs, which is why it is imperative to draw on FoK as mediational tools. This has even been acknowledged by Lee and Luykx (2006) who recognize that standards espouse an assimilationist perspective by defining science in terms of Western modern science
tradition or “Western mathematics” (Bishop, 1988) with little consideration of alternative views of science and ways of knowing from diverse backgrounds. Therefore, standard reforms need to move in the direction of “standards for complexity” and take into account language and culture in math and science (language)learning.

Moreover, as the trend towards adopting scripted curricula increases, we find teachers being de-professionalized in the field. Scripted curricula takes away from teachers’ decision making abilities and reduces to “deskilling” (Shannon, 2007) the profession into technical tasks. Administrators and curriculum specialists need to understand that given the complex cultural and linguistic needs of ELs, they must work toward supporting teachers’ professional knowledge. To professionalize the teaching field would require the school to provide a space for teachers to use their professional knowledge through action research methods. This includes reconsidering how current professional development is treated in schools. In this study, rather than provide one time workshops, the university researcher collaborated through on-going weekly meetings with the teachers. However, the goal shouldn't be to have the researcher there permanently, but teachers should sustain and make their own professional development community and lead their own study group meetings. Schools must provide the time and space for teachers to be a FoK inquiry teacher to reflect on their FoK practices, access funds, mediate funds, (re)conceptualize funds, and engage in action research. Professionalizing teaching would require teachers to shape their own curriculum and not be prescribed what a page on a textbook they should be at. This includes providing teachers with the ability to adapt curriculum, even from the ground up to create new curriculum and not simply adapting to insert supplements. Thus, future research should study how teachers of ELs can learn to adapt curriculum. Questions on what FoK are worthwhile knowing, experiencing, doing, needing, being, becoming, overcoming, sharing, and contributing are important to consider when adapting curriculum. Also, how do the FoK selected by the teacher in curriculum expand, restrict, benefit, and marginalize certain members in community of
practices? Teachers need to be careful that as they engage in mediating ELs’ FoK, they also tap into all students’ FoK, or multiple funds, and not just a select few to ensure that all students have access to their FoK resources.

Finally, teachers and university researchers need to enact agency. For teachers, their agency can lay in making ELs FoK a right and a resource for their (language)learning. ELs should be provided with familiar tools for learning as this right has already been provided to the mainstream students representing the culture of power. Teacher agency is also required to use students’ FoK for cultural capital. FoK for activism enables students to make change in their lives as it is becomes a responsibility, and a part of confianza, for teachers to not simply know their funds but to facilitate change with students and their respective communities. In doing so, ELs funds are legitimized as valuable tools for knowing, their status is elevated, and teachers build solidarity with students through their funds. Additionally, as university researchers we also need to consider how we can be agents of change too. For instance, how would the story of this study have looked like if the teachers did not enact agency or if the researcher had not been a part of advocating the curriculum to the principal? Would there even have been a place to do a FoK research on curriculum and instructional practices given the restrictive schooling environments that are being implemented. As researchers we need to recognize that we hold privileges of power when working with teachers and schools and to use this power for the development of the teachers. Therefore, university researchers will need to enact agency, given the restrictive schooling environments, to ensure nontraditional qualitative research. Thus, it is also our responsibility to enact agency with our teachers to support the type of work they do.

D. Conclusion

When I introduced this dissertation study, I began with a game. A game that pretended you, the reader, were my teacher. The game served as a simulation for you to feel the complexities in what the teachers in my study faced when learning about their ELs FoK. So embedded throughout this
dissertation were my FoK. My FoK were shared with you to sample experiencing what the teachers in my study went through. As you read through my FoK, were there any FoK that were unfamiliar to you? If so, how would you go about accessing my funds further to learn about what they mean in my everyday practices? What challenges might you face (i.e. ideational resistance, material resources, external factors) in gathering more about my FoK? Also, were there any difficulties in identifying or making connections to my math-science funds? Did you have to (re)conceptualize the way you saw math, science, or FoK? How might you use my funds to mediate math and science or to create a curriculum?

I hope that after reading this study, you too have come to value the power of students’ FoK, and recognize that the way we socially organize learning for our ELs is a determinant factor in their success. Bill Ayers (2004) reminds teachers that this process isn’t easy and “our challenge then is to live and work in the belief that we, ourselves, along with our students, can do what’s never been done, and we might- you can change your life, you can rock your world” (p. 140). It is challenging to redefine what knowledge is worthwhile because it is a complex question, rather than be prescribed that knowledge in a textbook. But we need to *reclaim the contexts* that are important for ELs academic success. You, the teacher, have the power to do this, and has been demonstrated from the teachers from my study, they rocked their own worlds!
Approval Notice
Amendment to Research Protocol – Expedited Review
UIC Amendment # 2

July 22, 2009

Aria Razfar, Ph.D.
Curriculum and Instruction
1040 W. Harrison
M/C 147
Chicago, IL 60612
Phone: (312) 413-8373 / Fax: (312) 996-8134

RE: Protocol # 2008-0440
“LSciMAct Project (Transforming Literacy, Science, and Math Through Participatory Action Research)”

Dear Dr. Razfar:

Members of Institutional Review Board (IRB) #2 have reviewed this amendment to your research under expedited procedures for minor changes to previously approved research allowed by Federal regulations [45 CFR 46.110(b)(2)]. The amendment to your research was determined to be acceptable and may now be implemented.

Please note the following information about your approved amendment:

Amendment Approval Date: July 22, 2009

Amendment:
Summary: UIC Amendment #2, dated 23 June 2009 and submitted to OPRS 15 July 2009, is an investigator-initiated amendment adding Lena Licon Khisty, Beverly Troiano, Ambareen Nasir, and Eunah Yang as key research personnel (Appendix P submitted).

Approved Subject Enrollment #: 630
Performance Site: UIC
Sponsor: Department of Education
PAF#: 2007-04345
Grant/Contract No: Not available
Grant/Contract Title: Transforming Literacy, Science, and Math Through Participatory Action Research
Please note the Review History of this submission:

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<th>Review Process</th>
<th>Review Date</th>
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<td>Expedited</td>
<td>07/22/2009</td>
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Please be sure to:

→ Use your research protocol number (2008-0440) on any documents or correspondence with the IRB concerning your research protocol.

→ Review and comply with all requirements on the enclosure, "UIC Investigator Responsibilities, Protection of Human Research Subjects"

Please note that the UIC IRB #2 has the right to ask further questions, seek additional information, or monitor the conduct of your research and the consent process.

Please be aware that if the scope of work in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact the OPRS at (312) 996-1711 or me at (312) 996-2014. Please send any correspondence about this protocol to OPRS at 203 AOB, M/C 672.

Sincerely,

Sandra Costello  
Assistant Director, IRB #2  
Office for the Protection of Research Subjects

Enclosure: UIC Investigator Responsibilities, Protection of Human Research Subjects

cc: Danny Martin, Curriculum and Instruction, M/C 147
### B.1 SAMPLE INVENTORY TABLE

<table>
<thead>
<tr>
<th>State Standards (and Benchmarks)</th>
<th>Content Objectives</th>
<th>Community Knowledge (Funds of knowledge)</th>
<th>Values and Principles of Math, Science, and Literacy (language arts)</th>
</tr>
</thead>
</table>
| SS: 11.A.1a                      | Describe an observed event (slide experiences); homework: write a narrative that recounts your experience on a slide | Talk about experiences with slides | Science: giving detailed observations  
Literacy: communicating observations orally; listening to others’ observations; writing a narrative |
| SS: 13.B.1d                      | Brainstorming questions about how slides are designed/built | Many students’ parents work in construction (or have construction experience) | Science: developing questions for scientific inquiry  
Literacy: listening and speaking |
| SS: 11.A.1c                      | Students will collect and record data (on slope and speed) after implementing their experiments; students will use their data to compare results to see how to best design a slide | Students have a natural curiosity to explore phenomena | Science: data collection; data recording/organization (graph); comparing results  
Literacy: writing, sharing/discussing results, reading data  
Math: writing time (in seconds), represent/interpret data, graphing data; measure length / height |
| SS: 13.B.1d                      | Students will actually design and present a fun and functional slide; they will write an informational text explaining their reasons that the slide is fun and functional using appropriate new vocabulary | Students begin building things when they are very young (blocks, legos, etc.); parents as construction workers | Science: designing a possible solution to a problem  
Literacy: speaking/listening (presentations); writing (paper with final project) |
| SS: 5 (reading)                  | During a read aloud and student perusal of non-fiction texts, | Making connections to the text; daily experiences using signs | Literacy: reading non-fiction texts and making meaning; oral discussion of texts (pair) |
B.2 SAMPLE ACTIVITY TRIANGLE

Tools and Artifacts
- Teacher-typed "science question of the day"
- Hard-boiled eggs
- Styrofoam pipes
- Marbles
- Tape
- Cups
- Legos
- Tape measures
- FOSS reading for Balance and Motion
- Science journals
- Non-fiction books on gravity and slope
- Data tables and graphs
- Personal reflection
- Video camera
- Chart paper
- Graphic organizers
- Native language (Spanish)
- Peer assistance
- Code switching

Subjects
- Students (10 girls and 17 boys)
- Second graders
- 25 ELL students
- 1 transferred from other school
- 7 and 8 yrs old
- 1st grade partners
- Teachers (Ms. Gibson and I will lead)

How do we create a safe and fun slide for our playground?

Rules
- Everyone contributes
- Turn taking
- Everyone’s ideas are valued
- Listen to everyone
- Conversational
- Helping each other
- Share resources
- Working with groups
- Stay on task
- Complete tasks

Objects
- Students will become experts at analyzing data
- Students will become experts at organizing data
- Students will become experts at collecting data
- Students will become experts in the concept of gravity
- Students will become experts in the concept of slope
- Students will become experts in how slope affects speed
- Students will become experts at designing a slide
- Students will become experts at creating a functional structure

Outcomes
- Engineer
- Team player

Community
- Tonti school
- City
- Neighborhood (homes)
- Parents

Division of Effort
- Heterogeneous (ability, gender, background, language)
- 4 per group
- Tasks labor shared evenly (share talents)
- Whole group 30%
- Group work 70%
B.3 SAMPLE NVIVO REFERENCES
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<th>Source</th>
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<td>Teacher field notes</td>
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<td></td>
<td>• IPP</td>
<td>Teacher journal</td>
<td>46</td>
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<td>• Unit 1</td>
<td>Individual report</td>
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B5. OBSERVATION PROTOCOL

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### C.1 TEACHERS’ ACTIVITY TO ACCESS MATH-SCIENCE FUNDS

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<th>School Year</th>
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<td>X</td>
<td>My stripes</td>
<td>Students list four words that describe who they are and why.</td>
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<tr>
<td>X</td>
<td>Map of favorite place</td>
<td>Students draw a map of their favorite place.</td>
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<tr>
<td>X</td>
<td>Community walk</td>
<td>Second graders walk in community to give directions to and identify landmarks.</td>
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<td>X</td>
<td>Playground pictures</td>
<td>Students share pictures at a playground to identify types of play structures.</td>
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<td>X</td>
<td>All about me</td>
<td>Students write what their favorite items are and what they like to do at home, school, and in community.</td>
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<td>IPP</td>
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<td>X</td>
<td>Poster survey</td>
<td>Parents write responses on a poster to open ended topics on jobs, free time, community, and food.</td>
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<td>X</td>
<td>Playground survey</td>
<td>Parents and students write their concerns for having a school playground and identify what structures should be built.</td>
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<td>X</td>
<td>Student content survey</td>
<td>Students write their funds based on teachers’ scientific and mathematic questions.</td>
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<td>X</td>
<td>Parent content survey</td>
<td>Parents write their funds based on teachers’ scientific and mathematic questions.</td>
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<td>U2</td>
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<td>X</td>
<td>Lunch talks</td>
<td>Teacher has informal discussions with students during lunch.</td>
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<td>X</td>
<td>Questioning</td>
<td>Teacher asks verbal questions to learn funds.</td>
<td>U2 &amp; U3</td>
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**Surveys**

| X | All about me | Students write what their favorite items are and what they like to do at home, school, and in community. | IPP |
| X | Poster survey | Parents write responses on a poster to open ended topics on jobs, free time, community, and food. | IPP |
| X | Playground survey | Parents and students write their concerns for having a school playground and identify what structures should be built. | U1 |
| X | Student content survey | Students write their funds based on teachers’ scientific and mathematic questions. | U2 |
| X | Parent content survey | Parents write their funds based on teachers’ scientific and mathematic questions. | U2 |

**Other**

| X | Lunch talks | Teacher has informal discussions with students during lunch. | IPP |
| X | Questioning | Teacher asks verbal questions to learn funds. | U2 & U3 |
### C.2 ALL ABOUT ME FUNDS

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<td>Waka Waka, Mexico songs, radio, Down Earth, One More Time, California Girl, Not Afraid</td>
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<td>Mermaid, Iron Man, Scary Movie, Lion King, Scooby Doo, Shrek, Alice in Wonderland, Jeepers’ Creeper</td>
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<tr>
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<td>Nemo, Iron Man, funny book, cars, Toy Story, Goosebumps</td>
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<td>silver, red, yellow, blue, green, orange, pink, purple, blue,</td>
</tr>
<tr>
<td>Something good at</td>
<td>soccer, coloring, basketball, park, swim, football, run, cooking, reading, climbing, paint, sports, planting, dance</td>
</tr>
<tr>
<td>Like to do at home</td>
<td>play sister, play mom, play birds, play toys, watch TV, play game, video games, play, homework, basketball, sleep, paint, cook, color</td>
</tr>
<tr>
<td>Like to do at school</td>
<td>read, math, writing, study, drawing, lunch, library, computer, play, listen teacher, recess, color, learn, desk</td>
</tr>
<tr>
<td>Like to do in community</td>
<td>help people, play hide seek, play friend, put garbage, play outside, play park, ride bike, jump rope, run, skateboard, soccer, football, exercise, pick flowers, scooter</td>
</tr>
</tbody>
</table>

### C.3 KAREN RESULTS OF LUNCH TALK FUNDS

<table>
<thead>
<tr>
<th>Types of Funds</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family</td>
<td>Tara is the youngest of three siblings (brother is 26/sister is 16) and lives with his mom; Yamali lives with her mom, dad, and two brothers; Hob lives with mom, dad, brothers, and sisters. Crain lives with his mother and little sister. All students have Mexican background.</td>
</tr>
<tr>
<td>Parents’ Jobs</td>
<td>Menards, forklifts, construction, junkyard, subway, delivery, lawn mower</td>
</tr>
<tr>
<td>Interests</td>
<td>Chicago Bulls, soccer, dinosaurs, princesses, internet, video games, basketball, swimming, animals</td>
</tr>
<tr>
<td>Home</td>
<td>homework, watch TV, play</td>
</tr>
<tr>
<td>Food</td>
<td>oranges, chicken, apples, potato,</td>
</tr>
<tr>
<td>Academic</td>
<td>Brock has ADHD and receives speech services; Crain is gifted student advanced in all subject areas. Yamali is average in all subjects has slight speech impediment. Tara average in all subjects. Hob has a lot of Spanish influenced spelling.</td>
</tr>
<tr>
<td>Personality</td>
<td>Brock is imaginative; Tara is cheerful; Hob is quiet and diligent worker, Yamali is bright and talkative. Crain is talkative.</td>
</tr>
</tbody>
</table>

### C.4 STUDENT PLAYGROUND FUND SURVEY RESULTS

<table>
<thead>
<tr>
<th>Types of Funds</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>School play lot safety</td>
<td>falling, tripping in pot holes, concrete is hard and hurts, large rocks, dirty, broken glass, knee scraps when tie shoe, broken bones</td>
</tr>
<tr>
<td>School</td>
<td>no play equipment students can only run, size of play lot is small, ground is hard, need grass or rubber tiling, need recess, school needs to be fun, school needs a place to exercise</td>
</tr>
<tr>
<td>Community</td>
<td>Soya park is large and has soft ground</td>
</tr>
<tr>
<td>Playground structures</td>
<td>monkey bar, see saw, basket ball court, sand box, slide, swing, teeter totter, bridge, tire swing, rings, ladder, jungle gym, rock climbing, soccer field, rubber floor, water</td>
</tr>
<tr>
<td>Playground attendance</td>
<td>0-1 times (40%); 2-3 times (55%), 4 or more times (5%)</td>
</tr>
</tbody>
</table>
C.5 PARENT PLAYGROUND FUND SURVEY RESULTS

<table>
<thead>
<tr>
<th>Types of Funds</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>school does not have money to build playground, school doesn’t pay attention to students needs, school doesn’t use space properly</td>
</tr>
<tr>
<td>School play lot</td>
<td>Play lot functions as parking lot, kids falling, not leveled concrete, provide equal access to all kids, not enough time to play in school</td>
</tr>
<tr>
<td>Community</td>
<td>neighborhood needs more accessible parks</td>
</tr>
<tr>
<td>Playground structure</td>
<td>benches, walking path, bridge, swings, see-saw, football area, slides, monkey bars, jungle gym, mini soccer field, teeter totter</td>
</tr>
<tr>
<td>Playground safety</td>
<td>drugs, gangs, supervision, security, bullying, rapists</td>
</tr>
<tr>
<td>Playground attendance (per week)</td>
<td>0-1 times (70%); 2-3 times (25%); 4 or more (5%)</td>
</tr>
</tbody>
</table>

C.6 CONTENT SURVEY RESULTS

<table>
<thead>
<tr>
<th>Gravity Funds</th>
<th>Impact Funds</th>
<th>Speed Funds</th>
<th>Engineering Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play: Slides, bikes, running, swings, snow, side walk</td>
<td>Play: Stairs, swing, monkey bars, slides, bike</td>
<td>Play: scooter, running, swing, roller skates, roller coaster, water slide</td>
<td>Play: Legos, blocks, airplane, house, snowman, puzzle, fence, sand castle, doll house, gingerbread man</td>
</tr>
<tr>
<td>Non-Play: bed, shoes, pushed</td>
<td>Non-Play: bed</td>
<td>Non-Play: cars, airplane, train, bus, boat</td>
<td></td>
</tr>
</tbody>
</table>

C.7 ENGLISH PARENT CONTENT SURVEY

2-23-2011
Dear Parents/ Guardians,
As you are aware we are actively raising money for a future playground. Part of our efforts to engage students’ with math, science, and literacy skills is to teach a unit on slides. Students will be conducting various experiments centered around understanding the physics and mathematics of slides. The assessment of this unit will consist of students’ building their own model slides. Below is a survey for you to share your knowledge and skills that could help us in our project.

1. Have you ever built anything before? If so what?

2. Do you use any building skills in your job? If so what?

3. Do you have any experience with blueprints? If so what?

4. If time permits, would you be willing to come share your knowledge and skills with the class? We would love for you to share in Spanish if you’re willing.
### C.8 SPANISH PARENT CONTENT SURVEY

Estimado Padres/Tutor,

Como usted se ha dado cuenta la Escuela está recaudando fondos para que en un futuro cuente con su propio "patio de recreo". Parte de este proyecto es la enseñanza de ciencias, matemáticas y literatura con el tema de resbaladores. Los alumnos llevarán a cabo varios experimentos con el enfoque y entendimiento de física y matemáticas. Las pruebas de esta unidad consistirán en que los alumnos construyan su propio resbaladero a escala. Se adjunta una encuesta para que participen con sus conocimientos y habilidades en este proyecto.

1. ¿Alguna vez ha construido algo? Si sí es, ¿qué fue lo que construyo?

2. ¿En su trabajo, ¿usa usted alguna habilidad en construcción? ¿Si sí es, en qué forma?

3. ¿Tiene alguna experiencia en hacer planos de construcción? Si sí es ¿en qué forma?

4. Si el tiempo lo permite, ¿estarías dispuesto a compartir su conocimiento y habilidades en nuestro salón de clase? Si fuera posible nos gustaría que lo hiciera en su idioma Español.

---

### C.9 TEACHERS’ IDENTIFIED FoK IN FIRST UNIT

#### ABBY

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>Experiences in Genesis’ play lot</td>
<td></td>
<td>falling, tripping, pot holes,</td>
</tr>
<tr>
<td>Playground</td>
<td>Playground structures students know</td>
<td>playground topic*</td>
<td>bouncy thing*, squirting water*, toys in a park*, monkey bars, sandbox, slide, swing, soccer field</td>
</tr>
<tr>
<td>Family</td>
<td>Who students know and their resources to help get a playground</td>
<td></td>
<td>dad’s financial background, uncle’s building knowledge</td>
</tr>
</tbody>
</table>

#### KAREN

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>Experiences in Genesis’ play lot</td>
<td></td>
<td>falling, tripping, pot holes, large rocks, broken glass, soccer, uneven pavement</td>
</tr>
<tr>
<td>Playground</td>
<td>Playground structures students know</td>
<td>playground topic*</td>
<td>rubber squares*, zipline*, monkey bar cups*</td>
</tr>
<tr>
<td></td>
<td>Who students know and their resources to help get a playground</td>
<td></td>
<td>babysitter’s permission</td>
</tr>
<tr>
<td>Safety concerns</td>
<td></td>
<td></td>
<td>Latin Kings (gang), killer clowns (kidnappers)</td>
</tr>
<tr>
<td>Science</td>
<td>Defining hypothesis</td>
<td>Discovery Channel hypothesis definition</td>
<td></td>
</tr>
</tbody>
</table>
### C.10 TEACHERS’ IDENTIFIED FoK IN SECOND UNIT

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>Items student have built</td>
<td>Lego</td>
<td>airplane, block house, puzzle, sand castle, gingerbread man, cars, snowman, fence,</td>
</tr>
<tr>
<td></td>
<td>Materials students used to build</td>
<td>slide</td>
<td>screw drivers, hammers, nails, paint</td>
</tr>
<tr>
<td></td>
<td>Defining blueprint</td>
<td>Minute to Win It (TV show)</td>
<td>Muscle car,</td>
</tr>
<tr>
<td>Science</td>
<td>Students falling/gravity experiences</td>
<td>slide, stair</td>
<td>slipped on ice, fell side walk, bike, shoes knot, swing, monkey bar,</td>
</tr>
<tr>
<td></td>
<td>Students experience with speed</td>
<td>water slide,</td>
<td>roller coaster, boat, roller skates, airplane, bus, swing, scooter, car, bike</td>
</tr>
<tr>
<td></td>
<td>Identifying a design problem</td>
<td>slide</td>
<td>water slide, hit skull slide, sun rays, burned legs</td>
</tr>
<tr>
<td></td>
<td>Formulate solutions to design problem</td>
<td>slide</td>
<td>plastic window like McDonald’s slides, solar energy, going green, father works near pond, cousin fishes</td>
</tr>
<tr>
<td></td>
<td>Relationship between height and impact</td>
<td>slide, stair</td>
<td>Hulk,</td>
</tr>
<tr>
<td></td>
<td>Independent variables affecting slide speed</td>
<td>slides: water slide, straight slide, towel slide</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>Defining an engineer</td>
<td></td>
<td>uncle builds house, woman on street build house, parent build shelves</td>
</tr>
<tr>
<td></td>
<td>Items student have built</td>
<td>Lego</td>
<td>snowman, puzzle, doll house, sand,</td>
</tr>
<tr>
<td></td>
<td>Students falling and gravity experiences</td>
<td>slide, stair</td>
<td>dropped toy, run, swing, push, bike, fell in snow, bed,</td>
</tr>
<tr>
<td></td>
<td>Technological design of slides</td>
<td>slide, Lego</td>
<td>straight slide, bumpy slide, waterslide, three way slide, curly slide</td>
</tr>
<tr>
<td></td>
<td>Identifying problems on slides</td>
<td>slide</td>
<td>injured knee, hitting, kicking, shark movie</td>
</tr>
<tr>
<td></td>
<td>Relationship between height and impact</td>
<td>stair, slide</td>
<td>water slide, splashing,</td>
</tr>
<tr>
<td></td>
<td>Independent variables affecting slide speed</td>
<td>slide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Examples of different slopes</td>
<td></td>
<td>bent arm, roof, slanted paper, hill</td>
</tr>
</tbody>
</table>
### C.11 TEACHERS’ IDENTIFIED FoK IN THIRD UNIT

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>Student observations of living and non-living things in playground</td>
<td></td>
<td>trash, drain, rats, beetles, flies</td>
</tr>
<tr>
<td></td>
<td>Define organism</td>
<td>fence, tree</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant and worm needs</td>
<td>dirt in pot, compost, Wild Krats (TV), banana peels, newspaper, dirt, worm in</td>
<td>dinosaur plant, worms eyes like bats,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>daycare, venus fly trap eats bugs, cactus, worms dry in sun,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organisms habitat</td>
<td>Antarctica, igloo, built dog house</td>
<td>cat frontyard,</td>
</tr>
<tr>
<td></td>
<td>Human activities can affect organism survival</td>
<td>dogs protect against gangster, dog bite, dog chase, dog park, frogs with tongue,</td>
<td>cats nine lives, alderman letter, laser, cat eats bird, butterfly causes human hair</td>
</tr>
<tr>
<td></td>
<td></td>
<td>husky dog, butterfly cage at zoo, black cockroach,</td>
<td>loss, dad works near alderman office,</td>
</tr>
<tr>
<td></td>
<td>Characteristics of organisms and their needs for survival</td>
<td>biting red ants, itch red ant, bee hive, Planet Earth (TV), fire ants, Magic</td>
<td>ant crawl in ear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>School Bus (book), playing with ant, crab claws, ant farm, backyard, queen ant</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>larva, cockroach, rabbit poop</td>
<td></td>
</tr>
<tr>
<td>Science and</td>
<td>Plant needs</td>
<td>Nopal (cactus), espinos (spine)</td>
<td></td>
</tr>
<tr>
<td>Spanish</td>
<td>Spanish read aloud on worms</td>
<td>Students English to Spanish translations</td>
<td></td>
</tr>
</tbody>
</table>
C.11 TEACHERS’ IDENTIFIED FoK IN THIRD UNIT (continued)

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>Defining organism</td>
<td>Elephant, worm, rock, ant, people, fish, apple, noodles, apple tree, flower, sticks, leaves</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organisms want or don’t want on playground based on experiences</td>
<td>poison ivy, bee sting, spider, bug bites, ants, bull dog</td>
<td>penguin, seal, whales</td>
</tr>
<tr>
<td></td>
<td>Distinguish between living and non-living things by recalling what students observe in playgrounds</td>
<td>flower, rock, stick, baby bird, butterfly, grass, garden, leaf, tree, brick, sand, bush</td>
<td>water bottle, cloud</td>
</tr>
<tr>
<td></td>
<td>Characteristics of organism</td>
<td>bee sting, bee honey, bee nectar, bat vampires wings, bat vampire teeth, vampire like people, bats night, bats flashlight, bats cave, cat vampire movie,</td>
<td>blubber whale, deer fur, fish scales,</td>
</tr>
<tr>
<td></td>
<td>Human activity can affect organism survival</td>
<td>bee suit, bee spray</td>
<td>, bee honey to cereal</td>
</tr>
<tr>
<td></td>
<td>Cause and effect on organisms relationship to environment</td>
<td>Animal Channel, dog poop, dogs run flowers, dog holes, sunlight melt bats, vampire and bats like blood, ants eating chips, apple tree and market,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organisms survival needs</td>
<td>Spider webs, butterfly nectar,</td>
<td>dog cookies, dogs chase stick, bear family,</td>
</tr>
</tbody>
</table>

C.12 RESEARCHER IDENTIFIED FoK IN KAREN’S FIRST UNIT

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playground</td>
<td>Playground structures students know</td>
<td>playground topic*</td>
<td>rubber squares*, zipline*, monkey bar cups*, monkey bars, ladder, slide, tire swing</td>
</tr>
<tr>
<td></td>
<td>Safety concerns</td>
<td></td>
<td>bolts, Latin Kings (gang), killer clowns (kidnappers)</td>
</tr>
<tr>
<td></td>
<td>Who students know and their resources to help get a playground</td>
<td></td>
<td>babysitter permission</td>
</tr>
<tr>
<td>Science</td>
<td>Defining hypothesis</td>
<td>Discovery Channel hypothesis definition</td>
<td></td>
</tr>
</tbody>
</table>

C.12a RESEARCHER IDENTIFIED FoK IN ABBY’S FIRST UNIT

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playground</td>
<td>Playground structures students know</td>
<td>playground topic*</td>
<td>bouncy thing*, squirting water*, toys in a park*, monkey bars, sandbox, slide, swing, soccer field</td>
</tr>
<tr>
<td>Family</td>
<td>Who students know and their resources to help get a playground</td>
<td></td>
<td>dad’s financial background, uncle’s building knowledge,</td>
</tr>
</tbody>
</table>
### C.13 RESEARCHER IDENTIFIED FoK IN KAREN’S SECOND UNIT

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>Items student have built</td>
<td>Lego</td>
<td>airplane, block house, puzzle, sand castle, gingerbread man, cars, snowman, fence,</td>
</tr>
<tr>
<td></td>
<td>Materials students used to build</td>
<td>slide</td>
<td>screw drivers, hammers, nails, paint</td>
</tr>
<tr>
<td></td>
<td>Defining blueprint</td>
<td>Minute to Win It (TV show)</td>
<td>Muscle car</td>
</tr>
<tr>
<td>Playground</td>
<td>Students falling/gravity experiences</td>
<td>slide, stair</td>
<td>slipped on ice, fell side walk, bike, shoes knot, swing, monkey bar,</td>
</tr>
<tr>
<td>Science</td>
<td>Students experience with speed</td>
<td>slide: water slide,</td>
<td>roller coaster, boat, roller skates, airplane, bus, swing, scooter, car, bike</td>
</tr>
<tr>
<td></td>
<td>Identifying a design problem</td>
<td>sun rays, burned legs</td>
<td>water slide, hit skull slide,</td>
</tr>
<tr>
<td></td>
<td>Formulate solutions to design problem</td>
<td>solar energy, going green</td>
<td>plastic window like McDonald's slides, father works near pond, cousin fishes</td>
</tr>
<tr>
<td></td>
<td>Relationship between height and impact</td>
<td>slide, stair</td>
<td>Hulk,</td>
</tr>
<tr>
<td></td>
<td>Independent variables affecting slide speed</td>
<td>slides: water slide, straight slide, towel slide</td>
<td></td>
</tr>
<tr>
<td>Science &amp; Spanish</td>
<td>Students identify Spanish cognates</td>
<td>Velocidad (velocity), informacion (information)</td>
<td></td>
</tr>
<tr>
<td>Spanish</td>
<td>Non-academic talk</td>
<td></td>
<td>singing Mexican folk songs, interviewing Lorena</td>
</tr>
</tbody>
</table>
C.13a RESEARCHER IDENTIFIED FoK IN ABBY’S SECOND UNIT

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>Items student have built Lego</td>
<td>snowman, puzzle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Defining an engineer Building (i.e. uncle builds house, woman on street build house, parent built shelf)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playground</td>
<td>Students falling and gravity experiences slide, stair</td>
<td>run, swing, push, bike, fell in snow,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students experience with speed slide</td>
<td>water slide, car, bike, train, bus, airplane</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technological design of slides slide, Lego</td>
<td>straight slide, bumpy slide, waterslide, three way slide, curly slide</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>Identifying problems on slides slide</td>
<td>injured knee, hitting, kicking, shark movie</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relationship between height and impact slide, stair, Lego</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Independent variables affecting slide speed slide, Lego</td>
<td>water slide, splashing,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Examples of different slopes</td>
<td>bent arm, roof, slanted paper, hill</td>
<td></td>
</tr>
</tbody>
</table>
### C.14 RESEARCHER IDENTIFIED FoK IN KAREN’S THIRD UNIT

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science</strong></td>
<td>Student observations of living and non-living things in playground</td>
<td>trash, drain, rats, beetles, flies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Define organism</td>
<td>fence, tree</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant and worm needs</td>
<td>dirt in pot, compost, Wild Krats (TV), banana peels, newspaper, dirt, worm in daycare, venus fly trap eats bugs, cactus, worms dry in sun,</td>
<td>dinosaur plant, worms eyes like bats,</td>
</tr>
<tr>
<td></td>
<td>Organisms habitat</td>
<td>Antarctica, igloo, built dog house</td>
<td>cat frontyard,</td>
</tr>
<tr>
<td></td>
<td>Human activities can affect organism survival</td>
<td>dogs protect against gangster, dog bite, dog chase, dog park, frogs with tongue, husky dog, butterfly cage at zoo, black cockroach,</td>
<td>cats nine lives, alderman letter, laser, cat eats bird, butterfly causes human hair loss, dad works near alderman office,</td>
</tr>
<tr>
<td></td>
<td>Characteristics of organisms and their needs for survival</td>
<td>biting red ants, itch red ant, bee hive, Planet Earth (TV), fire ants, Magic School Bus (book), playing with ant, crab claws, ant farm, backyard, queen ant larva, cockroach, rabbit poop</td>
<td>ant crawl in ear</td>
</tr>
<tr>
<td><strong>Playground</strong></td>
<td>Plant needs</td>
<td>Nopal (cactus), espinos (spine)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spanish read aloud on worms</td>
<td>Students English to Spanish translations</td>
<td></td>
</tr>
</tbody>
</table>
### C.14a RESEARCHER IDENTIFIED FoK IN ABBY’S THIRD UNIT

<table>
<thead>
<tr>
<th>Type of Funds</th>
<th>Key Discourse(s)</th>
<th>Math-Science Funds</th>
<th>Non-Math Science Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playground and Science Funds</td>
<td>Organisms want or don’t want on playground based on experiences</td>
<td>poison ivy, bee sting, spider, bug bites, bull dog</td>
<td>penguin, seal, whale,</td>
</tr>
<tr>
<td></td>
<td>Distinguish between living and non-living by recalling what students observe in playgrounds</td>
<td>flower, rock, stick, baby bird, butterfly, grass, garden, leaf, tree, brick, sand, bush</td>
<td>water bottle, cloud,</td>
</tr>
<tr>
<td></td>
<td>Characteristics of organism</td>
<td>bee sting, bee honey, bee nectar, bat vampires wings, bat vampire teeth, vampire like people, bats night, bats flashlight, bats cave, cat vampire movie,</td>
<td>blubber whale, deer fur, fish scales,</td>
</tr>
<tr>
<td></td>
<td>Human activity can affect organism survival</td>
<td>bee suit, bee spray,</td>
<td>bee honey to cereal</td>
</tr>
<tr>
<td></td>
<td>Defining organism</td>
<td>ant size</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organisms survival needs</td>
<td>Spider webs, butterfly nectar,</td>
<td>dog cookies, dogs chase stick,</td>
</tr>
<tr>
<td></td>
<td>Cause and effect on organisms relationship to environment</td>
<td>Animal Channel, sunlight melt bats, vampire and bats like blood</td>
<td>ants eating chips, apple tree and market, dogs run flowers, dog holes, dog poop,</td>
</tr>
</tbody>
</table>

### C.15 LIFE-WORLD

| Physical Space                   | playground, park, house, neighborhood, junkyard, stadium, flower shop, grocery store, church, dollar store, beach, train, car, Six Flags, WI Dells, garden zoo, Mexico, backyard, |
| Ideational Space                 | Family, peers                                                                    |
### D.1 PLAYGROUND SURVEY DATA

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Yes</th>
<th>No</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should we have a playground in tent?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What kind of things should we have on our playground?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How often do you go to play ground each week?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### D.2 PLAYGROUND UNIT ASSESSMENT

[Image of playground unit assessment chart]
**Question:** What will happen when we drop an egg from different heights?

**Prediction:** I think the egg will go inside the bracket.

**Data**

<table>
<thead>
<tr>
<th>Height</th>
<th>Egg Picture</th>
<th>Egg Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 inches</td>
<td>![Image of egg cracked]</td>
<td>The egg cracked</td>
</tr>
<tr>
<td>12 inches</td>
<td>![Image of egg cracked]</td>
<td>The egg cracked a little egg</td>
</tr>
<tr>
<td>60 inches</td>
<td>![Image of egg broken]</td>
<td>The egg Brack Big</td>
</tr>
</tbody>
</table>

**Conclusion:** The egg Brack Big. The all The thank and Thank that in The egg yellow and little.
D.4 SLIDE-MARBLE EXPERIMENT

**Question:** What slope will make the slide go fastest?

**Prediction:** I think the slides will go faster.

<table>
<thead>
<tr>
<th>Height</th>
<th>Slope Picture (label the measurements)</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 inches</td>
<td></td>
<td>1. 4:56.2 Seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. 4:44.33 Seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. 4:48.04 Seconds</td>
</tr>
<tr>
<td>12 inches</td>
<td></td>
<td>1. 3:09.4 Seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. 2:11.1 Seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. 2:36.2 Seconds</td>
</tr>
<tr>
<td>60 inches</td>
<td></td>
<td>1. 1:33.3 Seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. 1:11.9 Seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. 1:14.4 Seconds</td>
</tr>
</tbody>
</table>

**Conclusion:** The fastest it is the 3rd.

D.5 OBSERVATION OF LIVING AND NON-LIVING THINGS

What can you find on our play lot?

- You can find birds and bees.
- And a garden and flowers, and you can find bugs and things you can tie in the fox with the rocks, and a pile of a fort and we found trash, and we found leaves and the tap, and we found a dig about flowers.
D.6 GRAPH OF ORGANISMS AND NON-ORGANISMS
I would like a playground because we know how to keep our playground safe.

We should have a playground because we know how to keep good organisms in and bad organisms out.

We have worked hard all year learning about playgrounds and hope you can help us get our dream playground!

Sincerely,
Day 2

**Objective:** Students will recognize gravity as the force that pulls us down.

**Whole group**
Teacher asks: “When we get on a slide, why do we go down?”

**Small group / partners**
Students TPS (think-pair-share) ideas in response to this question. They will write their ideas in their science/slides journal. (Ideas will be shared at the conclusion of the lesson.)

**Whole group**
Show students a wadded piece of paper and a marble. Ask them to verbally predict what will happen when you let go of them. Demonstration: drop a marble and a wadded piece of paper.

**Small group / partners**
Give students buckets of objects to drop. Ask partners to find two things in the buckets to drop and see what happens.

**Whole group**
Discuss what happened during the experiments. Discuss answers to the initial question. Introduce that **gravity** is the force that pulls on all objects to bring them to the ground. (Be prepared to answer questions such as, “Why do birds fly?” or “Why does a feather fall slower than a brick?”)

**Independent reflection:**
Students answer the question again, using the new information they’ve learned.

---

**D.9 TEACHER CREATED LESSON PLAN**

**Objective:** Students will design questions that are aimed to find out how people feel about having a playground at Tonti.

Begin the lesson by reviewing the pros and cons of having a playground that the students came up with. **Ask students** what the next stage of the scientific process would be. (Do an experiment.) **Ask them,** If we were to go to the principal and say, “Room 204 thinks that Tonti should have a playground!” what do they think he’d say? **Guide students to understanding** that we’d probably need some data to back up our claim. It’s not just about the students; we have to think beyond ourselves to convince people that a playground at Tonti is a good idea…

**Tell students** that one way to get data from these people is to do a survey. **Explain** that a survey is a set of questions that people answer so the surveyors can see what people think about something. They will also be doing interviews to get more information. Then, **tell students** that they will get the chance to survey/interview the people who they thought were “players” in this process. They’ll be working in teams – one for each grade (K-5) and one team for parents. **Assign 3-4 students** for each group (they’ll keep these for the rest of this unit). Then, have students brainstorm 4-5 questions that they’d like to ask in their surveys/interviews. **Remind them** that their focus is, “Should we have a playground at Tonti?” Once they’ve come up with questions, post them near the “players”/pros&cons poster. **Tell students** that these questions will be used to create the surveys that will go out soon.
D.11 SAMPLE GRAPHIC ORGANIZERS IN ORGANISM UNIT

[Diagram of a graphic organizer with circles labeled Needs, Habitat, Organism Name, Pros, Cons, Data, Safety, Organisms we want, Organisms we don’t want, Structures, Environment, Tonti Playground, with handwritten notes and phrases like “bees,” “only,” “grow,” “air.”]
Dear Alderman Burke,

Now we need a playground because we did research. Our students survey showed that everyone wants a playground. The parents survey showed they wanted a safe playground. Kids want swings, monkey bars, slides and ziplines. Kid interviews showed they wanted a blue, green and red playground and they want it to have bright colors. We should have a safe playground. The steeper the slide is, the faster it will go. The slide on our playground should not be too steep so no one will get hurt. The slide should also not be too tall because the higher you are when you fall the harder the impact will be. We also think there should be a smaller slide for little kids. We believe the playground should only be used in good weather because ice and storms can cause kids to get hurt. We think we should have a security guard, security camera or husky dogs to keep gangsters away.

We should have a playground because we know what organisms can harm us. We don’t want bees on the playground so we won’t have flowers. We don’t want cats. There will not be ice cream. We don’t want rats and mice so we won’t have garbage or cheese. We don’t want butterflies so we will have trees or flowers. We will have more kids at the school.

Your friend.

MAY 25, 2011


Gonzalez, N., (1999). What will we do when culture does not exist anymore?
Anthropology & Education Quarterly, 30(4), 431-435.


XIV. VITA

NAME: Ambareen Nasir

EDUCATION

University of Illinois at Chicago
Ph.D., Curriculum and Instruction
GPA: 4.00/4.00

Dominican University
Masters of Arts in Teaching Education
Type 22 Initial Alternative Elementary Certification
Endorsements: Social Studies (k-9), Math (k-9) Middle School, ESL (expected 2011)
GPA: 3.80/4.00

University of Wisconsin- Madison
Bachelor of Science, May 2005,
Majors: History, Political Science, and Languages and Cultures of Asia
Minors: African Studies and Religious Studies
GPA: History 3.58/4.00, Political Science 3.37/4.00, LCA 3.72/4.00 Overall 3.37/4.00

RESEARCH INTERESTS
Multidisciplinary focus on integrating math and science with literacy, language, and culture;
English language learners’ content area math, science, and literacy; home/school connection
Bilingual and/or ESL teacher education, professional development, and action research

RESEARCH EXPERIENCE
University of Illinois at Chicago
Transforming Literacy, Science, and Math through Participatory Action Research (LSciMAct)
Graduate Researcher, August 2008- present

American Education Research Association
Co-chair Division B “Ecological Justice and Critical Geography”, 2011

TEACHING EXPERIENCE
University of Illinois at Chicago
Teaching Apprentice, Department of Curriculum and Instruction, Fall, 2009
Teaching Apprentice, Department of Curriculum and Instruction, Spring 2009

WORK EXPERIENCE
Henderson Elementary
Teacher, Chicago Public Schools, September 2007-2008

White Elementary School
Teacher, Chicago Public Schools, September 2006- June 2007

Teach for America
Teacher, Los Angeles Unified School District, Summer 2005

Wisconsin Department of Natural Resources
Sewer Extension Reviewer, Summer 2001- Summer 2005

SCHOLARLY PRESENTATIONS
Razfar, A., Nasir, A., Troiano, B., Rumenapp, J. (April, 2013). English learning through scientific funds of knowledge and third space: Teachers and “at-risk” students taking risks

359


WORKSHOP PRESENTATIONS

Teacher Action Research: Using Video and Coding to Study Your Teaching
Haines Elementary (Chicago Public School), November 2010

2010 Bilingual/ESL Summer Institute: Start the Year Off Right Get to Know Your Students While Learning Academic Content
University of Chicago at Illinois, June 2010

Differentiated Instruction: Best Practices
Discover Music, Discover Life, April 2010

Instructional Planning: A Guide to Creating Effective Lesson Plans
Discover Music, Discover Life, July 2009

Reading Extended Responses
Henderson Elementary, December, 2009

Read Aloud Strategies
White Elementary, April, 2008

GRANTS/AWARDS

Graduate Student Research Presentation Travel Grant
University of Illinois at Chicago, April 2010, $200

Department of Curriculum Studies Travel Grant
University of Illinois at Chicago, March 2010, $250