Funds of Knowledge and Discourses and Hybrid Space

By: Angela Calabrese Barton and Edna Tan

Calabrese Barton, A. & Tan, E. (2009). *Funds of Knowledge and Discourses and Hybrid Space.* Journal of Research in Science Teaching, *46*(1), 50-73

Abstract:
The findings reported on in this manuscript emerged from a design experiment conducted at a low-income urban middle school intended to support the teacher in incorporating pedagogical practices supportive of students' everyday knowledge and practices during a 6th grade unit on food and nutrition from the LiFE curriculum. In studying the impact of the design experiment we noticed qualitative shifts in classroom Discourse marked by a changing role and understandings of the funds of knowledge students brought to science learning. Using qualitative data and grounded theory we present an analysis of the different types of funds of knowledge and Discourse that students brought into science class. We focus on how the students' strategic use of these funds augmented the learning experience of the students and the learning community as well as the learning outcomes. We discuss the implications these funds of knowledge and Discourses had on the development of three related third space transformations: physical, political, and pedagogical.
Keywords: sociocultural issues; urban education; middle school science

Article:
Science education theoreticians have argued that to better support learning among urban youth from nondominant backgrounds greater attention ought to be paid to the cultural knowledge and resources that such youth bring to learning. While some have argued for building bridges between the cultural knowledge and experience of youth and the culture and canon of school subject matter knowledge (Lee & Luykx, 2006), others have argued for the creation of hybrid spaces that rely upon such cultural knowledge and experience to shape and transform academic knowledge (Buxton, 2006; Seiler, 2001). Despite these differences, there is evidence that pedagogical approaches grounded in students' cultural backgrounds and everyday knowledge can make a difference in learning (Lee & Luykx, 2006).

Our work takes place in a large urban center in the United States, which has been highly influenced by US-based policy initiatives. The recent focus in the US on the No Child Left Behind legislation has turned attention directly to student test scores, which report only (some) cognitive gains. While such gains can be important in noting student progress towards science literacy, they reveal little about what students learn regarding science as a cultural practice, or the students' ontological development as participants in science (Brickhouse & Potter, 2000; Carlone, 2004). Yet, the science education community has a variety of models for linking student cultural knowledge and experiences with school science. For example, instructional congruence (Lee & Fradd, 1998), contextually authentic science (Buxton, 2006), and everyday sense-making (Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 200 1) all have provided needed insight into how bridging youth worlds with the world of school science can support students in building deeper scientific understanding. These models are valuable for advancing the field in thinking through what instructional practice might look like that not only values but also builds upon students' life worlds. Yet, in part, because the current policy climate has defined learning narrowly through cognitive lenses, as a community, we lack empirically grounded discussions of how such approaches promote student empowerment and engagement as intertwined with deep learning.

We have built on these efforts by working collaboratively with teachers to study how teachers and students work to merge students' sociocultural worlds with the worlds of school science. Through the application of embedded case study and design experiments we have been trying to unpack the process of building connections between students' worlds and school science to better understand what broader outcomes this carries for students. In particular, we have been interested in how youth's sociocultural worlds are made manifest by their articulated funds of knowledge. In this manuscript, we address two research questions: What funds of knowledge did students bring into 6th grade science and how did students leverage these funds in support of deeper engagement in science? In what ways did the incorporation of student funds of knowledge impact or transform the discourse and engagement of the 6th grade learning community and its members?

Our questions are investigated in the context of a 6th grade science class, located in a low-income urban school. Mr. M[1], the classroom teacher, is described by his teaching peers and his school principal as a master teacher who connects well with students and who also gets results. He worked with us over the course of 3 years to adapt curriculum and incorporate pedagogical practices that link student funds of knowledge with canonical science. This manuscript presents the results of a design experiment conducted in Mr. M.'s classroom over the course of 6 weeks, where he collaborated with us and a group of five students to develop a series of lesson adaptations for a major 6th grade unit on food and nutrition. To unpack the outcomes of this design experiment, we looked closely at how the curricular enactment shaped the classroom learning community as well as individual student learning. In particular, we analyzed the data for the funds of knowledge that students presented and were accepted as legitimate student resources for participation during the unit. We use this analysis to suggest how these nontraditional funds allowed the learning community to collectively broker for hybrid spaces where the official school science discourse was challenged and its boundaries pushed to become more inclusive of students' everyday Discourses and knowledge. In so doing, we speculate how these hybrid spaces matter in terms of students' learning in science and in the overarching educational goal of science for all.

Theoretical Perspectives

Discourses, Identities and Learning: A Sociocultural Perspective

Lave and Wenger (1991) posit a framework of situated cognition that emphasizes the link between learning and identity formation. Learning is viewed as legitimate peripheral participation where new members are inducted into a community of practice as apprentices. As students learn science in their classrooms, they are developing certain ways of being in the science classroom while engaging in activities and tasks, and in relating to the teacher and their peers. In the past decade, sociocultural studies in science education have highlighted the quandary faced by minority students as they endeavor to be inducted as potential members through the process of legitimate peripheral participation, due largely to the particular nature of school science. Learning science for minority students is as much about learning how to cross borders as it is about learning the content of science (Aikenhead & Jegede, 1999). These studies call attention to the exclusive nature of school science culture with its own ways of doing, speaking, and being that are sometimes in conflict with the ways of being of students from nondominant cultures.

Thus, integral to science learning are the "Discourses[2]'' that youth draw upon in their everyday and academic lives. Discourses are ways of knowing, doing, talking, interacting, valuing, reading, writing, and representing oneself that are "always and everywhere social,'' produced and reproduced in social and cultural practices (Gee, 1996). The Discourses that youth draw upon in their lives can be understood as reflections of their identities. As students engage in science in their classroom, they are acquiring certain identities that are related to who they are and who they want to be. Moving towards full membership entails "an increasing sense of identity as a master practitioner'' (Lave & Wenger, 1991, p. 111), as embodied by the science teacher and the culture of school science the teacher represents.

Earlier work on Discourse/ discourse, identity and science learning among minority students uncovered the pivotal role that language plays in how students learn to appropriate the cultures and practices of science (Warrenet al., 2001). For example Warren and her colleagues show us how, in bilingual classrooms, students often imagine themselves a part of science, and of the scientific phenomenon they are trying to understand, even

when they feel marginalized by school science. Their work serves as a foundation for a growing tradition in science education to identify the ways in which Discourse mediates engagement in science, including not only what one learns but how and why one comes to participate in science related communities of practice.

Brown and his colleagues (Brown, 2004; Brown, Reveles, & Kelly, 2005) also make a compelling case for the relationship between identity, Discourse and science learning. They use the construct of discursive identity, which "reflects an understanding that speakers select genres of discourse with the knowledge (tacit or implicit) that others will use to interpret their discourse as a signal of their cultural membership" (Brown et al., 2005, p. 783). Studies on discursive identities highlight the intrapersonal conflicts ethnic minority students experience as they grapple with cultural politics that motivate the shifting of discourse genres. These studies also foreground the roles teachers play in fostering student development in science by acknowledging inherent student identities that were brought into the science classroom. A focus on Discourse, or in this case, discursive identities, also calls into question the cultural knowledge and experiences that shape who students are and why.

Funds of Knowledge and Discourse

Recently, scholars have stressed the importance of acknowledging the diverse funds of knowledge that are grounded in students' membership and experiences in the out-of-school worlds that they inhabit (Gonzalez & Moll, 2001). Some researchers have worked to uncover the pivotal role the teacher plays in recruiting student funds of knowledge to engage in critical science pedagogy (Upadhyay, 2006). We echo Moje et al.'s (2004) tenet that it is crucial to examine how these diverse funds of knowledge are mediated through an attendant Discourse, or ways of being, talking, and writing that must occur in the right places, the right times, and the right ways. Viewing the funds and Discourses students have as valuable resources that can be recruited for school science allows not only for a smoother transition between students' life worlds and the science classroom, but more importantly, it also challenges the tight boundaries of school science funds and Discourse to be more fluid and porous to nontraditional student resources (Basu & Calabrese Barton, 2007). Valuing diverse funds of knowledge and Discourse as legitimate science classroom resources positions minority students as rightful experts of certain knowledges directly related and applicable to school science.

Hybrid Space

Moje et al. (2004) referred to three views on third or hybrid space: hybrid space as a supportive scaffold that links traditionally marginalized funds of knowledge and Discourses to academic funds and Discourse; hybrid space as a "navigational space" in gaining competency and expertise to negotiate differing discourse communities; and finally, hybrid space where different funds and Discourses coalesce to destabilize and expand the boundaries of official school Discourse. We draw from all three views of hybrid space with particular emphasis on the third view, in which "everyday resources are integrated with disciplinary learning to construct new texts and new [scientific] literacy practices that merge the different aspects of knowledge and ways of knowing offered in a variety of spaces" (Moje et al., 2004, p. 44).

Acts of creating hybrid spaces, Discourses and identities are always political and of the highest risk for those whose knowledge, Discourse, and identities are positioned as lesser. We know that students draw upon a diversity of resources to learn science, many of which are not traditionally viewed as scientific (Lee & Fradd, 1998; Moje et al., 2001). While some studies have shown some initial promise in how these nontraditional resources can be used to promote student learning in science (Bouillion & Gomez, 2001; Seiler, 2001). Third space, or hybridity, therefore, sheds light on science learning because it offers a way of understanding how learning science involves learning to negotiate the multiple texts, Discourses, and knowledges available within a community as it is about learning particular content and processes.

We are interested in notions of hybridity because we have observed how youth take up knowledges, resources, and identities that often go unsanctioned in school. In so doing, they author new identities, drawing from nontraditional funds and Discourses to renegotiate the boundaries of their participation in class in ways that allow them to build their social identities while establishing epistemic authority. However, we could not locate any studies that attended to the nature of the change in Discourse communities that emerged from the

hybrid spaces created. A focus, then, on the nature of the hybrid spaces and resulting Discourses became central to our analysis.

Research Design and Methods

Context of the Study

We undertook the methodological approach of design experiments to make the link between the strategic use of funds of knowledge and learning in science (Brown, 1992; Kelly & Lesh, 2000). Design experiments are a form of research that is focused on addressing specific problems of practice while also being accountable for developing and testing general principles of learning and teaching that can be expected to apply broadly beyond the original research site. In our particular study, we used a "conjecture-driven approach" (Confrey & Lachance, 2000) to design the experiment, allowing us to explore, revise and elaborate on the connections we see emerging between pedagogy and student participation in science.

We had been involved with a team of teachers and schools investigating how girls merge their social worlds with the world of school science. From the first year of our participant observation in these classrooms, we observed that certain kinds of lessons and pedagogical practices seemed to foster greater public use of student funds of knowledge. We were particularly interested in a unit the teachers had taught on food and nutrition because it seemed especially compelling to the students. During end of school year focus group interviews with a set of case-study girls reported on elsewhere (Calabrese Barton, Tan, & Rivet, 2008), they spoke passionately about how they enjoyed the lessons related to food. We had also identified through these case studies a set of pedagogical strategies that seemed particularly fruitful in supporting students in making these connections between home and school.

Thus we conjectured that if we worked with students and teachers to plan lesson adaptations that incorporated these pedagogical strategies, students would be afforded greater opportunities to articulate and draw upon their own funds of knowledge in learning science. The following year, as a collaborative team, we decided to look more closely at the food and nutrition unit to make sense of why the lessons seemed to draw upon students' cultural knowledge and experiences, and to adapt a set of lessons in the unit to more explicitly recruit what we imagined would be a rich source of funds of knowledge from Mr. M.'s next cohort of 6th graders.

After we had conducted the design experiment, what further compelled us to pay more attention to student engagement was that during this unit we noted a significant shift in student participation and achievement. Two interesting changes in student participation caught our attention. The first is that the students in Mr. M.'s 6th grade science classes who participated in the design experiment performed significantly better on this unit than other units throughout the school year, as indicated by student work scores and assignment completion rates.

During the unit, the students completed four assignments, two major and two minor: a comprehensive nutrition guide (major, also see Appendix A), a poster describing and explaining the healthy appetizer competition (major), snack competition explanations (minor), and the healthy appetizer activity sheet (minor). Each assignment was graded on a scale of 1–4 (1: fail; 2: pass; 3: good; 4: excellent) drawing upon the City's learning goals and other criteria meaningful to Mr. M. According to Mr. M., while these assignments incorporated student funds of knowledge, they were also what he considered rigorous science in terms of what students were expected to know (i.e., what a calorie is), and do (calculate daily caloric intake as a function of body mass).

All of the students in Mr. M.'s five sections of science completed the two major assignments with passing grades. We think that this is remarkable because it was rare that Mr. M. had all students complete assignments, and he himself indicated to us how surprised he was at the level of effort and completion he noted on these assignments. This differs somewhat appreciably from other units where multiple students were often called to task for not turning in work (Fieldnotes, May 15,2006). Mr. M. usually found it challenging to get his students to complete their tasks and turn in their assignments and it is a daily routine for him to spend time lecturing students on the importance of turning in work. Furthermore, each co-planner not only turned in each assignment

on time, but received perfect scores (4 out of 4) on each assignment. While this may seem trivial, 3 of the 5 co-planners were not strong science students, often carrying rather low grades (i.e., 1 s and 2s out of 4). We also noticed that more students participated in class discussions, including those who were previously less engaged or silent.

The second pattern we noticed was that students used items from this unit to include in their 6th grade portfolio more than any other science unit, demonstrating a level of care and commitment to work performed in this unit. We had worked with Mr. M. to provide each student with a science portfolio where students can elect to showcase pieces of work that they were especially satisfied with. The science portfolio augmented the traditional pen and paper assessment of 6th grade science. At the year-end evaluation of the portfolio, we found that many students and every one of our case study students had included work from the nutrition unit.

The Inquiry School and Neighborhood

The Inquiry School (TIS) where the study was conducted is situated in a low-income, economically depressed neighborhood of a large northeastern city in the US. TIS is a relatively new school set up in 2004 to replace the middle grades of a failing large K-8 school. This large K-8 school has 9 10 students, 45% of whom are African American, and 55% are Hispanic. A telling indicator of the socioeconomic status of these children is the fact that 93% of the students are on the school's free lunch program. Each class in TIS has between 28 and 32 students, with a roughly equal distribution of boys and girls. As the school has a science focus, each class of students gets five periods of science each week, with each period lasting 45 minutes. While a science-focused school, the middle school is a zoned school, serving the local population of the students. It is not one of the "magnet" or "specialized" schools that students travel distances to attend. The school was chosen for this study because we also had a fairly long-standing collaborative relationship with the school, having placed many urban science education fellows and student teachers there. As a white woman and a Chinese woman, we were outsiders to the students' worlds, but given each of our extensive participation in urban schools and community centers we felt that we had some of the knowledge and skills that would help us navigate these differences.

The neighborhood is easily accessible by public transportation though most of its students walk to school. The neighborhood is full of rich cultural knowledge and traditions. It is a predominantly multigenerational African American and first generation and immigrant Dominican and Puerto Rican neighborhood. A walk down the street on a school afternoon shows many Dominican-centered stores and churches well populated by children and adults. From the windows of the 6th grade science classroom, overhead subway railings are in clear sight. On route to the school from the subway station, one passes a funeral house, a dollar store, a mechanics shop and a few small eateries including a fried chicken and pizza place, a deli and a Chinese take-out restaurant, places the children in our study frequent after school. There is also a small grocery across the school where students like to frequent and a gospel church known in the neighborhood with free gifts of groceries, household essentials and clothing. The walls of the apartments as well as the metal grills of shops are liberally scrawled with graffiti, some of which are profoundly artistic, all of which speaks to the cultural experiences of youth.

Mr. M., the 6th Grade Science Teacher

Mr. M., the lead teacher in the investigation reported here, had 5 years of experience teaching urban students at the inception of the study. In many ways, Mr. M.'s teaching practice is filled with contradiction. While he is a firm advocate of student-centered science learning and uses different student-empowering pedagogical strategies such as group discussions, projects, student presentations and role-play, he is also known for his no-nonsense teaching and strong management skills. He wrestled with a desire to "hand over" science class to his students, while also wanting to maintain control in an effort to help his students succeed.

He worked hard to listen to and build on his students' experiences, yet struggled with how to make them matter in light of the top down pressure for students to succeed on standardized testing in his school. Yet, we did not experience these contradictions as problematic, but rather as an artifact of his continual efforts to work towards a more democratic and rigorous science classroom experience for his students.

His classroom was physically inviting to students, with a menagerie of class pets, such as dwarf hamsters, frogs, fish, snakes, and a praying mantis. Many students asked for permission to care for these animals before school and during the lunch hour. Of Irish and Italian descent, Mr. M. was often the only Euro-American in his classroom. But having grown up in this region of the city himself, he possessed a great deal of local, cultural knowledge and had immense rapport with the majority of students, many of whom regard him as their favorite teacher. Due to his admirable classroom management and relational ties with many of his students, Mr. M. was the resident "expert-teacher" other teachers look up to and consult with.

Methods: Curriculum Planning, Data Sources and Analysis

As part of our design we invited four girls for a dialogue with us to brainstorm lesson ideas that would be meaningful to them. We selected the four girls collaboratively with Mr. M. to ensure that the girls reflected a range of interest in science (including high and low interest), success in science (including students ranging from levels 1 to 4), and our own observed level of participation in the classroom. We had decided to include only girls in the planning group at this point because we were basing the lesson adaptations on the findings we had from our investigations into girls' science practices from the previous year. However, when one boy, who was known as a low-performer but a highly social student, asked to participate, we readily agreed.

The five students, researchers and Mr. M. participated in hour-long curriculum planning conversations to discuss ideas for incorporating their cultural knowledge and experience into the unit. Conversations were structured around the questions: How is learning about food and nutrition relevant to your life? What experiences have you had with food and nutrition in terms of what you eat and how you make decisions about what to eat? What do you think youth need to know about food and nutrition? From the dialogue, six ideas were proposed by the students and Mr. M. went on to enact three of the activities (Comparing fast food restaurants, Healthiest snack competition with $2, Making and sharing appetizers). Throughout the process, we worked closely with Mr. M. to develop the handouts and flesh out the activities. A flowchart on the sequence of events is shown in Figure 1. Additionally a sample activity from lesson two is shared in Appendix A.

After each lesson, we conducted focus group interviews with the student co-planners to get their feedback and opinions on how they thought the lesson went, which were video taped and transcribed. Weekly meetings were also held with Mr. M. as we reflect together on the lessons and the students' responses. Since we were constantly in Mr. M.'s classroom during the unit, there were many opportunities for informal conversations and member checking of our observations with him throughout. At the end of the unit, we solicited Mr. M.'s feedback formally with a teacher interview. Each of these lessons was video taped, and student work from the lessons was collected. Other data sources included field notes from participant observation of the lessons, formal and informal interviews with students and teacher; video footage and transcripts of each lesson; and video footage and transcripts of the interviews held with the students and the teacher.

We used constant comparative analysis (Strauss & Corbin, 1990) in the tradition of grounded theory for data analysis. We engaged initially in open coding of the data, guided by the categories of nontraditional funds and Discourses reported by Moje et al. (2004), including the categories of home, community, peer and popular cultural funds and Discourses. Through our open coding, we also discovered important subcategories for each area. We then moved into axial coding, watching the videos of each lesson and interview session repeatedly to carefully surface the relationships between the student usage of these funds and their participation in order to understand how such funds mediated hybridity practices. We also paid attention to the interaction between Mr. M. and his students to elucidate the ways in which teacher action facilitated or hindered the creation of hybrid spaces. We looked for what funds and Discourses were invoked, how and when they were invoked, what happened to the learning community and individual students after they were invoked, and the cumulative effects these had in creating hybrid spaces. Finally, we looked across all the lessons to see if we could detect patterns in how the hybrid spaces were created in the refined lessons in an effort to understand what a hybrid space really looks like and how it works in a science classroom.

Insights into the Funds of Knowledge and Discourse in Mr. M.'s Classroom

In this section focused on the funds of knowledge and Discourse in Mr. M.'s classroom we take up two key insights. First, we describe the different types of funds of knowledge and Discourse that students brought to the focal unit and how hybrid spaces were borne out of the utilization of such funds. Second we focus more on how the students' strategic use of these funds augmented the learning experience and outcomes of the students and the learning community.

Premise: Based on year 1 girls' new identities-in-practice and interviews, we see that they are utilizing non-traditional funds of knowledge to renegotiate their participation in science class, so we worked with the teacher to plan some curriculum focused on food and nutrition.

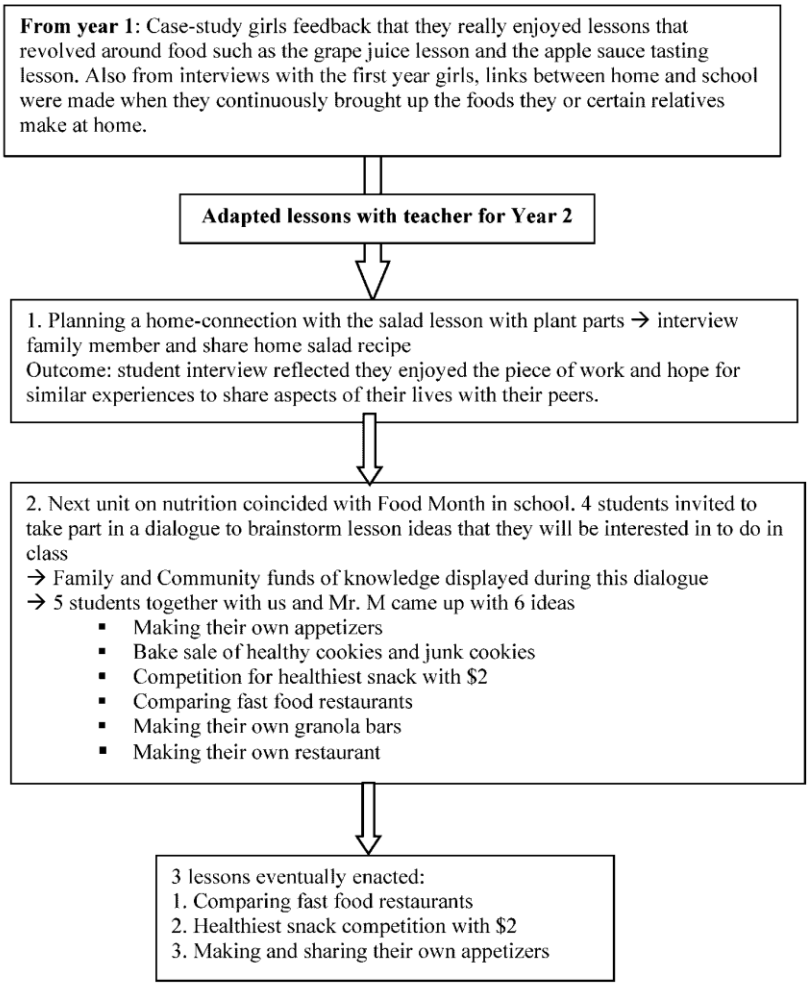

Figure 1. **Flowchart showing the sequence of events on the planning and enactment of food and nutrition centered lessons with Mr. M.'s students.**

Funds of Knowledge Threads

Adapting and expanding Moje et al.'s (2004) characterization of student funds of knowledge in science, we present the following categories: Family, Community, Peer, and Popular Cultural funds and Discourses. Within each category, we tease out more nuanced emergent Discourse threads and how they contribute to the creation of hybrid spaces in school science.

Family Funds of Knowledge and Discourse

The family funds that students specifically drew from in this study revolved around family life involving food such as birthday celebrations, everyday nutritional habits and specific roles students play in their family related to food preparation. While parents' or relatives' work did surface as other scholars (Gonzalez & Moll, 2001; Moll et al., 1992) had reported, the nature of the curriculum drew out food-related home-based funds specifically for our study. With candor and humor, the students related many stories on how they had to help

influence the food choices of younger relatives as well as their personal struggles between choosing foods for their nutritional value versus choosing food based on taste. In this section we note four Discourse threads that emerged as part of this fund of knowledge and Discourse: Family and ethnic tradition in food, cooking, and diet; Matriarchal leadership; Shared child raising; and Materials from the home, shared communally.

Family and Ethnic Traditions. In a lesson on the different parts of a plant, the students made a class salad from various plant parts brought in by Mr. M. In an effort to make more explicit connections to students' lives, the students were assigned to interview a family member for a favorite home salad recipe to share with the class. Many students were eager to share their home salad recipe and Mr. M. felt hard pressed to pick only a few. Carina, the first student chosen to share her recipe, recited a lengthy description of potato salad, including the specific ingredients and amounts, detailed procedures, and how the recipe was part of her family history. Mr. M. used Carina's recipe as an exemplar of how to write scientifically and to initiate a discussion on how her home salad is a "root salad" with potato and carrot as the plant ingredients.

Some students who did not raise their hands initially, upon hearing their peers share home salad stories, began to volunteer. Mr. M. used the student sharing to revise plant anatomy with the class in an interesting and meaningful manner. This opportunity allowed students to participate by sharing something in which they were the expert, and that contributed to the science discourse.

While talk about home recipes themselves did not carry much scientific talk, the classroom conversation and subsequent tasks Mr. M. expected of the students that built on the salad recipes was rich with content exploration. For example, each student had to identify every plant part of their salad ingredients as well as represent them pictorially in a personal worksheet. The teacher also drew up a class salad ingredient chart and required students to categorize and list all the different salad ingredients according to the parts of plants. Such talk served as scaffolds for the students to learn the academic content. Yet, we noted that embedded within the science talk about salads were deeper connections to family traditions and histories. In a focus group interview after the lesson, some of the co-planners reflected on why they liked this activity:

> Cindy: I thought it was very easy because all you did was to ask someone how to make a salad or put a picture of your family salad but the things that's special is that you put in your own recipe, not just something from a book. And technically, it was just easy, that's one homework that everybody actually did!
>
> Carina: I felt very great because I told everybody how my father does um, his potato salad and what ingredients he put, and some people don't put the same ingredients as my father does.

These exemplars represent how the students' talk around the salad recipes moved beyond simply connecting school science and the home experiences or prior knowledge. The funds of cooking and sharing food among family were relevant to how students learned about and valued plants, but such talk is grounded within the histories of families. Apart from the homework assignment being a "sure thing," a piece of homework that Cindy pointed out "everyone actually did" because it technically could not be done "wrongly," the students also took delight in being able to share something personal about their lives with their peers. As Cindy explained, "We're not all the same culture, we're different. And we like to share about ourselves because we don't always get the opportunity to." This seemed important given that popular media groups all students into broad categories, such as "minorities." Cindy suggested that her neighborhood is ethnically diverse despite similarities in skin color. Carina as well, expressed her deep level of engagement with the homework. In addition to the very detailed steps to the potato salad she shared as described before, Carina augmented her homework assignment with many pictures of the ingredients. She was very glad to be chosen to share, saying "I was the first one up, Mr. M. picked me, I was happy cause um, I picked up the drinks too, I actually went to the supermarket to look for the little potatoes and stuff to put it [the supermarket newsletter with pictures of groceries], and I was happy cause I really wanted to tell people how my dad did his potato salad."

The extent to which sharing knowledge of family traditions in food and having that matter is important. The students' positive sentiments could be summed up by Jess, who explained that the salad homework allowed for reciprocity between herself and her peers: "I want to hear other people's experiences and also I want to let myself out, I want them to know the real me, like how I live at home and how I live in school." Valuing home funds in science class opens the door to such "letting out." Valuing home funds also allows the students to participate in school science as individuals who are situated with histories and cultural experiences.

Matriarchal Leadership. Across lessons, the students brought up the expertise of their mothers and the tradition of the female member taking charge of cooking responsibilities for the family from a tender age, a tradition that carries on with many of the girls in the co-planning group. Matriarchal dominance in the kitchen, but also mother as family leader is deeply rooted in the African American and Hispanic familial traditions in this neighborhood (Dickerson, 1995; Mullings, 1996), and in the tradition of mothers teaching daughters "through consejos (advice), cuentos (stories), and la experiencia (experience)" (Villenas & Moreno, 2001, p. 671). A dominant theme is how mothers apprenticed at home with the grandmothers:

> Jess: I interviewed my mom and basically the same story as Cindy, she's been cooking since she was young.
>
> Shona: I interviewed my mom cause she's the only one, you know, who knows how to cook in the family... and, well, not actually from the family, but she, you know, she knew how to cook since she was 13, and I wanted to know how to cook and I asked myself what experience she had and so I interviewed her.
>
> Kassie: The person I interviewed is my mom, and the reason why I picked [her] is because my mom's been cooking for a long time, she started since she was 9, cooking for her mom and stuff cause my grandmother's real sick.

In the lesson where the students made appetizers to share with one another, Kassie used one of her mother's recipes and made a grilled chicken and vegetable kebab, which was enjoyed by her peers. To encourage her family to consume more vegetables, Cindy's mother uses a juicer on a medley of vegetables including broccoli, carrot, and celery. Lionel told us how his mother keeps three varieties of milk (regular, 2% and skim) to cater to the tastes of everyone in the household but subtly uses her maternal authority to encourage Lionel to drink skim milk, watching over him as he made his choice, shaking her head silently till he picked up the skim milk before offering her approval with "you doing the right thing." Lionel then confessed that after his mother left the kitchen, he went back for "the gallon milk because skim milk taste like ... like nothing," alluding again to personal struggles with a healthy diet.

In looking over the discourse about food choices, salad recipes and appetizers brought by the students, clear preferences in salads reflected both African American and immigrant Latino/ a culture with attention to communal cooking methods, combining meats and fruits, and attention to rice, greens, plantains, and yams. In knowing which family member to turn to for this assignment, many students demonstrated awareness of where their resources lay in home funds and the connections between the science they were learning and their families' lives. The students also alluded to the relevance between female cultural roles in taking care of family nutrition, a role some of them had already undertaken and the relevance of such roles with scientific knowledge. In discussing the ingredients used in some salads, the students offered reasons that the mothers were not only motivated by how the salad will "taste" but also that certain ingredients are "good for you" and added to increase the nutritional value of a salad, again weaving in aspects of consejos, cuentos, and la experiencia in how such stories are brought to bear in the science class.

Shared Responsibility. In addition to the role of the mother in the family, the theme of shared responsibility within and across families for child care (hooks, 1984), also emerged in the students' conversation around decision making about food. The students talked about being advised on food choices by an older family

member or they themselves assumed the role of nutrition advisor with younger relatives. For example, Jess learned about nutritious foods that she should eat from her "one aunt [who] finished through college and ... now she's a home attendant and she tells me what foods are good and what are not." Jess herself was able to render similar advice to a younger cousin in turn when the cousin was going to give her baby sister soda in a bottle. Jess explained that, "if she's a baby you can't give her that because if she's a baby, its worse cause they'll get sick easily because they're small." Other students shared similar experiences. Carina struggled in getting her younger sister to choose healthier snacks, she was exasperated, telling us "my sister buys a dollar of [candy] 'burgers', they're like 10 cents each one and she buys a whole dollar. And I'm like, buy something else and she's like, I don't care." The students understood from the challenges of a healthy diet, and they played the role of care-giver to younger family members with regards to food choices, a practice common in their community.

Material Capital. Finally a little often talked about dimension of family funds relate to the material capital that the students bring from home. These were evident in the nutrition unit in the form of the food and preparation materials the students brought into the classroom when they were making appetizers. Parents were supportive as almost every student contributed to the activity and in substantial amounts to be shared with their peers. The amount of food resources brought in by the students included apples, bananas, strawberries, grapes, honey dew, cantaloupe, watermelon, lemons, limes, grilled chicken, bell peppers, salad greens, dipping sauce, raisin and rice pudding, whole-meal turkey sandwiches, canned fruits for cocktails, as well as waffles, milk, and orange juice. While it may seem trivial to highlight the point that the students' families can and do supply them with materials they need for school, we were moved by the wide selection and sheer quantity of food resources the parents had so enthusiastically sent with their children into the science classroom in support of their endeavors to create healthy appetizers.

We realized what was happening was something atypical when teacher after teacher who passed the classroom came in and stood watching for a few minutes at what was going on before leaving to inform another colleague who would then appear in Mr. M.'s classroom minutes later to take in the scene. Both the principal and assistant principal came into the class to congratulate the students and to taste the appetizers they created. Mr. M. was very surprised and pleased at the resources the students had shown up with, given that he had frequently struggled with getting students to bring things from home for class, "even simple things like empty Gatorade bottles!"

Throughout their sharing, the students revealed the complexities in the multi-faceted relationship they have with food and nutrition. While they identify with being experts who give advise on good nutritional habits, they also empathize with the difficulties in always choosing healthy food. It is therefore likely that the students can appreciate the various perspectives surrounding the issue of food and nutrition, making for meaningful discussions in the classroom. A wealth of food-related information does exist in the family funds of knowledge and Discourse of these students. While they may not come packaged in the form of what is traditionally regarded as "educational material" these funds no doubt endow the students with useful information pertaining to food and nutrition as their stories testified. These funds have the added advantage of being borne from personal experiences or girded in strong familial relationships, making them integral elements that are authentic and pertinent to the students' out-of-school identities rather than a disparate piece of information students just happened to know.

Community Funds of Knowledge and Discourse

Students also drew from community funds of knowledge and Discourse to aid their participation in school science. We define community funds and Discourse as the experiences, knowledge and ways of being students possess from being members of various figured worlds that matter to them, such as being members in the neighborhood where they live or members of the larger school community. The community funds of knowledge and Discourse can be seen along two emergent Discourse threads: Peer challenges, habits and priorities, and fast food.

Peer Challenges, Habits and Priorities. During the nutrition unit, the students displayed their community funds of knowledge and Discourse with regards to the habits and priorities of their peers and how this related to opportunities afforded by the school and community. For example, the practice of skipping breakfast and lunch was something they were deeply concerned about. Lionel, while brainstorming with us for lesson ideas, suggested that we should have a lesson where we sell healthy snacks in class so as to circumvent the school rule that forbids student eating after 8:05 am. Cindy observed that, "kids in school don't eat breakfast and also skip the school cafeteria lunch." Although the school cafeteria caters free breakfast for the students who come to school earlier, we were regaled with stories, perhaps exaggerated, by the students on how "gross" the cafeteria food really is. When asked about school lunch, one of the girls explained:

Natasha: Yeah it's like what he said, fake cheese, fake lettuce...!

Researcher: But they serve different things every day don't they?

Natasha: Yeah but there's always a piece of hair in your food! Researcher: A piece of hair?

Natasha: Yeah I saw a piece of hair in my pizza once, it was nasty.

Many students also do not eat breakfast at home before coming to school. According to Mr. M. most students would rather "chew gum instead of eat proper food." Natasha also told us that "kids go to the grocery store and come out with bags of chips" to eat for breakfast. The students were thus cognizant of the mitigating factors resulting in the poor nutrition habits of the student population: no breakfast at home, unwilling to eat "gross" cafeteria fare and choosing instead to eat junk food like chips and gum. Community funds of knowledge and Discourse such as these influenced the student's decision to enact a particular appetizer sharing lesson and their subsequent participation during that lesson.

In that lesson, instead of merely preparing an appetizer, Abram, Meekia and their team came into class early to prepare a complete meal to share with their peers. During their preparation, they told us what they were preparing to serve and the rationale behind each item:

Abram: I made sandwiches with a hundred percent of um, whole grain wheat bread, with um, turkey and cheese with light mayonnaise so the mayonnaise would not have that many calories. And then, she [another member] made waffles.

Meekia: Because we thought it would be a good breakfast for everybody to try.

Researcher: Breakfast!? Very nice!

Meekia: Cause everybody don't eat breakfast so something that people might like to eat rather than not feel like eating.

Abram: Ok, then we sort of looked to the food pyramid and we got the grains, the bread, the turkey from the protein department, then we got the cheese from the dairy department, then we got the, the um ... the cherries which goes into the fruit and vegetables...!

Researcher: So you got the food pyramid covered?

Abram: Yeah. And it's all healthy.

Meekia: See if we go like this, [holding up a cup of fruit cocktail decorated with lemon and lime slices on the cup rim] then people will be motivated to eat it, it's healthy, but it's also motivating to drink.

During their presentation, Meekia again returned to the reason behind her concocting a fruit cocktail garnished with lime and lemon wedges. Knowing that her peers may be more attracted to food that is more grown up and glamorous, she made a fruit cocktail with decorations to "lure" her peers to eat fruit. She explained her motivation to her class, "We wanted to make something that everybody would want to have. Something that people were attracted to. And it's healthy. So we tried using a cocktail. It's for kids, like Kassie, who likes to be "older" and she would want to try something different so we tried a cocktail." The group also made about 50 finger sandwiches and 8 large waffles cut up into 80 little squares of waffles so that everyone in their class could have some. Abram and Meekia's team made so much tasty food that some classmates had "second, third, and fifth helpings."

In this event, science became a tool rather than an end in itself in the sense that it served a means for providing food for peers in addition to something to learn. Abram and Meekia recognized the opportunity to serve their friends a good breakfast with this lesson taking place in during first period. Aware of the dietary habits of most of their peers, they created a sophisticated, wholesome breakfast to cater to the "grown up" tastes of friends. A hybrid space emerged where science knowledge (Abram's analysis of how their breakfast fit the food pyramid) coalesced with students' interest, concerns, and agency (the group's intention to serve breakfast) to build relevance and applicability of science knowledge to students' out-of-school lives and identities.

Fast Food. Apart from having community funds related to their peers, the students also revealed that they were highly observant with regards to the fast-food restaurants, corner grocery stores and delis that they frequent. Lionel observed that the commonality between all Chinese take-out restaurants is that they always seem to "fry things in a pot that is filled all the way up with oil" when they could "use much less." The corner deli opposite the school sold him "beef patties that is just dripping oil." Carina also shared how she dislikes eating "McNuggets" because "when you break them they are dripping with so much oil." Lionel went on to add, "McDonalds just gives you the burger in a box with no [nutritional] information." The students agreed that in spite of it being unhealthy, they and their peers frequent these fast-food joints. Lionel offered "addiction to fast food" as a reason: "its real hard to eat anything healthy once you've tasted how GOOD fat is." He went on to postulate that addiction to fast food causes obesity later on in life. Together with the students and Mr. M., we then devised a lesson where students try to choose healthy meals from what was available in two popular fast-food restaurants based on the nutritional information of each item on the two menus.

During the lesson where the students were comparing Kentucky Fried Chicken with McDonalds based on the nutritional information we researched and handed out to them, they again used their community funds of knowledge and Discourse to help them with the task of planning three healthy meals each not exceeding $5.00 from either of the fast-food restaurants. Many students were aware of the newer, healthier items on the menu. Meekia shared with the class healthier alternatives now available on the children's menu, "Now they have healthy things for kids. Now they have happy meals, I know they [always] have had happy meals, but now they have apple sauce, apple slices, milk but not whole milk, juice ... like orange juice and stuff like that."

Fast food community funds also impacted how the teachers and students positioned themselves with each other. When the students were discussing fast-food restaurants using the data sheets provided, Mr. M. went from table to table, sat and pored through the nutritional data with the students and appeared to be just as excited (or appalled) as the students as they discovered new information. At one point in the lesson, he came to one of us and whispered, "I was sitting at table two and we discovered that one McFlurry is worth almost your entire day's calories!"

While fast food is a part of the national diet, we think the students' knowledge of and experience with these eateries is salient. Access to fresh food is a major concern, with few opportunities to shop in comprehensive grocery stores and an inordinate number of fast food establishments. The rapid spread of fast food, which is high in fat and salt, is a growing challenge in the low-income urban community. The South Los Angeles Community Coalition reported that in 2002 a two square mile area of south central Los Angeles contained 52

fast food establishments and only one sit down restaurant (LA Times, March 10, 2002). While we do not have the same kind of data for the TIS neighborhood, our own experience in the city, and the Discourse of the students reflect a similar reality.

Students also brought in economic funds when they discussed the attractions of McDonald's "dollar menu," which was pertinent to this school community of students where 93% of them are on the free lunch program. Mr. M. facilitated the conversation tactfully. The following discussion transpired when Mr. M. called on Shona to share a healthy fast-food meal her team had planned from the fast-food menus under $5.00:

> Shona: The total for our meal was $4.89. We got a milkshake, that's $1.89, and then we got a side garden salad, which was a dollar, then we got a 'Big & Tasty', which was a dollar, then we got a small fries, which was a dollar.
>
> Jonathan: God bless you, that's from the dollar menu!
>
> Shona: * nods and reaches out to high-five with Jonathan*
>
> Classmate: *sings out* That's TOO. MUCH. CALORIES!!!!
>
> Mr. M.: Were all the food groups represented?
>
> Shona: Yup.
>
> Mr. M.: So realize with 5 dollars, the dollar menu is a good economic choice. But, let's hear from another team, let's see if you can beat, nutritionally this team's options.
>
> Cindy: We have the Asian salad with orange juice, which comes up directly to 5 dollars. Mr. M.: What does the Asian salad contain?
>
> Meekia: The salad has croutons for grain, fruit was the tangerine, we have protein by chicken, grilled chicken, calcium, by the dark green vegetables ... and it has walnuts and the orange juice.
>
> Mr. M.: Alright that's pretty healthy and it came at $5.00 exactly.

Without being overly critical of Shona's choices, Mr. M. used Cindy's suggestions to offer a healthier alternative apart from the dollar menu.

The students also revealed an understanding of the sales tactics employed by the grocery stores in their neighborhood. One of the adapted lessons co-planned by the students involved each team of students going into a neighborhood grocery store to find the healthiest snacks under $2.00. After the lesson, some of the co-planners shared their reflections with us in an interview:

> Researcher: Were you surprised at the range of healthier snacks in the grocery store? Did you go in expecting that you will find this kind of stuff or really bad food?
>
> Carina: Really bad food. There's not that much good food, but there are some ... because they kind of hide it, so you don't see it.
>
> Researcher: What were they hiding?
>
> Carina: They were hiding the pumpkin seeds, they had something like chips in the front and we had to look for it pumpkin seeds at the back to take it out.

Natasha: They always put the candy in the front so that you would buy it.

Researcher: Why do you think they put the candy and all that supposedly unhealthy stuff in the front?

Cindy: Because people think it tastes good so they're tempted to buy it.

Jess: I was surprised because [Store X] had a lot of stuff and we wanted to buy apples and stuff but we didn't see no apples, they had cakes and stuff... but we didn't see no apples.

The students also shared with us how their peers and siblings would frequent Store X precisely because of its prominently displayed, wide selection of candies. The class also discussed the poor source of nutrients present in these candies. Understanding cognitively that healthier snacks are good for you may not necessarily be the case of learning a straight forward applicable science fact when it is considered alongside the specific nutrition-related contexts of these students. When faced with a limited budget coupled with undesirable cafeteria food and the hunger pangs of a growing teenager without regular breakfast and lunch meals, understanding and practicing good nutrition habits demands the incorporation of community funds of knowledge and Discourse that these students have shown.

Peers Funds of knowledge and Discourse

Students also drew from peer funds of knowledge and Discourse to support each other in learning science in ways that sustained peer culture. We define peer funds and Discourse as the experiences, knowledge and ways of being students possess that support them in "helping each other do school" in ways that value who youth are and what they have to offer (Moje et al., 2004). The peer funds of knowledge and Discourse can be seen along three emergent Discourse threads: Studenting, Solidarity, and Talents and interests.

Studenting. As with Moje et al. (2004), we found that peer support and a "studenting" Discourse (p. 57) is evident in Mr. M.'s classroom. Mr. M. has a practice of rotating students among the six team tables in his classroom. Based on how well students interact and work together, Mr. M. sometimes arranges specific students to sit together when he thinks they can benefit from working with one another. On several occasions, we witnessed students helping their peers by sharing resources or explaining the teacher's instructions. For example, during the lesson where fast food restaurants were compared, students reviewed McDonalds' data sheets containing data tables with calories, fat content, vitamin content, iron, and cholesterol of each item on the fast-food menu. When Mr. M. gave a general explanation to the class on how to read these intimidating tables (e.g., the McDonalds data sheet table had more than a hundred items, each with 18 categories of nutritional information, i.e., 120 rows, 18 columns), we witnessed how students who had "figured it out'' then explained to their teammates using the examples on the menu they were more familiar with, such as a "Big Mac.''

Solidarity. A more central peer fund of knowledge and Discourse that dominated our observations was that of solidarity. One episode that was especially interesting to us was when the students showed solidarity with one another while trying to align what they learned about healthy snacks with personal practices. In the lesson following the healthiest snack competition, Mr. M. asked if the students had gone back to the corner stores over the weekend. The students had learned the more nutritious options that the corner stores offer that were within their budget. Mr. M. was hoping that the students would apply this knowledge when he asked for volunteers to share their latest snack choices from these stores.

Mr. M.: Raise your hands if you've gone back to either of those stores since Friday. Shernice, what did you get there?

Shernice: I got ... two bags of chips and a candy? *class laughs, including Mr. M.*

Mr. M.: Ok, why?

Shernice: Because I like to eat them.

Mr. M.: Because you like your junk food, ok. Now is that replacing a meal, or is that one of your two snacks? Was that going to be your lunch?

Shernice: It was actually my breakfast. *class goes "wow''*

Mr. M.: For this morning? Ok ... anyone else? Go back to those stores? I like the honesty and you're probably not alone. Mabel?

Mabel: I went back to the store, and I got two bags of chips and a lollipop. *class laughs again, but not so loudly this time*

Mr. M.: Was that a snack or was that a full meal?

Mabel: A meal. *some classmates go "Oh gosh''*

Mr. M.: Mabel, what did you buy for two dollars last Friday, you and your team?

Mabel: We got granolas and some orange juice.

Mr. M.: Did you think about what you did on Friday when you went in there to buy those? What was your thought process? Why did you take what you learned and make a different choice? Was it purely taste? That it was something you were craving?

Mabel: Yes ... !

Mr. M.: Ok, that's honest ... yes, Cindy?

Cindy: I only bought ONE bag of chips ... but, I was going to buy more, I felt bad, so I just bought one.

Mr. M.: Why didn't you buy more?

Cindy: Because, I know its not healthy ...!

Mr. M.: Ok, what could you buy in place of another bag of chips? I'm OKAY with one bag of chips cause it's small enough for a nice little snack ... !

Mabel and Cindy tried to build solidarity with Shernice after her unhealthy snack choice "confession.'' While some classmates expressed disapproval at her poor snack choices, Mabel volunteered her equally unhealthy snack choices in the face of such peer pressure to ally herself with Shernice. Finally, Cindy shared that she had chips for snacks too, although she limited herself to one bag, hinting that chips inherently are not that deplorable a food choice, as she stated, "at least it has grain.'' By their actions, Mabel and Cindy seemed to be forming a support system behind Shernice in getting Mr. M. and the rest of the class to accept Shernice's reasons for her grocery store purchase. The students' sharing also caused Mr. M. to acknowledge that choosing one bag is better than two and that the caloric content in two bags of chips is perhaps justifiable when it is eaten for a meal and not a snack. In this discussion, peer funds of knowledge boosted Shernice from a marginalized position to one that is more central and reframed her identity from an isolated student who "still eats junk for breakfast after learning about healthy snacks'' to one who had a tough decision to make. Cindy further challenged this discourse to position Shernice as someone who might even be making a somewhat healthy choice given her circumstances.

Other examples of student solidarity were apparent during the lesson on making appetizers when students were to bring in their own ingredients, utensils and crockery. Lionel surprised the class by bringing in a huge amount of fruit including half a watermelon, pears, oranges, lemons, cantaloupe, bananas, and apples. Lionel and his team cut up all the fruits and shared it with all the other groups who were lacking certain ingredients for their appetizers. Lionel's team also made enough fruit smoothie to share with the rest of the class. In the same way, Abram and Meekia also made enough wholesome snacks to share with everyone in the class as previously described.

Talents and Interests. While producing the written pieces for this nutrition unit, namely a nutrition guide and a poster advertising their appetizer, the students drew from their funds of talents and interest, specifically that of art and drawing. Mr. M. gave them the freedom to "be creative" instead of just writing a piece of text and the students chose to make a nutritional guide in the form of a booklet that included science facts such as the sources of essential vitamins and minerals as well as a healthy menu planned by the student. Similarly, the appetizer posters were attractive pieces featuring colorful drawings as well as text.

Mr. M. felt that the students performed well and their work was "much more applicable to their lives." He likes to fill the walls of the classroom with their work and even hangs "laundry lines" from the ceiling to showcase students' work (see Figure 2). We agree with Mr. M. that these pieces of work gave a more holistic reflection of the students' abilities and showcased students' talents and progress especially when, in Mr. M.'s words, "in this city it's all about a specific test." As Shona reflected, she liked these pieces of work that showed another side of her identity, "that I'm a creative person and a good drawer because I like to draw a lot, and that it is about my life ... and I feel proud when my work is up hanging on the bulletin board."

Figure 2. Mr. M.'s bulletin board.

Popular Culture Funds of Knowledge and Discourse

The students in Mr. M.'s classroom were avid consumers of popular culture, which includes music, magazines, news media, television and movies. In our study, the students displayed ownership in all these subcategories, including the Internet. They were especially in tune with music and television-related resources. During the many interview sessions we have held with the students, they would be singing some popular song that was the current "hit" song of the moment or trading notes over movies and TV shows. Shona and Belinda wrote a simple but catchy jingle to go with their appetizer, and sang it for us while they were designing the advertisement poster of their appetizer—"Puts a smile on your face, it will blow you away!!!"

Another source of popular culture funds the students drew on for the nutrition unit was from television cooking shows. Kelly prepared and brought a pot of rice pudding made with raisins and cinnamon, a recipe she had seen

on the food network channel on television which she found again on the show's website. When deciding on which appetizers to make, many students drew from television food programs that they had seen. Carina was inspired by television cooking shows to concoct her group's "Tropicana fruit smoothie." She enjoys watching cooking programs, saying, "I put on the cooking channel ... and um, I see the cookers slicing things that and they are trying to make healthy meals not bad ones, and they chop things up and they blend things, and they say all the vitamins it has, and I want to try something like that."

As with Moje et al. (2004), we found that Popular culture funds of knowledge and Discourse was important to student learning. For the nutrition unit, the students were secure in drawing from cooking programs on television because cooking takes place legitimately in the kitchen at home or in restaurants rather than in middle school science classrooms and the cooking programs reflect these authentic locations. Many of the students have revealed that they are all experienced in the kitchen and they watch food network programs because they are interested in learning more recipes. They reminded us that it makes sense to learn how to cook by watching and doing, rather than by reading. Popular culture funds are also important to the students given that they invoke television programs and advertisements as supporting evidence for sharing an opinion or asking a question. To the students, these associations with popular culture were deemed personal and a salient part of their identity. Table 1 below summarizes all the funds and Discourses with their key discourse threads presented.

Transforming the Learning Community Thread

Following our analysis of the threads of funds of knowledge that students expressed and leveraged in class, we wanted to further discern how these funds mattered in their engagement and learning. We noted in our description of the context that we were compelled to study the impact of the adapted unit on student learning more broadly from a sociocultural perspective because we noticed important shifts with respect to student scores on both the major and minor unit assignments. However, as we articulated in our conceptual framework, we also believe that to make sense of powerful learning in science we must look at how developing deep understandings is reflected in student engagement in science. While such a sociocultural perspective highlights the importance of framing science learning as a process of enculturation for minority students, we also drew upon hybridity theory to argue for the importance of reciprocity in the enculturation process, one in which incorporates students' nontraditional funds and Discourses in order to enrich and broaden the boundaries of official school science Discourse. Delpit(1988) reminds us that to deny students of their own expert knowledge is to disempower them. Thus in building claims about learning we focused our analytic attention on changes in the form and function of student participation in the science learning community rooted in both developing scientific understanding and the leveraging of student funds of knowledge. From this perspective, we noticed two critical patterns in the data with regards to student participation during this unit, regarding floor time and taking a scientific stance through the strategic use of their funds of knowledge.

Table 1
A summary of the funds of knowledge, Discourses and key discourse threads

Funds of Knowledge and Discourse	Key Discourse Threads
Family funds	Family traditions in food, cooking, and diet
	Ethnic diversity within minority culture
	Matriarchal leadership
	Shared child raising
	Materials from the home, shared communally
Community funds	Knowledge of peer challenge, habits, and priorities
	Fast food
Peer culture	Studenting
	Solidarity
	Talents and interest
Popular culture	Music
	Fashion
	Television
	Internet
	Magazines

First, we found that the process of expanding the enculturation process to incorporate reciprocity created new ways of participating in science class that were legitimate and that fostered new opportunities to engage the subject matter that promoted both academic achievement and inclusion. During those class episodes where funds of knowledge and Discourses were actively sanctioned by the teacher, we witnessed an increase in the number of classroom speakers and in the nature of their talk. Over the course of the unit, we noticed that all students volunteered information at one point or another, a disruption of the usual pattern of classroom discourse, where only about half of the class actively volunteered information. For example, in the healthy appetizer lesson all the students volunteered information that related to the content of the lesson. In the debate following the $2 healthy snack competition, 23 of 27 students participated with content-based comments. More importantly, we also noticed that some students, who were noticeably quiet during the school year, volunteered ideas and contributed to science talk in the classroom, a point that Mr. M. himself also brought up during an interview. The subject matter lent itself to positioning students as experts, as Mr. M. reflected, "Students would bring up their families, cultural differences that in another setting they may be inhibited to share or talk about. It's a moment for them to be very proud. It's like celebrating something which I think, far too often, in an environment like this, they hear more negative than positive things about themselves. So I think that's also why they like science, because it's framed more, where they get their own voice."

During the discussion of the salad stories, for example, several quiet students who also received low grades earlier in the term, centrally participated in the discussion, sharing recipes and talking about how their recipes contained different parts of plants, the focal science concept of the lesson. In the follow up to the lesson on the $2 healthy snack competition, when Mr. M. asked students to report on what a healthy snack is, students were initially "sluggish" in their participation, meaning they would say something if called on but unlikely to volunteer new ideas to push the conversation ahead. As the transcript indicates, conversation was marked by silence, and a struggle by Mr. M. to get the students to share their ideas, with Mr. M. repeatedly having to say, "Does anyone agree or disagree" to elicit student responses.

However, when Mr. M. shifted his pedagogical approach to question students about their food choices over the weekend and what made those choices healthy (or not), the conversation palpably changed. Almost immediately, the vast majority of students actively debated with each other their purchases, not even waiting to be called on by Mr. M. The catalyst for the change appeared to be a simple shift in pedagogical technique of referencing the $2 healthy snack competition and their funds of knowledge. The push for content understanding was much more deeply supported by a more authentic engagement and high participation levels by the students.

Another good example of how this pattern played out with an individual student was with Kassie, a student who rarely participated. During the appetizer lesson, Kassie was excited about her team's kebabs. She called us over with the videocamera and acted the role of a chef presenting her creations on television. Smiling into the camera while holding onto a plate of kebabs, she gestured to each ingredient in turn, describing the goodness of her appetizer to an audience, "Yo, people! Alright! First we made a rice pudding, and it's very good ... we made two things, we made a vegetable shish kebab with grilled chicken, with some sauce, and it's GOOD. And it's healthy." Kassie also elaborated on how her group's kebabs "contains the important nutrients and vitamins to promote good health, build strong immune system and strong body and enables the person to live a longer, happier and more slimming lifestyle." Mr. M. recognized her participation as he said later to us during an interview, "Kassie has a lot to say and I think in a traditional class she is a bit stifled so those kinds of opportunities, to have a voice and be heard, helps."

In another example, Lionel was a student who routinely got in trouble for misbehaving and incompleted homework. Yet, in the nutrition unit, he was engaged in the tasks and volunteered in class discussions. For the appetizer lesson, Lionel brought in an abundance of fruit in both variety and number that his father had to help him bring the fruits to school. Lionel brought in those resources with the intention of sharing it with his peers for this lesson. He was not just interested in his own participation, he was also looking out for his classmates' participation, anticipating that should they not bring enough resources, they would still be able to engage in the science task by using some of the fruit he brought. Mr. M. commended on Lionel's thoughtfulness, telling

the class that Lionel's actions showed how "the community unit[ed] together."

Lionel's story also helps us make our second claim about engagement and learning, which focuses on the shifting nature of legitimate participation, or what we are calling learning to take a scientific stance. Lionel seemed to leverage the opportunity to use his funds of knowledge to talk and act scientifically in ways that were less risky and that did not seem to challenge his social status. Prior to this unit, his peers described him much like Cindy did when she said, "Lionel doesn't do anything. In fact, [he] kind of fools around." Yet, his role in the nutrition unit shifted. His food items served as a boundary spanner in linking his location as a popular kid and someone who could participate with authority in science. While other groups stood around their tables at the end of the appetizer sharing lesson to give a short presentation of their group's appetizers, Lionel introduced the name of his group's appetizer as "The Fruit Express" and promptly went around the class with a big bowl of pear slices and mangoes which he offered to his peers, describing the value of fruit in the nutritional diet. Lionel's group had decided that fruits make the healthiest snacks and he was the one responsible for bringing in all the fruits for his group.

Like Lionel, many of the 6th graders in Mr. M.'s classroom deployed their funds with clear ideas about audience and purpose. As described earlier, when Abram and Meekia served a full breakfast to their friends, they leveraged on a combination of funds to serve a complete breakfast to their hungry classmates. While the food resources were tangible material funds, what they chose to prepare were informed by school science funds and community funds. While Abram studiously checked off each food item on their meal against the food pyramid, Meekia's concoction of a sophisticated fruit cocktail was aimed at appealing to the more grown up tastes of her friends.

The students also showed strategic skills in invoking funds during our curriculum planning dialogue. For example, when we expressed surprise and interest at Natasha's story of her unsuccessful attempt to steer her cousin away from unhealthy snacks in the grocery store, the other students immediately caught on that this was both relevant and interesting information that they too possess. The students built solidarity around what they thought was valuable to the discussion.

The students also seemed to be strategic in knowing what kinds of funds to draw upon for different activities. As previously described with the salad homework recipe, Kelly, on watching a particular food network program, knew how to access it's website for the recipe of raisin and cinnamon rice pudding. Kelly's Internet skills was not surprising since many of the students are avid "bloggers" who maintain personal blogs on web platforms such as MySpace.com. Such popular culture funds were also leveraged in combination with peer funds as the students, all well-informed consumers of popular culture especially in terms of food television programs, negotiate and decide what food items to finally prepare.

The value of nontraditional funds and Discourses helps to legitimize multiple ways of participating within the science learning community. In those spaces, instead of being "casualties" of symbolic violence, students were rich with valuable nontraditional funds and Discourses they could utilize to secure a different kind of sanctioned participation. We note that for Kassie and Lionel, these "new and different" forms of legitimized participation greatly impacted their "traditional school success." Both students were given a "level 4," the highest grade, for their participation with their teams for the nutrition unit.

Discussion: Funds of Knowledge and Building Hybrid Spaces

Why and how do student funds of knowledge matter? It has been posited that the creation of hybrid spaces can support student learning. However, little attention has been given to the different kinds of hybrid spaces that might be created. Throughout the planning and the lessons that were enacted, we witnessed an abundance of funds of knowledge and Discourses the students possessed that were implicitly connected to the school science funds and Discourse. Invoking these funds and Discourses allowed the students to author new hybrid spaces that supported their out of school experiences with in school expectations. As stated in the previous section, we

found that such acts of authoring helped to shift both the breadth and depth of student participation. We also found that the students often used the funds in combinations that are thoughtful and strategic.

We believe that our data tell us that students were active creators of hybrid space, or hybrid Discourse. While the students in Moje et al.'s (2004) study were "unwilling to bring everyday knowledges and Discourses to bear on academic texts in explicit or public ways" (p. 66), the students in our study were ready to use their funds openly in school science because the teacher was actively inviting such funds in the discussions, reading and writing activities as well as the science tasks. As Mr. M. reflected, "the whole process was very organic, very authentic, student driven, inquiry based, and students brought up their families, cultural differences, their communities which made it so much more applicable to their lives." With Mr. M.'s strong support in the inclusion of multiple funds in his classroom in addition to school science funds and Discourse, the students experienced validation of their nontraditional funds and Discourses.

We present three ways in which the hybrid spaces in Mr. M.'s classroom were transformed: physically, both in transforming classroom space and moving out to different spaces; politically, because of the shifts in power dynamics; and, pedagogically, as evident in how Mr. M. and the students' roles were changed. Figure 3 summarizes how hybrid spaces are brokered for in Mr. M.'s classroom.

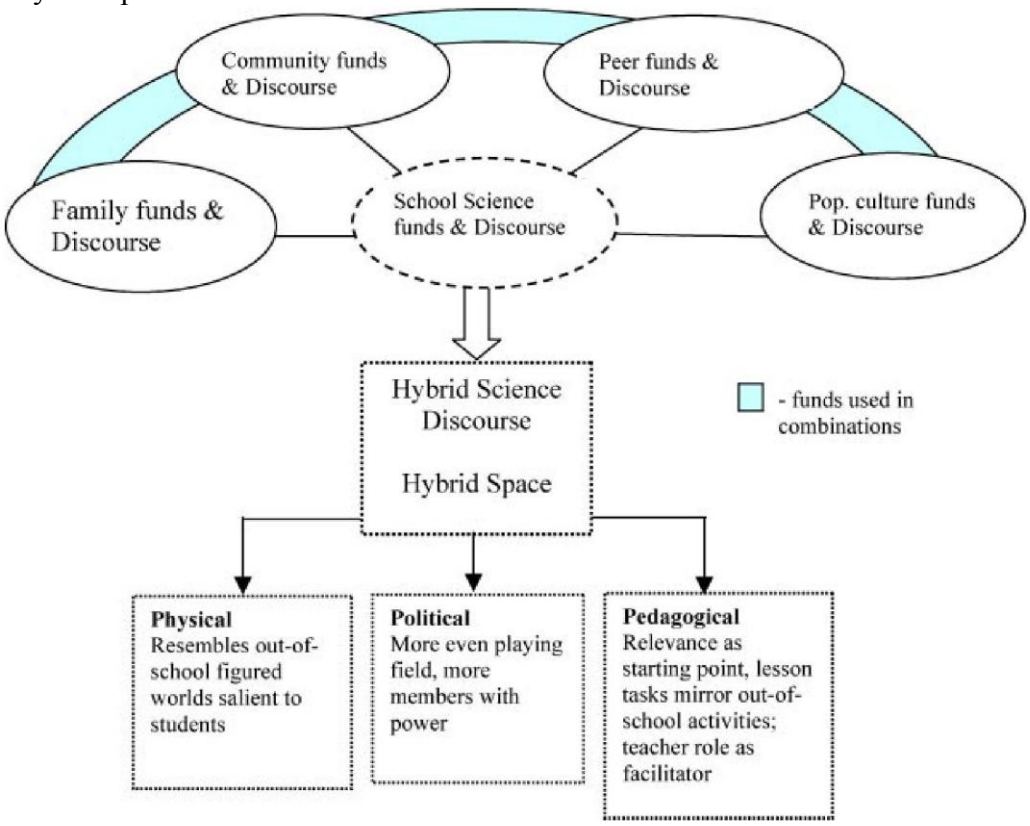

Figure 3. Elements involved in brokering for a hybrid space in Mr. M.'s science class.

The Hybrid Space in Mr. M.'s Classroom: Physically

The physical space of the classroom changed during the lessons on the nutrition unit, transforming to resemble physical spaces that students were familiar with in their out-of-school lives. During the appetizer lesson, the classroom resembled a large kitchen with the different teams of students chopping and assembling food items on their tables. It was abuzz with nontraditional funds and Discourse, so radically different that the other teachers in the school as well as both principals stopped in one after another to witness the scene.

Such a change in the physical space had a positive impact on the students, and allowed them to experience a "home-ground advantage." A kitchen is a familiar space for many of the students and represents an arena in which they are comfortable and confident of their abilities. Carina talked about the change as something she particularly enjoyed about the lesson, "It was like a cooking place I thought, like, Mr. M. was

cutting lemons, we were washing, they were blending and it looked like a kitchen or something."

Similarly, with the healthiest snack competition, we left the science classroom to go into local grocery stores chosen by the students who co-planned the lesson with us. Since neither Mr. M. nor ourselves were regular clients of these stores, the students were the official experts even though we accompanied them as adult chaperones. We witnessed how familiar the students were with the store owners, how they knew where the goods were displayed along particular aisles and where the healthy snacks were "hidden." While the argument can be made that most middle school students typically appear more "alive" when they are out of the classroom, we believe that this "excursion" was different from a regular school fieldtrip both because the sites of visit were chosen by the students and because these sites were integral to their out of school activities.

The importance of a transformed physical space was emphasized when, due to logistical and administrative limitations, we adapted the lesson on comparing fast-food restaurants from an on site visit to one based in the classroom. The original lesson co-planned by the students involved sending teams of students into the fast-food restaurants to visit their kitchens and to interview their employees on the nutritional content of their food before coming together to select the healthiest fast-food meal one could get from these restaurants. Instead, we provided nutritional information downloaded from the websites of these fast-food companies and had the students use these data sheets to suggest three healthy meals they would buy under 5 dollars. While the students appreciated this lesson as the information was new and at some points shocking to them, they were disappointed that the on site visits did not materialize. Getting data sheets with tables and comparing information by analyzing the contents of those tables is the epitome of school science text and Discourse. Even as Natasha tried to find merit in the way we had drastically adapted their original design of this lesson by suggesting that perhaps the employees at the fast food restaurants would be unwilling to share their information even if we had made the trip as planned, Cindy was quick to point out that as customers, we would have the right with the law on our side to request for nutritional information of the food we might be interested in purchasing. Cindy recognized that physically going to a fast food restaurant would have allowed them a more powerful position as an "informed fast-food consumer" who can invoke the federal law to engage in a school science task. In short, physically transforming the space where science class takes place redefines who students can be and proffers them a wider berth in taking an authorial stance in science.

The Hybrid Space in Mr. M.'s Classroom: Politically

The students were positioned with more authority in the hybrid spaces of Mr. M.'s classroom. With Mr. M.'s steady efforts to draw out nontraditional funds and Discourse from the students, students had more opportunities to become "experts." While Mr. M. made connections between students' nontraditional funds and Discourse with school science funds and Discourse such as during classroom discussions of the home salad recipes and the healthiest snack competition, school science funds and Discourse was not overtly privileged by the teacher in these lessons. Mr. M.'s himself changed from that of "science expert authority figure" to "facilitator" of a round table discussion where each member, students and teacher alike, came with valuable resources to add to the dialogue. While Mr. M. offered predominantly school science funds and Discourse, the students contributed nontraditional funds and Discourses in addition to school science funds and Discourse. In these lessons, Mr. M. "shared" his authority as the resident expert with the students.

Mr. M.'s also took up actions that positioned him as equals with his students. In the appetizer lesson, Mr. M. joined with his students as they engaged in food preparation activities. During the fast food activities he discovered new knowledge along side the students. Since fast-food nutritional data were not an official school science text, Mr. M. was not compelled to identify himself as the "expert science teacher" but was a "co-learner of fast-food nutritional facts."

The power distribution in the hybrid spaces thus appeared to be less polarized and top-down. Mr. M. was not the only official authority figure in the classroom, at least not in terms of knowledge and valuable content; and some of the more marginal students who lacked epistemic authority and who were not as good with "school skills" gained narrative and positional authority by virtue of the validation of their nontraditional funds and

Discourse. Bourdieu and Passeron (1977) postulated that symbolic violence is the imposition of systems and meaning upon groups and classes in such a manner that they are experienced as legitimate. Symbolic violence can be particularly hurtful to students through exclusion. Exclusion works most powerfully as self-exclusion when students self-censor and cease to participate in class (such as Lionel and Kassie had before), causing them to earn labels such as "disengaged," "disinterested," and "on the edge."

We also noticed that when the space of the classroom was different from the norm, such as when it resembled a kitchen and when the students were physically in the grocery stores, nontraditional funds and Discourses were more frequently invoked by the students during their participation. We noticed that during those lessons when the figured world of school science resembled a traditional classroom, such as when they were back at their tables with Mr. M. leading a class discussion, even though the discussion was still based on nontraditional funds and Discourse such as the snacks they bought from the corner stores, the students veered towards the official science text and Discourse. However, we think this is powerful evidence for how these hybrid spaces allow students to take up—and test—multiple Discourses.

The Hybrid Space in Mr. M.'s Classroom: Pedagogically

The most obvious change pedagogically was the involvement of the students in planning all the lessons with the exception of the salad recipe homework assignment. The lessons on nutrition that were enacted all arose from the co-planning session we had with the students and Mr. M. As the lessons showed, the content and themes were heavily based on the students' nontraditional funds and Discourses, especially the home and community funds. While traditional science lessons tend to follow the trajectory of learning content before searching for applicability, these lessons traced the reverse arc by focusing first on relevance and applicability while incorporating science content knowledge along the way.

The lessons were important not only to the academic life of the students, their learning goals went beyond getting a good grade or a "level 4" from Mr. M. for 6th grade science. They were interested in exploring the roles nutrition and food played in their everyday lives. The activities and science tasks that took place during the lessons mirrored students' everyday activities outside of school. The writing pieces the students did also emphasized nontraditional funds and Discourse rather than school funds and Discourse, such as the posters they made and the salad recipes they wrote up from interviewing a family member.

The nutrition unit helped to transform school science Discourse by increasing the overlap between school science Discourse and the nontraditional Discourses germane to students. The participants in Mr. M.'s class exhibited change in what they said, did and produced during this unit. The discussions that took place, the activities that students and teacher engaged in, and what they produced in the culmination of these lessons—complete meals and healthy appetizers reflecting both the science content they learned and their identities—were radically different from the norm in a traditional science class. As Cindy enthusiastically concluded at the end of the unit, "I think in this whole entire school, I think this is the first time we did this."

Conclusions

Through Mr. M. and his students, we have learned a great deal about the potential and necessity of hybrid spaces in the science classroom. We see these hybrid spaces as moments where science is no longer a separate world as students learned to display competent and meaningful scientific literacy in applying scientific knowledge to their local communities and their daily living. Yet, we also understand the inherent difficulties and challenges in creating such hybrid spaces. We agree with Mr. M. that while the lessons enacted through inhabiting hybrid spaces were promising and beneficial for his students, "you just can't have these kinds of lessons everyday and with every class." It is difficult to physically change the figured world of the science classroom for every lesson or to invite students to co-plan every lesson unit. Neither is it feasible or practical to do so. In addition, even with such a framework in place for creating hybrid spaces, students still manifested tendencies to "do school" the traditional way. We need to continue to explore the factors that help mitigate the creation of hybrid spaces in science class with other science topics that are not as explicitly universal as food

and nutrition was. We also need to identify more teaching practices and pedagogies that foster the creation of hybrid spaces that are more practical and can be carried out on a more frequent basis.

Notes

[1]All names in the paper are pseudonyms.

[2]"Discourse" with a capital D is distinguished from "discourse" in that it is inclusive of ways of knowing and being in addition to written or spoken communication as is traditionally defined by a small d "discourse" (see Gee, 1999).

Appendix A: Healthiest Snack Competition Worksheets

THE 6TH GRADE BXSSII
MOST NUTRITUOUS SNACK COMPETITION!!!

TASK: Imagine you have $2.00 to buy some snacks from a grocery store near the school. Your task with your team is to find a combination of snacks that you and your team think are the healthiest that can be bought with $2.00.

KEEP IN MIND:

- Daily intake of total calories for a 6th grader is 45-55 calories per Kg of weight (2.2 pounds).
- Snacks are to fill in the gaps left by the three main meals
- Two different snacks with the same calories can differ in nutrition → one can have more vitamins, protein, or minerals than the other

Before you set off to the grocery store…

- Decide how many calories your snack is going to consist of, keeping in mind the total daily calories for a teenager
- Decide which snack nutritional qualities are most important to you and your team, e.g.
  - Giving more energy? (complex carbohydrates, protein)
  - Giving more vitamins and minerals?
  - Taste of the snack?

Name: _____ Date: _____ Class: _____

Buying Healthy Foods Contest

Directions:
Pretend you are hungry, you have $2.00, and you want to buy some HEALTHY food from the local store. What healthy foods can you buy for $2.00 or less? For each food that you pretend to buy, write down the nutrition information on this chart.

Food	Servings Per Container	Fat	Cholesterol	Sodium	Sugar	Protein	Vitamin A	Vitamin C	Calcium	Iron	Cost$$$
Total											

OUR GROUP'S SNACK CHOICES FOR $2.00

Choice:

Evidence:

Explanation:

References

Aikenhead, G.S., & Jegede, O.J. (1999). Cross-cultural science education: A cognitive education of a cultural phenomenon. Journal of Research in Science Teaching, 36(3), 269–287.

Basu, S.J., & Calabrese Barton, A. (2007). Urban students' sustained interest in science. Journal of Research in Science Teaching, 44(3), 466–489.

Bouillion, L., & Gomez, L. (2001). Connecting school and community partnerships as contextual scaffolds. Journal of Research in Science Teaching, 38(8), 899–917.

Bourdieu, P., & Passeron, J.C. (1977). Reproduction in education, society and culture (2nd ed.). London: Sage.

Brickhouse, N.W., & Potter, J.T. (2000). Young women's scientific identity formation in an urban context. Journal of Research in Science Teaching, 38(8), 965–980.

Brown, A. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. Journal of the Learning Sciences, 2, 141–178.

Brown, B.A. (2004). Discursive identity: Assimilation into the culture of science and its implications for minority students. Journal of Research in Science Teaching, 41(8), 810–834.

Brown, B.A., Reveles, J.M., & Kelly, G.J. (2005). Scientific literacy and discursive identity: A theoretical framework for understanding science learning. Science Education, 89, 779 – 802.

Buxton, C. (2006). Creating contextually authentic science in a low performing urban elementary school. Journal of Research in Science Teaching, 43(7), 695–72 1.

Calabrese Barton, A., Tan, E., & Rivet, A. (2008). Creating hybrid spaces for engaging school science among urban middle school girls. American Education Research Journal, 45, 68–103.

Carlone, H.B. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. Journal of Research in Science Teaching, 41(4), 392–414.

Confrey, J., & Lachance, A. (2000). Transforming teaching experiments through conjecture driven research design. In: A. Kelly & R. Lesh (Eds.), Handbook of research design in mathematics and science education (pp. 231–266). Mahwah, NJ: Lawrence Erlbaum Associates.

Delpit, L.D. (1988). The silenced dialogue: power and pedagogy in educating other people's children. Harvard Educational Review, 58(3), 280–298.

Dickerson, B. (1995). African American Single Mothers. CA: Sage Publications.

Gee, J.P. (1996). Social linguistics and literacies: Ideologies in discourses. London: Falmer.

Gee, J.P. (1999). An introduction to discourse analysis. Theory and method. London: Routledge. Gonzalez, N., & Moll, L.C. (2001). Cruzando el Puente: Building bridges to funds of knowledge.

Educational Policy, 16(4), 623–641.

hooks, b. (1984). Feminist theory: From margin to center. Boston, MA: South End Press.

Kelly, A., & Lesh, R. (2000). Handbook of research design in mathematics and science education. Mahwah, NJ: Lawrence Erlbaum Associates.

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge: Cambridge University Press.

Lee, O., & Fradd, S.H. (1998). Science for All, including students from non English language backgrounds. Educational Researcher, 27(4),12–21.

Lee, O., & Luykx, A. (2006). Science education and student diversity: Synthesis and research agenda. Cambridge: Cambridge University Press.

Moll, L.C., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching. Theory Into Practice, 31(2), 132–141.

Moje, E.B., Tehani, C., Carillo, R., & Marx, R.W. (2001). "Maestro, What is 'quality'?": Language, literacy, and discourse in project-based science. Journal of Research in Science Teaching, 38(4), 469–498.

Moje, E.B., Ciechanowski, K.M., Kramer, K., Ellis, L., Carrillo, R., & Collazo, T. (2004). Working toward third space in content area literacy: An examination of everyday funds of knowledge and Discourse. Reading Research Quarterly, 39(1), 38–70.

Mullings, L. (1996). On our own terms: Race, class, and gender in the lives of African American women. London: Routledge.

Seiler, G. (2001). Reversing the "standard" direction: Science emerging from the lives of African American students. Journal of Research in Science Teaching, 38(9), 1000–1014.

Strauss, A., & Corbin, J. (1990). Basis of qualitative research: Grounded theory procedures and techniques. Newbury Park, CA: Sage.
Upadhyay, B. (2006). Using students' lived experiences in an urban classroom: An elementary school teacher's thinking. Science Education, 90, 94 – 1 10.
Villenas, S., & Moreno, M. (2001). To valerse por si misma between race, capitalism, and patriarchy: Latina mother-daughter pedagogies in North Carolina. International Journal of Qualitative Studies in Education, 14(5), 671–687.
Warren, B., Ballenger, C., Ogonowski, M., Rosebery, A., & Hudicourt-Barnes, J. (2001). Rethinking diversity in learning science: The logic of everyday languages. Journal of Research in Science Teaching, 38, 529–552.